



**HYDROUSA**

**Demonstration of water loops  
with innovative regenerative business models  
for the Mediterranean region**

## **Support of the Horizon2020 Innovation Action Project HYDROUSA Towards the implementation of the EUROPEAN Green Deal and the Battle Against COVID-19**

**HYDROUSA** is a Horizon2020 Innovation Action project funded by the European Union, focusing on a decentralised and circular management of non-conventional water resources. The project aims to **revolutionize the water supply chain in Mediterranean regions** by demonstrating **innovative solutions for water/wastewater management**, to **close the water loops** and **boost the agricultural and energy profile of these areas**.

HYDROUSA project addresses several issues raised by the European Green Deal.

### **- JUST AND INCLUSIVE TRANSITION GOES ALSO THROUGH SMART-WATER MANAGEMENT**

The focus of innovation efforts and the results of the project must put people first and must pay attention to regions that face the greatest challenges. By 2030 it is predicted that approximately 30% of EU land will suffer from water scarcity. The Mediterranean regions face significant challenges in terms of water management and conservation. Fresh water reserves are scarce, while the high touristic activities during summer months cause additional stress to the limited water reserves. Furthermore, small communities are often neglected when compared to populations living in towns and large urban centres. For example, the Urban Wastewater Treatment Directive (91/271/EEC) falls short of specifying the characteristics and the design specifications of Individual or Appropriate Systems (IAS) that meet the needs of treatment of domestic wastewater in remote and rural regions.

By focusing in the **Mediterranean region** and more specifically on **small and decentralised communities (SDCs)**, **HYDROUSA**:

- Addresses both **water scarcity challenges** and **pollution issues from wastewater** in these SDCs and hence contributes to provide innovative solutions for a just transition by fully considering the true value of water.
- Promotes **inclusive governance** through a strong, active participation by stakeholders and the community at local level, including farmers, water utilities, municipalities and sustainable tourist businesses.

**HYDROUSA proposes to create suitable financing and legislative schemes to enable the creation of circular business opportunities based on the valorisation of water and nutrients contained in wastewater and the recovery of energy stored in wastewater to promote food production and the energy needs of transportation.**



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Target circularity performance indicators will be developed to provide evidence for the potential benefits towards energy and food security from the HYDROUSA integrated water-food-energy management approach.

## **- ACHIEVING A CLIMATE NEUTRAL AND CIRCULAR ECONOMY THROUGH A SYSTEMIC AND CIRCULAR APPROACH WITH MULTIPLE WATER SOURCES**

Water management in the water industry follows the silo approach, where each stage of the water cycle is fragmented and managed separately. It is a deeply ingrained historic approach, and resistant to changes. This results in lack of coordination within the water sector itself, but also hinders to address potential nexus opportunities. Circularity philosophy and perspective need to be introduced so that alternative water sources (e.g. wastewater, rainwater, seawater, stormwater), spanning beyond local surface or groundwater supply and inter-basin water transfers are brought to the fore.

Once established and embedded within the water-food-energy nexus, the circular economy approach will bring the foresight-tools to better appreciate and differentiate the value of water at the point of need. The circular model is a major cultural and technological shift towards integrated water management systems.

HYDROUSA solutions on water management address climate adaptation measures focusing on water scarce, SDCs through circular and regenerative solutions. The circular economy approach also enables to differentiate the value and potential uses of water and match the right water quality to its particular use. **HYDROUSA implements completely circular solutions for the management of non-conventional water sources**, including green and energy recovery solutions, characterized by low carbon footprint. Wastewater is perceived as a resource which is treated to produce a pathogen free but nutrient rich effluent, to be recycled through fertigation practices. Generated sewage sludge is composted and applied to land. Stormwater, desalinated water and rainwater are effectively collected, treated and used for agricultural irrigation and domestic purposes, including tourist activities.

**HYDROUSA proposes a series of specific mechanisms to make use of non-conventional water sources a reality. Through HYDROUSA and other similar projects (clustering effort), we propose a catalogue of nature-based and nature-inspired water management scenarios**, which are adapted to different climate conditions and can be supported by the Common Agricultural Policy (CAP) mechanism, at agricultural sites or by thematic investment platforms at municipal level. The latter significantly contributes to biodiversity and biomass conversion, which is crucial for the support of sustainable climate neutral and circular economy transition.

**The project has a strong ICT component to enable the measurement and evaluation of the circularity performance of the HYDROUSA solutions.** This includes tracking and tracing methods to follow critical material flows throughout the supply chain, energy monitoring, yield, quality and cost of resources. The latter will provide data for the circularity assessment based on the joint application of established and proven tools such as Material Flow Analysis (MFA), Life Cycle Assessment (LCA) and Life Cycle Costing (LCC), which will result in a set of multidimensional circularity performance indicators to describe material, environmental and economic merits of the HYDROUSA solutions in a circular economy context.



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## **- FROM FARM TO FORK: A VALORIZATION OF WATER, ENERGY AND MATERIALS THROUGH WATER-SMART MANAGEMENT FOR A HEALTHY, GREEN AND AFFORDABLE FOOD**

**HYDROUSA services and systems support the decentralised management of non-conventional water sources developing and demonstrating circular solutions to valorise water, energy and materials.** These solutions support the use of resources in local context, at the place where they are produced. This way, farms are able to valorise local water sources such as harvested rainwater, reclaimed water, stormwater, desalinated water to irrigate/fertigate cultivations producing food and other high added value products (e.g. essential oils) which are used at a local level.

**HYDROUSA promotes** the practice of fertigation of nutrient rich reclaimed water and thus the recycling of nutrients in the fields, reducing the use of conventional fertilizers and supporting organic farming practices. By use of fertigation and recycled nutrients, **HYDROUSA supports the development of sustainable Integrated Nutrient Management Plans according to the new Circular Economy Action Plan, while reducing pollution from excess nutrients. HYDROUSA promotes the principle of “producing locally and consuming locally” in small communities.** This principle can also be extended to an urban environment by recycling water in buildings and using the treated water for urban farming activities, especially in lower density populated areas in the periphery of big urban areas. HYDROUSA solutions can also be extended to sewer mining applications where decentralised wastewater treatment is coupled with onsite water reclamation at urban level. Moreover, advanced and more sustainable touristic activity can be fostered, including local food production directly or indirectly related to touristic activities. HYDROUSA encourages the production of a diverse, localised food supply chain by fostering local stakeholders’ interrelationships and integration of local commerce. The Milan Urban Food Policy Pact is a step in the right direction. This and other initiatives could be promoted through binding food production sufficiency targets for countries.

**HYDROUSA welcomes the EU Water Reuse Regulation and the EU Fertilising Product Regulation 2019/1009 which includes EU-based end-of-waste criteria for compost and digestate which can be used in organic fertilisers, soil improvers and growing media. The eminent revision of the Urban Wastewater Treatment Directive should also support water reuse and the recycling of nutrients contained in wastewater in order to grow crops and produce food.** This can be supported with concrete examples of this project towards 2022, when all HYDROUSA demonstration sites will be operating for a significant time.

## **- FURTHER DECARBONISING THE WATER SYSTEM IS CRITICAL TO REACH GREEN DEAL OBJECTIVES**

The production and use of energy across economic sectors account for more than 75% of the EU’s greenhouse gas emissions. The energy consumed for water supply, wastewater collection and treatment amounts to about 2% of the total energy consumption globally, with 30-40% of this related to wastewater treatment. According to the OECD/IEA Outlook report of 2016, global energy uses in the water sector will more than double by 2040.



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The amount of energy required by water systems varies. It is influenced by a range of factors, such as topography, distance the water needs to be transported, water loss and inefficiencies, type of treatment technology applied and the level of treatment necessary. Therefore, energy use and the carbon footprint for water must be optimised through a threefold approach with the ultimate goal to have energy neutral water systems:

💧 **Implement energy efficiency in water/wastewater treatment plants and networks, to enhance treatment/purification processes in drinking water and wastewater treatment plants and to optimise water use/reuse.** The HYDROUSA project is dealing with these aspects by local collection systems (minimising energy for transportation), endorsing renewable energy, low-energy and carbon footprint nature-based solutions (NBS) and reuse of water and nutrients.

💧 **Produce energy from the organic content of wastewater.** HYDROUSA serves this purpose by adopting anaerobic, high carbon capture systems, thus maximizing biogas production. It also develops solutions to convert the biogas to biomethane that increases the potential options on the final use of the fuel.

💧 **Monitor greenhouse gas emissions and energy consumption** within the HYDROUSA water loops and implement measures to decrease the energy and carbon footprint of NBS and other systems.

**The perception of wastewater treatment plants as biorefineries should be reflected within the revised Urban Wastewater Treatment Directive and promoted at local, national and European level.** We should ensure that wastewater treatment plants are always coupled to higher valorisation routes recovering water, energy and materials, including decentralised treatment systems (e.g. IAS). In addition, HYDROUSA can provide technology evidence-based information that can support end-of-waste criteria for recovered nutrients and materials within the framework of the challenge of the Sewage Sludge Directive (86/278/EEC).

### - PRODUCE LOCALLY AND CONSUME LOCALLY TO TACKLE TRANSPORT GREENHOUSE GAS EMISSION

Transport accounts for a quarter of the EU's greenhouse gas emissions and is still growing. To achieve climate neutrality, a 90% reduction in transport emissions is needed by 2050. **With HYDROUSA, long-supply chains are eliminated in favour of producing and consuming locally.** Local supply chains reduce transportation costs of goods, by promoting self-sufficiency and resilience in regional food supply. Through the recycling of nutrients HYDROUSA supports the development of sustainable Integrated Nutrient Management Plans.





**HYDROUSA proposes to enable short and ultra-short food supply chains by creating nutrient conversion and utilisation hubs.** Water-oriented living Labs with adequate financial support can encourage the inclusive co-creation of these hubs and green jobs.

### - AN UNTAPPED OPPORTUNITY TO PRESERVE AND RESTORE ECOSYSTEMS AND BIODIVERSITY THROUGH WATER INFRASTRUCTURES

Our natural capital delivers ecosystem services that underpin our economy. Its deterioration and loss jeopardise the provision of these services: we lose species and habitats and the wealth and employment we derive from nature, and endanger our own wellbeing. This makes biodiversity loss the most critical global environmental threat alongside climate change. Ecosystem-based approaches to climate change mitigation and adaptation can offer cost-effective alternatives to technological solutions, while delivering multiple benefits beyond biodiversity conservation. Furthermore, nature-based innovation, and action to restore ecosystems and conserve biodiversity, can create new skills, jobs and business opportunities, particularly for sustainable tourism.

**HYDROUSA makes a substantial contribution** by adopting and implementing full scale constructed wetlands for wastewater treatment and reuse, novel constructed wetlands such as electroactive and aerated wetlands, novel nature-inspired solutions for rainwater harvesting, bioswales for collection and treatment of stormwater, developing a rich agroforestry system fertigated/irrigated with reclaimed water (enhancing habitats) and regenerating barren land, through remote rainwater harvesting techniques and novel desalination processes. The eco-agricultural practices introduced by HYDROUSA are allowing greening semi-arid areas and thus the generation of biodiversity and related ecosystem services (e.g. carbon sequestration, biomass provision, support of habitat, soil improvement, cultural activities for local population and tourists).

**HYDROUSA proposes to include biodiversity restoring agriculture with zero impact on water resources at the top of a series of actions.** The new wave of CAP measures should ensure that:

💧 **Farmlands**, including conventional industrial farming businesses, devote a certain percentage of land to multi-cropping

💧 **Permaculture** and **agroforestry** should also be perceived as the new norm by introducing its methods in farming schools in Europe as these systems can capture more carbon and increase biodiversity.

💧 **Seed banks** with the development of European network should ensure crop diversity from farm to fork and save old European varieties of food crops. Market mechanisms and organic food labels could include the use of multi-cropping practices.

💧 Define and implement a **regulatory and financial mechanism** enabling payments for ecosystem services such as the ones provided by HYDROUSA solutions.





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**HYDROUSA also makes a significant contribution towards achieving zero pollution for a toxic-free environment, more specifically regarding the aquatic environment.** By means of suitable wastewater treatment methods, largely based on decentralised NBS, a number of pollutants, including organic matter and pathogens, are removed and prevented from being disposed to and/or causing pollution of the environment. Furthermore, the adoption of water and sludge recycling at specific sites, besides the inherent recovery of materials minimises the disposal of nutrients to the water recipients. Still, persisting chemicals in wastewater might pose risks of possibly contaminating the crops that are cultivated using reclaimed water. For this reason, HYDROUSA will evaluate the fate and removal of substances of emerging concern by NBS and other applied solutions. Among the considered compounds investigated are selected pharmaceutical active compounds, including antibiotics, bisphenol A, pesticides; some of them belonging to 2015/495, 2018/840, and 2020/1161 EU watch lists.

**HYDROUSA will identify and track** targeted **contaminants of emerging concern within the supply chain.** The project will provide suggestions on the potential substitution of targeted toxic, xenobiotic or non-biodegradable substances found in wastewater by alternative, more biodegradable and less harmful substances. These products can enter the wastewater network and should be regulated for example through the REACH framework.

**HYDROUSA also tackles** the topic of **zero-brine-discharge in seawater desalination processes.** Using a solar driven desalination system, the fresh water produced from seawater and from the brine is utilized to grow fruits and vegetables. Salt is recovered to be utilized for local commercial products. Finally, by collecting and valorising rainwater and stormwater, HYDROUSA decreases pollution from runoff and mitigates flooding problems in rural areas.

## **HOW HYDROUSA CAN SUPPORT THE BATTLE TOWARDS COVID-19?**

HYDROUSA monitors the basic pathogens within the circular water chains, but does not implement monitoring of viruses in water. However, we believe the decentralised approach of HYDROUSA systems could contribute to the battle against the COVID-19 pandemic.

Long-supply chains require transportation of people, services and goods thus spreading COVID-19. The current measures against COVID-19, has brought Europe's seasonal migration patterns to a halt. This leaves some European farms facing an acute labour shortage issue, which can result in lower production of agricultural goods, increased prices for the consumer and in the long-run unavailability of goods in the market. HYDROUSA services and solutions promote zero km farming practices, local treatment of water/wastewater and valorisation of resources for the benefit of local communities. **The opportunity to develop in rural areas autonomous, circular, and resilient water production and wastewater treatment systems, contribute to tackle COVID-19 by a better monitoring, reduction of diffuse pollution, and a better quality control from the source to tap and back to source.**



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**HYDROUSA impact on water, energy and food in the context of circular economy for decentralized schemes**

	Water	Energy	Agriculture & Biodiversity
<b>Source</b>	<b>Recovery of five different non-conventional water sources:</b> treated wastewater, rainwater, stormwater, seawater and vapour water.	<b>70% conversion of the organic content</b> of wastewater into biomethane.	<b>Abolish use of inorganic fertilizers</b> through nutrient recycling by fertigation and organic fertilizer use.
<b>Effective use of resources</b>	<b>100% water reuse</b> during the summer period.	Demonstrate the use of <b>biomethane to power vehicle</b> .  Demonstrate <b>low-energy consumption of rainwater harvesting</b> .	<b>Complete nutrient recycling</b> through fertigation and land application of sewage sludge. <b>Diversification of agricultural practices</b> to multi-cropping (agroforestry), enhancing production and income.
<b>Targets</b>	<b>Decrease of water consumption</b> for domestic and agricultural use by more than 20%.	<b>&lt;0.5 kWh/m<sup>3</sup> energy consumption</b> for rainwater harvesting. <b>&lt;0.3 kWh/m<sup>3</sup> energy consumption</b> for decentralized wastewater purification.	<b>20% increase of species</b> by fertigation and nature-based solutions implementation.
<b>Monitoring</b>	<b>Low-cost water monitoring and precision irrigation practices.</b>	<b>Decentralized energy metering</b> to accomplish more than <b>20% energy savings</b> .	<b>&gt;10% increase in agricultural yields</b> due to the use of reclaimed water.

