HYDROUSA

H2020-CIRC-2-2017

Water in the context of circular economy

Full project title:

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HYDROUSA Service including transferability and replication plan

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DOCUMENT INFORMATION

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Brief Description	This report details the content and criteria of the replication tool, as well as the transferability and replication plan developed in the framework of HYDROUSA. This plan describes all the information needed to be collected from the site to carry out assessment according to methodology implemented in deliverable D7.2.
Keywords	Feasibility Assessment; Guidance Methodology; Decentralized Solution Replicability

Version log Revision history

Rev. No.	Issue Date	Modified by	Comments
1.0	03/05/2023	Francesco Fatone Lucia De Simoni Josué González Camejo	Fully draft for internal revision
1.1	27/05/2023	Elena Koumaki	Internal revision
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1.3	30/06/2023	Eleni Nyktari	Final version for submission

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EXECUTIVE SUMMARY

Deliverable D7.6 is implemented within the activities of Task 7.6 of HYDROUSA project. It includes information about:

(1) the content and selected criteria to develop an online HYDROUSA service tool to rapidly evaluate the feasibility of the HYDROs in the replication sites;
(2) simulation of the HYDROUSA service in 10 follower sites;
(3) transferability and replication plan (TRP) that includes standardization of activities and approaches that have been validated within the HYDROUSA actions and will facilitate the replication and/or the transfer of the project's results beyond, including other regions and countries.

The online service tool has been developed within the frame of within WP7 of HYDROUSA project (Task 7.6), and aimed to quickly assess the replicability of the solutions proposed in the HYDROUSA project based on the information they have on the area under study. This tool is disseminated through a link within **HYDROUSA website** to make it available online to all stakeholders. In fact, the tool has two levels of users: i) basic users (in this case the tool aims to raise awareness on decentralized circular solutions); and ii) expert users (the tool serves for decision-making by recommending the most suitable HYDRO solution for the site under investigation). The tool has been designed with the aim of being self-explanatory and user-friendly. Users can follow step-by-step instructions in order to obtain an initial indication of the best applicable HYDRO solution for the given study area.

The tool has been disseminated to HYDROUSA stakeholders. At the time of submission of this report, 10 responses have been received. The relevant KPI has been achieved and more are expected to be obtained in future dissemination activities involving HYDROUSA partners.

The Transferability and Replication Plan will serve for technology providers and other partners of the HYDROUSA project (and even to selected stakeholders) to increase the level of exploitation and dissemination of HYDRO solutions after the end of HYDROUSA project. For this, it is important that all the steps needed for assessing HYDROs' replicability and the information provided to stakeholders and potential clients are clear, including the data which is necessary and how to assess and score the information collected on the local site.

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ABBREVIATIONS

CAPEX	**Capital Expenditures**
EIA	**Environmental Impact Assessment**
GA	**Grant Agreement**
GPP	**Green Public Procurement**
GUI	**Graphical user interface**
KPI	**Key performance indicator**
MENA	**Middle East and North Africa**
OPEX	**Operational Expenditures**
RP	**Replication plan**
TRP	**Transferability and Replication Plan**
UDESC	**Universidade do Estado de Santa Catarina**
XAUAT	**Xi’an University of Architecture and Technology**

1. INTRODUCTION

The implementation of the HYDRO solutions developed in the HYDROUSA project allows the reuse of non-conventional water sources to reduce water pressures in water-scarce regions, while implementing circular water economy and closing water loops. These new technical solutions are crucial to revaluing what is currently not considered as a water source. Even if applied only in small areas, HYDROs are of utmost importance to address the issue of water scarcity due to climate change. The six solutions developed are:

- HYDRO1 (Municipal wastewater treatment system) consists of a sewage treatment system that combines anaerobic process with constructed wetlands and disinfection.
- HYDRO2 (Agroforestry system) is an agroforestry system that can use the nutrient-rich reclaimed water from HYDRO1 (or other water source) to cultivate edible and non-edible trees, shrubs, and herbs.
- HYDRO3 (Subsurface rainwater harvesting system) is an innovative rainwater harvesting system to irrigate croplands in a self-sufficient way (without external sources of water such as potable water and groundwater).
- HYDRO4 (Residential rainwater harvesting system) is a rainwater harvesting system that can be applied to domestic residences to reclaim water for multiple purposes.
- HYDRO5 (Desalination system - Greenhouse) that consists of a desalination system powered by solar energy, coupled to saltwater evaporation. Desalinated water is used to irrigate a greenhouse with tropical fruits.
- HYDRO6 (Ecotourist water-loops) that consists of an agro-ecotourism facility, which is a form of tourism that combines both ecotourism and agrotourism, involving tourists' participation in sustainable farming, learning about local agricultural practices, and moving towards water, energy and food self-sufficiency.

In D7.2, a new methodology for assessing the replicability of HYDROs was developed to evaluate social, political, technical, and economic aspects (quantified by indicators) in the respective study area. This methodology transforms the qualitative and quantitative information collected from local stakeholders into a quantitative score. This feasibility assessment methodology has been applied in European (D7.3), the Middle East and North Africa (MENA) (D7.4) and non-European replication sites (D7.5).

Based on the approach of this methodology, a new open tool (replication service tool) was developed to allow different users to quickly assess the replicability of the solutions proposed in the HYDROUSA project, based on the information available to them about the area under study. This tool was developed as a link within the HYDROUSA website (www.hydrousa.org) in order to make it available online to all stakeholders. Therefore, a graphical user interface (GUI) was developed, where users can follow step by step instructions to get a first indication of the best applicable HYDRO solution for the study area in question.

2. TOOL INTERFACE

The first two pages of the tool serve the purpose of providing an overview of its structure and explaining the various HYDRO solutions, thereby assisting users in navigating and utilizing the tool effectively.

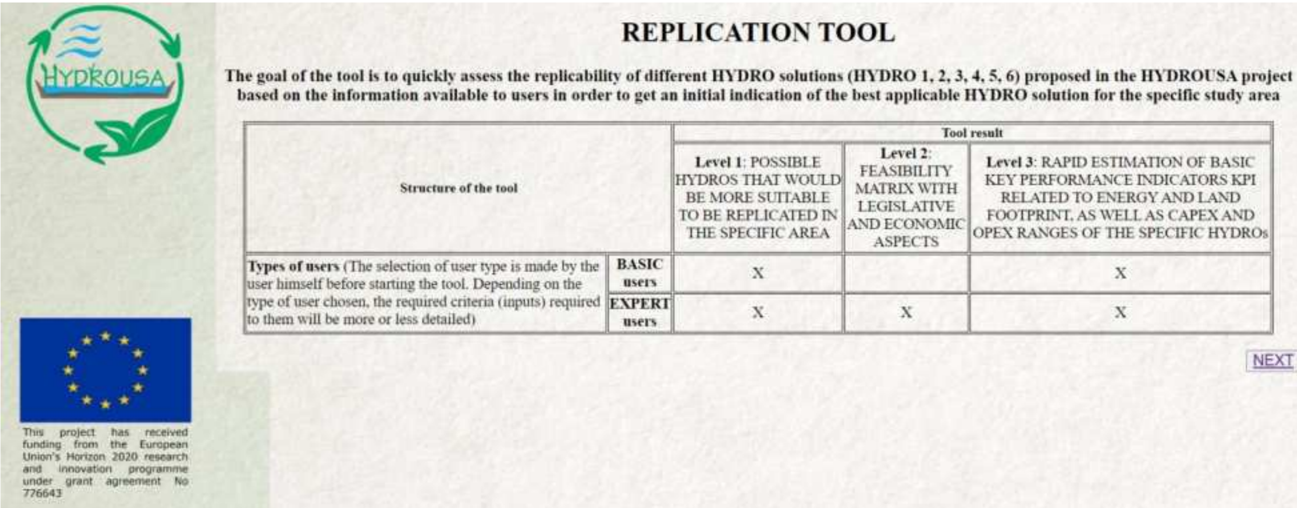

Figure 2.1 Page 0 - Structure of the tool

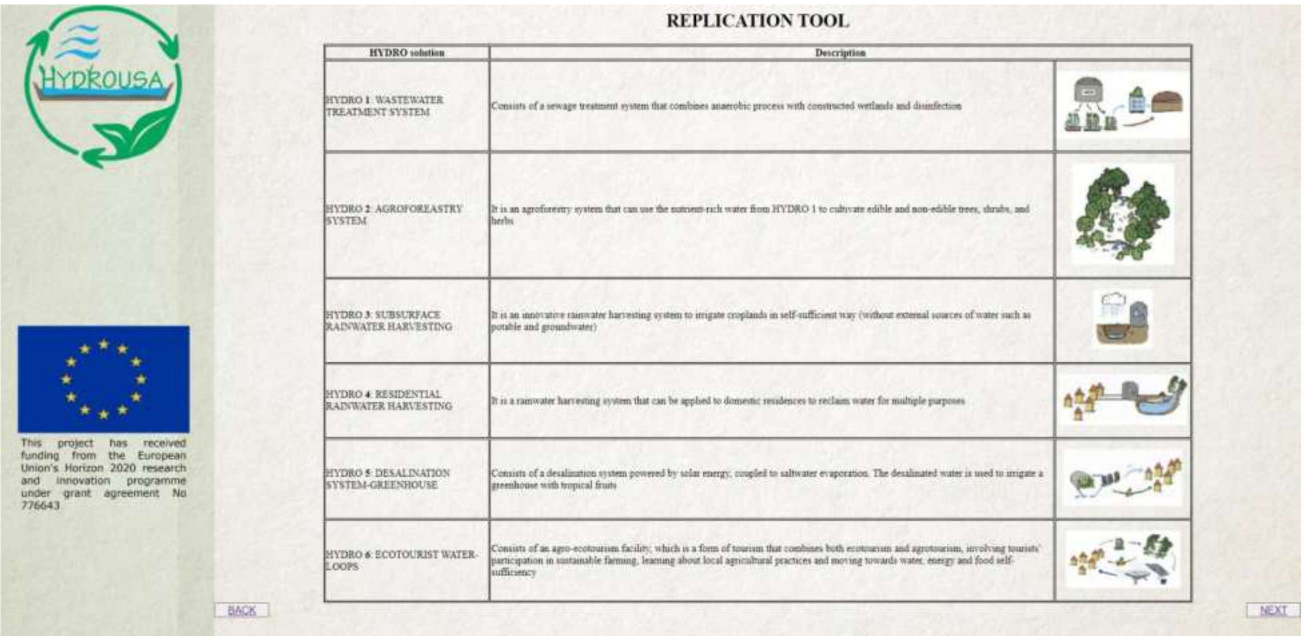

Figure 2.2 Page 1 - Description of the HYDRO solutions

The results of the tool are developed in two or three levels depending on the type of user who is carrying out the analysis. In fact, the tool is designed for two different types of users:

- BASIC USER: the users who are generally familiar with the project and have basic information about the site they want to implement (general users);

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- EXPERT USER: Users with clear knowledge of HYDROs' operation as well as a deep awareness of their distinguishing features. These individuals are typically decision-makers who can assess the suitability and applicability of HYDROs based on site-specific numerical data.

The selection of user type is made by the user himself/herself before starting the tool.

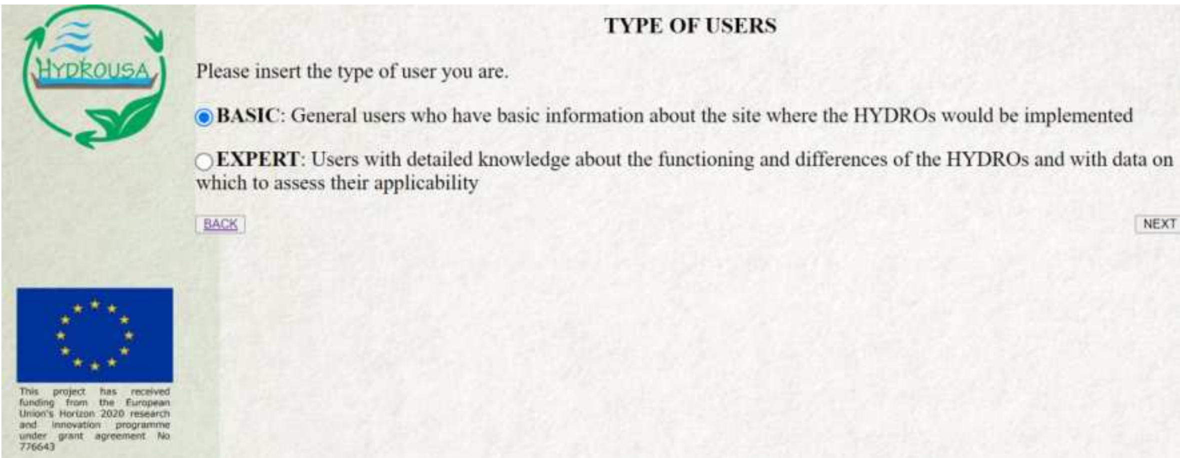

Figure 2.3 Page 2 - Selection of type of users

Depending on the type of user, this tool can facilitate the replication assessment and the transfer of HYDROUSA's results beyond the project to other regions and countries, as well as serve as a decision-making tool for expert users (mainly to obtain a preliminary estimation of the HYDRO to be implemented in their specific region). It can also serve to raise awareness of the importance of implementing decentralized solutions to close water loops (in the case of basic users).

3. TOOL DESIGN

The tool is developed in two levels for basic users and three levels for expert users.

The initial level, known as "General Assessment," focuses on framing the area of interest. This includes considering site characteristics, identifying the most relevant issues that need to be addressed, and determining the anticipated benefits that the user expects to achieve through the implementation of the HYDRO solution. The result of this level is the possible HYDROs that would be most suitable to be replicated in the specific area. It should be noted that prior to the development of this replicability tool of the HYDROUSA solutions in the European, MENA and non-European sites (D7.3-5), this "General Assessment" phase was conducted in 30-60 min meetings. In these meetings, the replication managers explained the objectives of the HYDROUSA project and the characteristics of HYDROs in order to agree on the best HYDRO solution and to meet the characteristics and needs of each region. Therefore, the first stage of the tools aims to facilitate this first step of the replication assessment.

The second level "Specific Assessment" includes basic legislative and economic information, considering local water governance, policies, tariffs and subsidies and the result is the feasibility matrix with legislative and economic aspects. This level is only for **expert users**.

Finally, the third level "Technical analysis" is based on design parameters that the user must provide, and the result is a rapid estimation of the basic Key Performance Indicators (KPIs) related to energy and land footprint, as well as CAPEX and OPEX ranges of the specific HYDROs. It must be noted that these KPIs will provide illustrative numbers. Detailed design should be carried out for an accurate estimation of the KPIs.

Summarizing, the application of the tool provides a general overview of the HYDRO solutions that have more potential of replicability at the site of consideration, along with an economic-legislative feasibility analysis (only for expert users).

3.1 Level 1 – General assessment

Level 1 consists of two steps of questions, more or less detailed depending on the type of user.

In the first step, referred to as "SITE CHARACTERISTICS" (Figure 3.1 & Figure 3.2), users are prompted to select the potential access limitations that may apply to their site. They can indicate these limitations by answering with a simple "Yes" or "No" response.

In addition, for expert users only, there are also questions regarding possible legislation that would prohibit the implementation of HYDRO solutions, which users must answer with a "Yes" or "No."

Table 3.1). If the "limiting" parameter directly disables implementation of any of the HYDROs (for instance, lack of saltwater for desalination (HYDRO5)), it will have a "0" score associated; whereas if it has no limitation, it will have a "1" score.

This first step of questions could be eliminatory. In fact, if some HYDROs obtain a 0 in any of these first set of questions, they will not be further considered in the assessment because it will be assumed that those characteristics would completely prevent the corresponding HYDRO implementation.

Table 3.1 Level 1 - Step 1 "Site characteristics"

SITE CHARACTERISTICS	*BASIC USER*	*EXPERT USER*
DOES THE SITE HAVE ANY LEGISLATION THAT FORBIDS ("first set of questions"):		
Wastewater reuse	-	*Y/N*
Fertigation	-	*Y/N*
Collection and reuse of rainwater	-	*Y/N*
Desalination of seawater	-	*Y/N*
Crop production using reclaimed water/rainwater	-	*Y/N*
Construction of touristic facilities	-	*Y/N*
SITE HAS LIMITED ACCESS TO ("second set of questions"):		
Freshwater	*Y/N*	*Y/N*
Seawater	*Y/N*	*Y/N*
Sanitation system	*Y/N*	*Y/N*
Available land	*Y/N*	*Y/N*
Arable land	*Y/N*	*Y/N*
Residences and touristic facilities	*Y/N*	*Y/N*

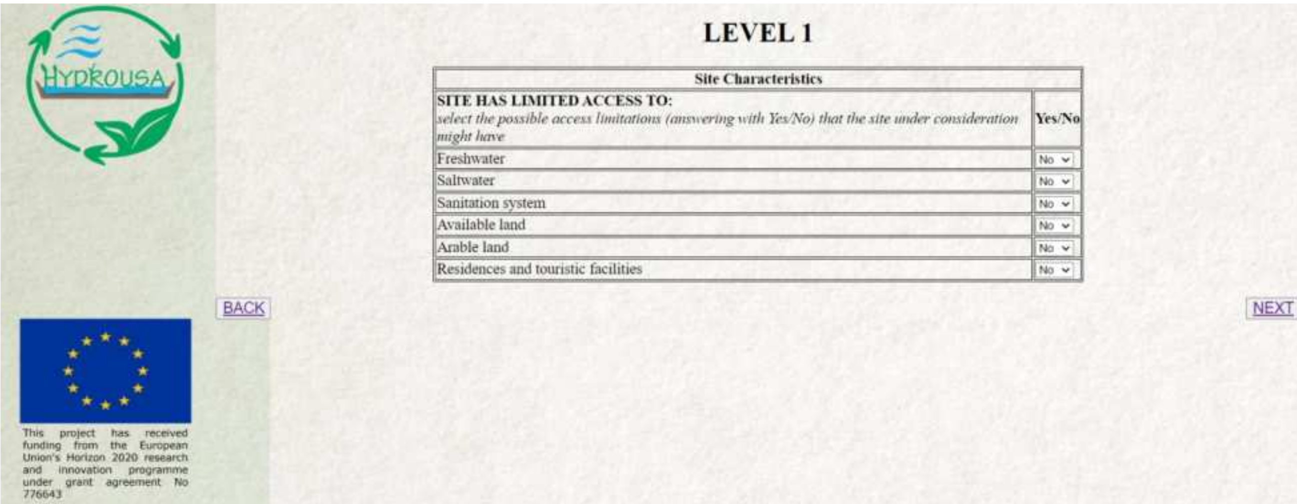

Figure 3.1 Page 3 - Level 1, Step 1 for Basic user

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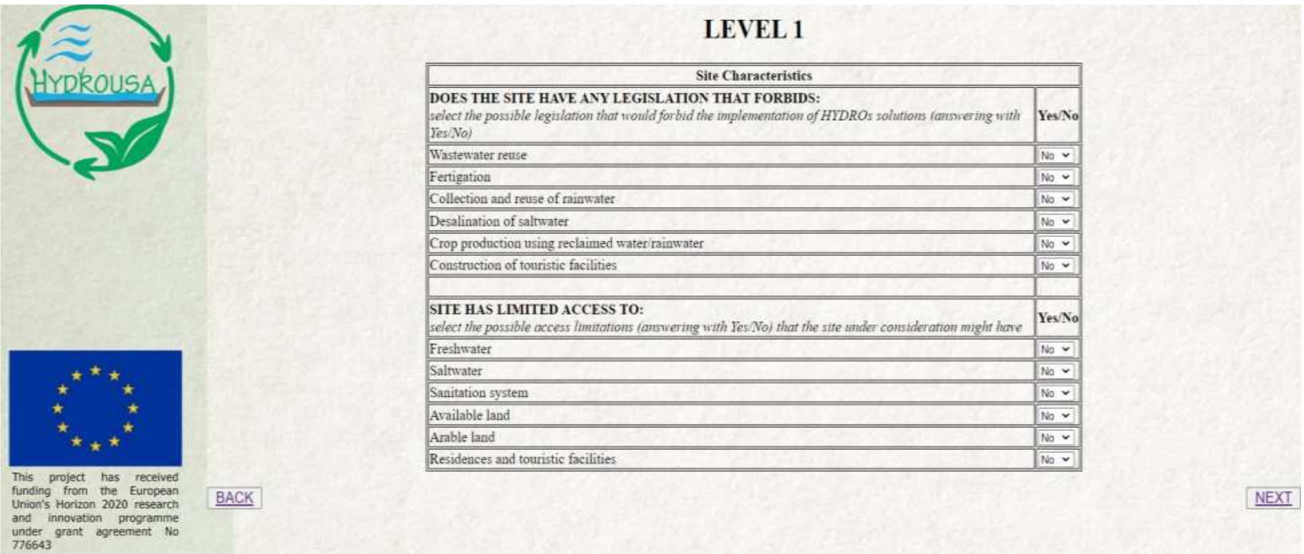


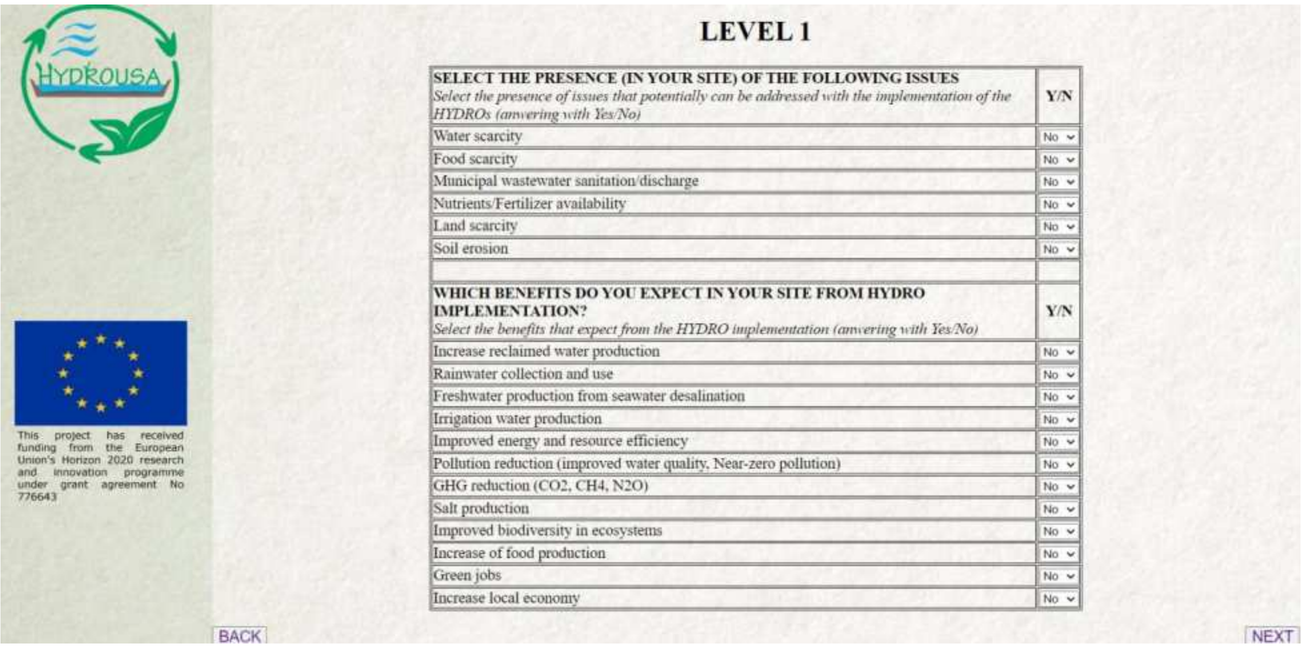
Figure 3.2 Page 3 - Level 1, Step 1 for Expert user

The second step consists of two set of questions regarding the presence/level of importance of issues that can be addressed potentially with the implementation of the HYDROs ("ISSUES") and the benefits that the user expects from the HYDRO implementation ("BENEFITS"). In this step, Basic Users should only answer with Yes/No (Y/N) for all questions, while Expert Users need to provide a weight score (Low "L", Medium "M", High "H") (Table 3.2, Figure 3.3 &Figure 3.4). The goal is to obtain more specific information and, consequently to better weight the scores of HYDROs. A different score is provided to each HYDRO for each of the answers obtained according to their relevance for the implementation of the specific HYDRO (that were not discarded in the first set of questions). Therefore, the scoring system for Y/N (0 or 1 point, respectively) and L, M, H level (0, 1, or 2 points, respectively) varies for each HYDRO, depending on the relative importance of that factor in the corresponding HYDRO.

Table 3.2 Level 1 - Step 2 "ISSUES" and "BENEFITS"

	BASIC USER	EXPERT USER
SELECT THE PRESENCE/LEVEL OF IMPORTANCE (IN YOUR SITE) OF THE FOLLOWING ISSUES:		
Water scarcity	*Y/N*	*L/M/H*
Energy scarcity	-	*L/M/H*
Food scarcity	*Y/N*	*L/M/H*
Municipal wastewater sanitation/discharge	*Y/N*	*L/M/H*
Nutrients/Fertilizer availability	*Y/N*	*L/M/H*
Environmental pollution (water, soil, air)	-	*L/M/H*
Land scarcity	*Y/N*	*L/M/H*
Brine management	-	*L/M/H*
Unsustainable tourism	-	*L/M/H*
Off-grid residences	-	*L/M/H*
Flooding	-	*L/M/H*
Soil erosion	*Y/N*	*L/M/H*

WHICH BENEFITS DO YOU EXPECT IN YOUR SITE FROM HYDRO IMPLEMENTATION?		
Increase reclaimed water production	*Y/N*	*L/M/H*
Rainwater collection and use	*Y/N*	*L/M/H*
Freshwater production from seawater desalination	*Y/N*	*L/M/H*
Irrigation water production	*Y/N*	*L/M/H*
Improved energy and resource efficiency	*Y/N*	*L/M/H*
Pollution reduction (improved water quality, Near-zero pollution)	*Y/N*	*L/M/H*
GHG reduction (CO_2, CH_4, N_2O)	*Y/N*	*L/M/H*
Salt production	*Y/N*	*L/M/H*
Resilience and adaptation to climate change	-	*L/M/H*
Improved biodiversity in ecosystems	*Y/N*	*L/M/H*
Increase of food production	*Y/N*	*L/M/H*
Green jobs	*Y/N*	*L/M/H*
Increase local economy	*Y/N*	*L/M/H*



LEVEL 1

SELECT THE PRESENCE (IN YOUR SITE) OF THE FOLLOWING ISSUES *Select the presence of issues that potentially can be addressed with the implementation of the HYDROs (answering with Yes/No)*	Y/N
Water scarcity	No
Food scarcity	No
Municipal wastewater sanitation/discharge	No
Nutrients/Fertilizer availability	No
Land scarcity	No
Soil erosion	No
WHICH BENEFITS DO YOU EXPECT IN YOUR SITE FROM HYDRO IMPLEMENTATION? *Select the benefits that expect from the HYDRO implementation (answering with Yes/No)*	Y/N
Increase reclaimed water production	No
Rainwater collection and use	No
Freshwater production from seawater desalination	No
Irrigation water production	No
Improved energy and resource efficiency	No
Pollution reduction (improved water quality, Near-zero pollution)	No
GHG reduction (CO2, CH4, N2O)	No
Salt production	No
Improved biodiversity in ecosystems	No
Increase of food production	No
Green jobs	No
Increase local economy	No

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Figure 3.3 Page 4 - Level 1, Step 2 for Basic user

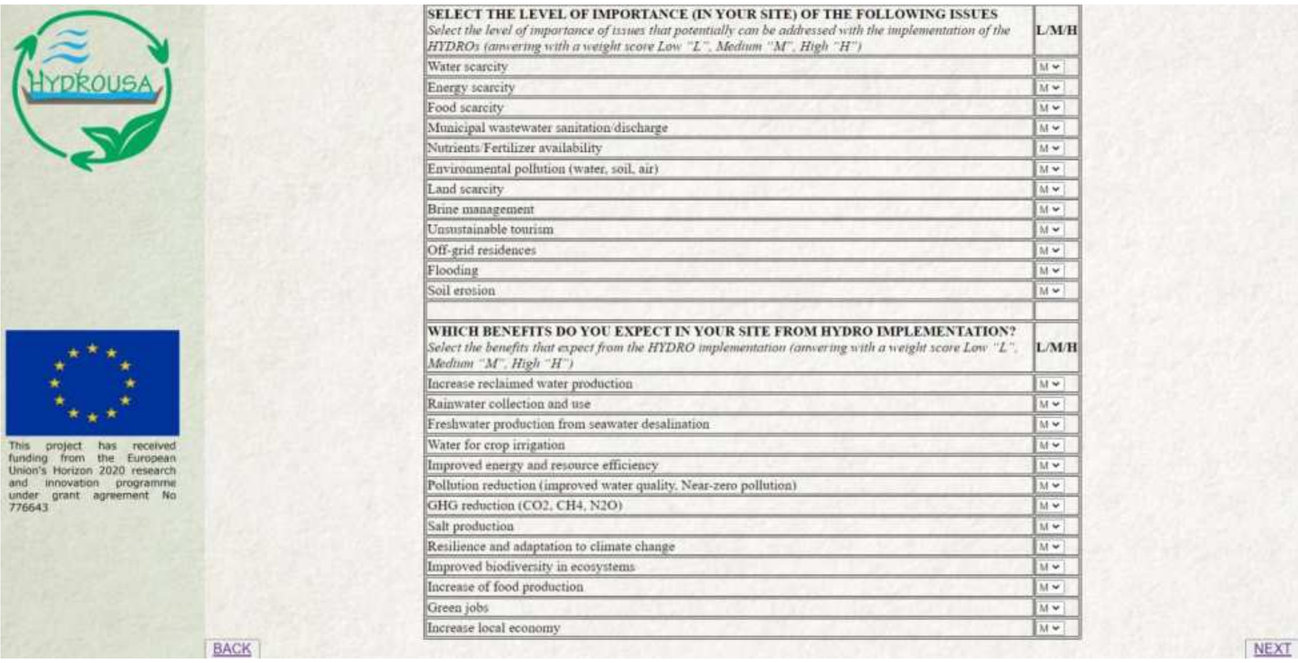


Figure 3.4 Page 4 - Level 1, Step 2 for Expert user

The result gives the final score of each HYDRO pre-selecting the one with the highest score, which is supposed to be the most convenient for the site, although the users can change this selection according to his/her preferences (Figure 3.5). This means that the user will have the final decision for HYDRO selection.

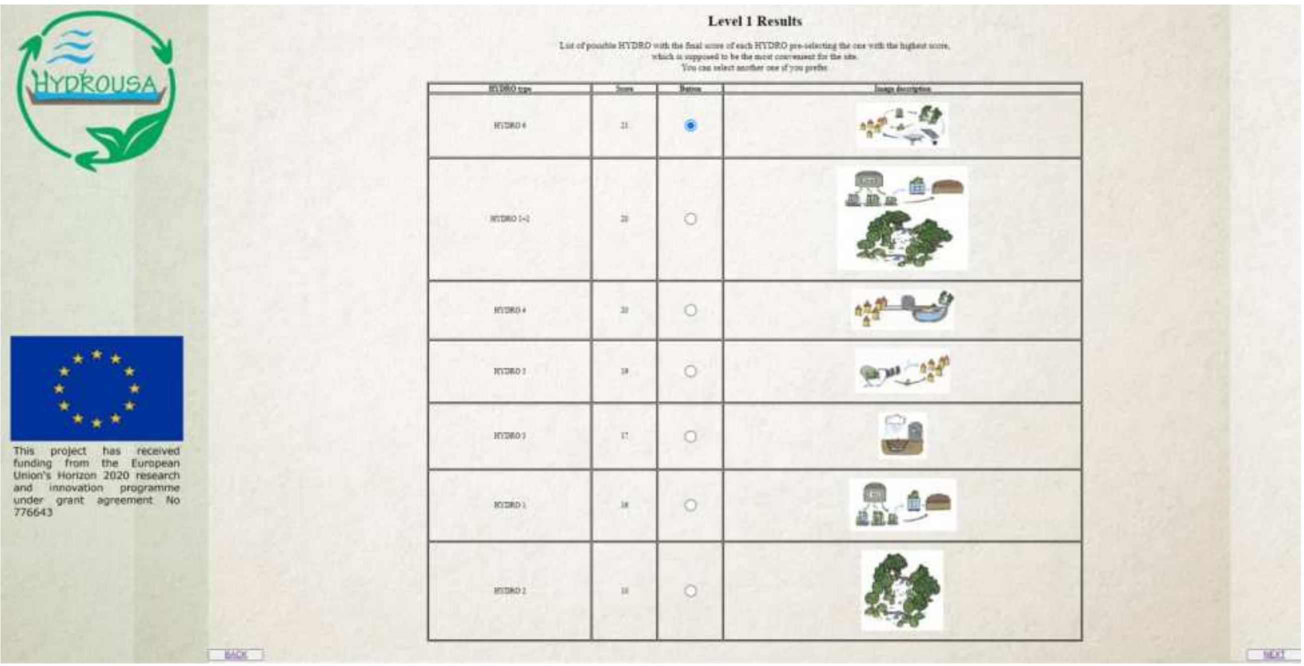


Figure 3.5 Page 5 - Level 1 Results

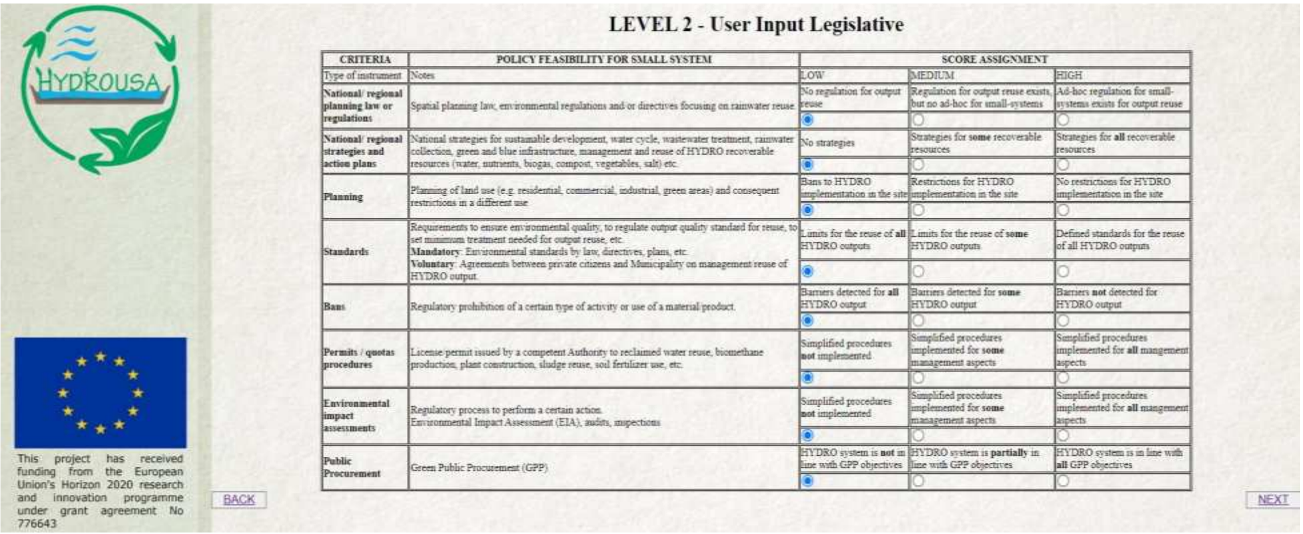
3.2 Level 2 – Specific assessment

Level 2 combines economic and legislative aspects to produce a feasibility matrix. It is only carried out by expert users. Therefore, there are two panels that the user must fill with the legislative analysis (Table 3.3 and Figure 3.6) and economic instruments (Table 3.4 and Figure 3.7). They are the same factors considered in the feasibility assessment methodology for HYDRO replicability (D7.2).

Table 3.3 Level 2 - Legislative assessment

CRITERIA	POLICY FEASIBILITY FOR SMALL SYSTEM	SCORE ASSIGNMENT		
Type of instrument	Notes	LOW	MEDIUM	HIGH
National/ Regional planning law or regulations	Spatial planning law, environmental regulations and/or Directives focusing on water reuse.	No regulation for output reuse	Regulation for output reuse exists, but no ad-hoc for small-systems	Ad-hoc regulation for small-systems exists for output reuse
National/ Regional strategies and action plans	National strategies for sustainable development, water cycle, wastewater treatment, rainwater collection, green and blue infrastructure, management and reuse of HYDRO recoverable resources (water, nutrients, biogas, compost, vegetables, salt, etc)	No strategies	Strategies for some recoverable resources	Strategies for all recoverable resources
Planning	Planning of land use (e.g., residential, commercial, industrial, green areas) and consequent restrictions in a different use	Bans to HYDRO implementation in the site	Restrictions for HYDRO implementation in the site	No restrictions for HYDRO implementation in the site
Standards	Requirements to ensure environmental quality, to regulate output quality standard for reuse, to set minimum treatment needed for output reuse, etc. Mandatory: Environmental standards by law, directives, plans, etc. Voluntary: Agreements between private citizens and Municipality on management/reuse of HYDRO output.	Limits for the reuse of all HYDRO outputs	Limits for the reuse of some HYDRO outputs	Defined standards for the reuse of all HYDRO outputs

Bans	Regulatory prohibition of a certain type of activity or use of a material/ product.	Barriers detected for all HYDRO outputs	Barriers detected for some HYDRO outputs	Barriers not detected for HYDRO outputs
Permits / quotas procedures	License/permit issued by a competent Authority to reclaimed water reuse, biomethane production, plant construction, sludge reuse, soil fertilizer use, etc.	Simplified procedures not implemented	Simplified procedures implemented for some management aspects	Simplified procedures implemented for all management aspects
Environmental impact assessment	Regulatory process to perform a certain action Environmental Impact Assessment (EIA), audits, inspections	Simplified procedures not implemented	Simplified procedures implemented for some management aspects	Simplified procedures implemented for all management aspects
Public Procurement	Green Public Procurement (GPP)	HYDRO system is not in line with GPP objectives	HYDRO system is partially in line with GPP objectives	HYDRO system is in line with all GPP objectives



LEVEL 2 - User Input Legislative

CRITERIA	POLICY FEASIBILITY FOR SMALL SYSTEM	SCORE ASSIGNMENT		
Type of instrument	Notes	LOW	MEDIUM	HIGH
National/ regional planning law or regulations	Spatial planning law, environmental regulations and/or directives focusing on rainwater reuse	No regulation for output reuse	Regulation for output reuse exists, but no ad-hoc for small-systems	Ad-hoc regulation for small-systems exists for output reuse
National/ regional strategies and action plans	National strategies for sustainable development, water cycle, wastewater treatment, rainwater collection, green and blue infrastructure, management and reuse of HYDRO recoverable resources (water, nutrients, biogas, compost, vegetables, salt) etc.	No strategies	Strategies for **some** recoverable resources	Strategies for **all** recoverable resources
Planning	Planning of land use (e.g. residential, commercial, industrial, green areas) and consequent restrictions in a different use	Bans to HYDRO implementation in the site	Restrictions for HYDRO implementation in the site	No restrictions for HYDRO implementation in the site
Standards	Requirements to ensure environmental quality, to regulate output quality standard for reuse, to set minimum treatment needed for output reuse, etc. **Mandatory**: Environmental standards by law, directives, plans, etc. **Voluntary**: Agreements between private citizens and Municipality on management reuse of HYDRO output.	Limits for the reuse of **all** HYDRO outputs	Limits for the reuse of **some** HYDRO outputs	Defined standards for the reuse of all HYDRO outputs
Bans	Regulatory prohibition of a certain type of activity or use of a material/product.	Barriers detected for **all** HYDRO output	Barriers detected for **some** HYDRO output	Barriers **not** detected for HYDRO output
Permits / quotas procedures	License/permit issued by a competent Authority to reclaimed water reuse, biomethane production, plant construction, sludge reuse, soil fertilizer use, etc.	Simplified procedures **not** implemented	Simplified procedures implemented for **some** management aspects	Simplified procedures implemented for **all** mangement aspects
Environmental impact assessments	Regulatory process to perform a certain action. Environmental Impact Assessment (EIA), audits, inspections	Simplified procedures **not** implemented	Simplified procedures implemented for **some** management aspects	Simplified procedures implemented for **all** mangement aspects
Public Procurement	Green Public Procurement (GPP)	HYDRO system is **not** in line with GPP objectives	HYDRO system is **partially** in line with GPP objectives	HYDRO system is in line with **all** GPP objectives

Figure 3.6 Page 6 - Level 2, Step 1

Table 3.4 Level 2 - Economic assessment

CRITERIA	ECONOMIC FEASIBILITY FOR SMALL SYSTEM	SCORE ASSIGNMENT	
Type of financing instrument	Notes	Y	N
Tariff	Taxes and charges/fees: Payment to the fiscal authority as mean of recovering costs for HYDRO investments (cost recovery policies)		
Payments/ Subsidies	Payments to landowners or private actors for practices (e.g., installing sustainable solutions)		
	Financing targeted research projects (e.g., developing more efficient urban sustainable solutions)		
	Payments for insurances which can cover the risk associated with the performance of newer green technologies		
Voluntary Agreements / Cooperation	Individual voluntary agreements: between parties to adopt practices by governmental bodies to develop/adopt processes which benefit the HYDRO implementation		

	Public-Private Partnerships: to enhance the ability of the public sector to provide public services thanks to the involvement of the private sector. These can be structured in: • Private sector has control over all assets, including investment, maintenance and operations decisions, although some decisions remain subject to regulatory oversight; • Concessions in the form of long-term contracts, the private sector has full responsibility for the asset operation, recouping investment costs with provision revenues; • Management and lease agreements, the private sector takes control on operations for shorter time and initial capital investment is assured by the public.		
Private sector	Loans (from investment and commercial banks) to invest in sustainable solution projects (e.g., stormwater technologies, restoration or urban regeneration projects, etc.).		
	Bonds (from capital market) e.g., financing of adaptation measures via an investment instrument with returns, green bonds for investing in sustainable/nature-based solutions.		
	Crowdfunding e.g., established by the municipality/city council which allows citizens to propose/finance their ideas such as urban farming for residents of a social housing quarter, etc.		
Liability schemes	Offsetting schemes where liability for environmental degradation leads to payments of compensation for environmental damage (e.g., eco-accounts, wetland destruction, brownfields funds, habitat banking)		

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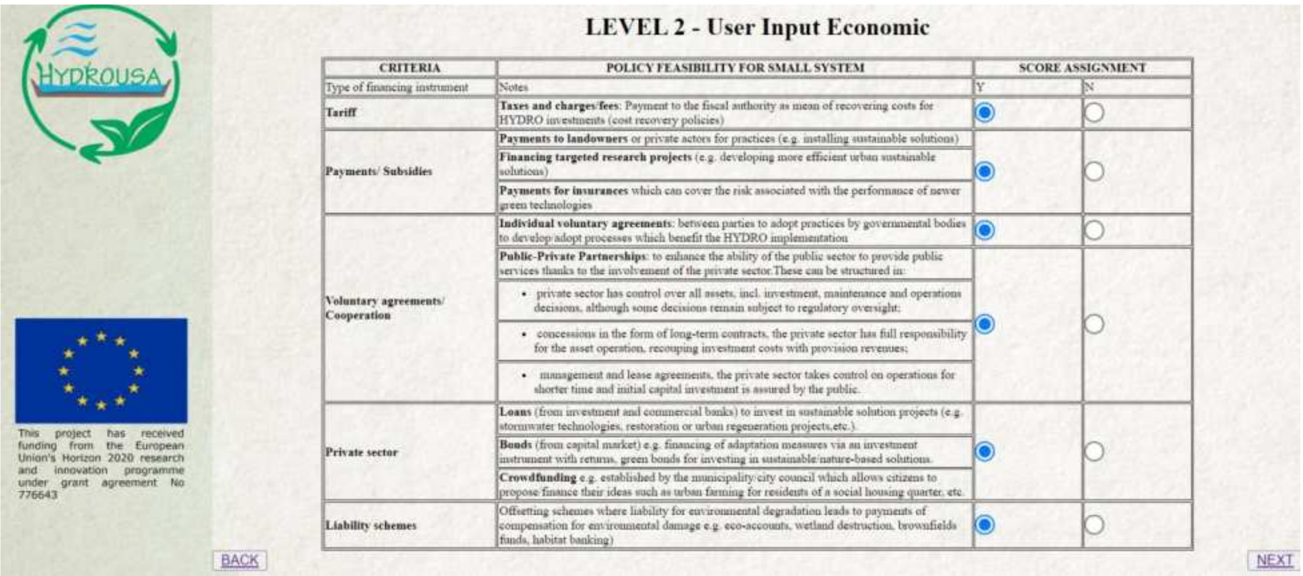

LEVEL 2 - User Input Economic

CRITERIA	POLICY FEASIBILITY FOR SMALL SYSTEM	SCORE ASSIGNMENT	
Type of financing instrument	Notes	Y	N
Tariff	**Taxes and charges/fees**: Payment to the fiscal authority as mean of recovering costs for HYDRO investments (cost recovery policies)		
Payments/ Subsidies	**Payments to landowners** or private actors for practices (e.g. installing sustainable solutions)		
	Financing targeted research projects (e.g. developing more efficient urban sustainable solutions)		
	Payments for insurances which can cover the risk associated with the performance of newer green technologies		
Voluntary agreements/ Cooperation	**Individual voluntary agreements**: between parties to adopt practices by governmental bodies to develop/adopt processes which benefit the HYDRO implementation		
	Public-Private Partnerships: to enhance the ability of the public sector to provide public services thanks to the involvement of the private sector.These can be structured in:		
	• private sector has control over all assets, incl. investment, maintenance and operations decisions, although some decisions remain subject to regulatory oversight;		
	• concessions in the form of long-term contracts, the private sector has full responsibility for the asset operation, recouping investment costs with provision revenues;		
	• management and lease agreements, the private sector takes control on operations for shorter time and initial capital investment is assured by the public.		
Private sector	**Loans** (from investment and commercial banks) to invest in sustainable solution projects (e.g. stormwater technologies, restoration or urban regeneration projects,etc.).		
	Bonds (from capital market) e.g. financing of adaptation measures via an investment instrument with returns, green bonds for investing in sustainable/nature-based solutions.		
	Crowdfunding e.g. established by the municipality/city council which allows citizens to propose/finance their ideas such as urban farming for residents of a social housing quarter, etc.		
Liability schemes	Offsetting schemes where liability for environmental degradation leads to payments of compensation for environmental damage e.g. eco-accounts, wetland destruction, brownfields funds, habitat banking)		

Figure 3.7 Page 7 - Level 2, Step 2

Following a similar approach to Level 1, each factor receives a score depending on the site's capacity for the implementation of the selected HYDROs. In particular, for the legislative assessment a score of 1, 2, or 3 is associated, respectively, for L, M, or H; whereas for the economic assessment a score of 0 or 1 is associated, respectively, for Y or N. A final score, for both the legislative and economic aspects, is obtained from the sum of all partial scores in order to define the overall low/medium/high degree of economic and legal support. The final result of level 2 is the feasibility matrix in which the results of the economic and legislative aspects are combined (see Table 3.5 as example).

Table 3.5 Level 2 Result

FEASIBILITY MATRIX		LEGISLATIVE SUPPORT		
		LOW	MEDIUM	HIGH
ECONOMIC SUPPORT	LOW			
	MEDIUM		X	
	HIGH			

The feasibility matrix highlights the Low, Medium, High level for both economic and legislative support based on the following meaning:

Table 3.6 Level 2 meaning of results

	ECONOMIC SUPPORT	LEGISLATIVE SUPPORT
LOW	Poor economic instruments were detected to finance HYDRO implementation. Economic viability of HYDRO solution could be a barrier	Local institutional barriers were detected for the HYDRO implementation due to unclear ad-hoc regulatory instruments for decentralized solutions
MEDIUM	Some economic support could be provided with a view of the HYDRO replicability	Local institutional assets do not hinder HYDRO implementation, but no clear ad-hoc regulatory instruments are detected for decentralized solutions
HIGH	Different economic strategies can be exploited to finance HYDRO replicability	Local institutional assets support well HYDRO implementation thanks to the adoption of ad-hoc regulatory instruments for decentralized solutions

3.3 Level 3 - Technical analysis

Level 3 concerns a technical analysis of the HYDRO pre-selected in Level 1. Depending on the HYDRO selected, the user must insert some basic sizing information (Table 3.7 to Table 3.13).

Table 3.7 Level 3 - Sizing information for HYDRO1

PARAMETERS HYDRO1	
Total PE (PE)	
Flowrate (m^3/d)	
Electricity Price in your country (€/kWh)	
Cost for personnel (€/d)	

Table 3.8 Level 3 - Sizing information for HYDRO2

PARAMETERS HYDRO2	
Land requirements (m^2)	
Electricity price in your country (€/kWh)	
Cost for personnel (€/d)	

Table 3.9 Level 3 - Sizing information for HYDRO1+2

PARAMETERS HYDRO1+2	
Total PE (PE)	
Flowrate (m^3/d)	
Irrigation land (m^2)	

Electricity price in your country (€/kWh)	
Cost for personnel (€/d)	

Table 3.10 Level 3 - Sizing information for HYDRO3

PARAMETERS HYDRO3	
Average annual rainfall (mm)	
Electricity price in your country (€/kWh)	
Catchment area (m^2)	
Cost for personnel (€/d)	

Table 3.11 Level 3 - Sizing information for HYDRO4

PARAMETERS HYDRO4	
Average annual rainfall (mm)	
Electricity price in your country (€/kWh)	
Surface catchment area (m^2)	
Cost for personnel (€/d)	

Table 3.12 Level 3 - Sizing information for HYDRO5

PARAMETERS HYDRO5	
Freshwater flow (L/d)	
Electricity price in your country (€/kWh)	
Cost for personnel (€/d)	

Table 3.13 Level 3 - Sizing information for HYDRO6

PARAMETERS HYDRO6	
Total guests	
Cost for personnel (€/d)	

By extrapolating the KPIs obtained in the HYDROs implemented in Greece (energy footprint, land footprint, CAPEX, OPEX), the illustrative results of the replicated HYDRO will be calculated (only for the HYDRO that was previously selected) (Table 3.14). Detailed assessment should be done to obtain more accurate values.

Table 3.14 Level 3 – Result

HYDRO	
Water collected (m^3/y)	Only for HYDRO3 and HYDRO4
Energy Footprint (kWh/y)	
Land Footprint (m^2)	
CAPEX (€)	
OPEX (€/y)	

4. TOOL DISSEMINATION

According to the grant agreement (GA), the tool was disseminated to different stakeholders outside the HYDROUSA Consortium in order to assess how HYDROUSA solutions can actually be sustainable in relevant sites around the world. In particular, 20 sites were contacted directly (Table 4.1), whereas more than 60 stakeholders were indirectly contacted by dissemination activities showing the replication too.

Table 4.1 List of stakeholders for dissemination of the tool

N.	Country	Organization	Target group
1	Italy	Parco Nazionale Alta Murgia	Natural Parks (protected areas)
2	Italy	Acquedotto Lucano	Water utilities in decentralized areas
3	Italy	Alto Trevigiano Servizi	Water utility north Italy
4	Greece	Technical University of Crete	Research Organization - University
5	Brazil	Universidade do Estado de Santa Catarina (UDESC)	Research Organization - University
6	China	Xi'an University of Architecture and Technology (XAUAT)	Research Organization - University
7	Germany	Berlin Competence Centre for Water	Research Organization - University
8	Spain	BETA Tech Centre	Research Organization - University
9	Israel	MEKOROT	Water utility
10	Romania	Technical University of Iasi	Research Organization - University
11	UK	Water Reuse Europe	Association
12	Italy	A2A	Water utility
13	Italy	HERA	Water utility
14	Italy	SMAT	Water utility
15	Italy	ACEA	Water utility
16	Netherlands	Rijksinstituut voor Volksgezondheid en Milieu	Health and Environmental Protection Agency
17	Netherlands	Delftland	Water Utility
18	Spain	Bioazul	SME
19	UK/Spain	ISLE Utilities	Engineering Ass
20	Spain	AQUALIA	Water utility

At the conclusion of all the tool's steps, an automated process generates a text file that includes all the answers selected and provided by the user. Therefore, each stakeholder, after utilizing the tool, receives the obtained result from the web pages as a text file.

Ten results were collected from the identified stakeholders (30% expert user and 70% basic user), resulting in the application of all types of HYDROs (Table 4.2). In particular, the results show that HYDRO1+2 is the most applicable solution with a percentage of 40%, HYDRO3 with a percentage of 20% and all other types of HYDROs (HYDRO 1, 4, 5, 6) have an application rate of 10% each.

These results align with those observed in the replication sites of the HYDROUSA project (D7.3-7.5), where HYDRO1+2 was also the preferred option. This indicates that water scarcity and diffuse wastewater pollution are the primary concerns in most of these sites' regions.

Table 4.2 Results of dissemination tool

N.	Country	Organization	HYDRO obtained
1	China	Research Organization - University	HYDRO1+2
2	China	Research Organization - University	HYDRO6
3	Spain	BETA Tech Centre (Research Organization - University)	HYDRO1+2
4	Israel	MEKOROT (Water utility)	HYDRO4
5	Netherlands	Rijksinstituut voor Volksgezondheid en Milieu (Health and Environmental Protection Agency)	HYDRO3
6	Netherlands	Delftland (Water Utility)	HYDRO5
7	Spain	Bioazul (SME)	HYDRO1+2
8	Morocco	WATREX Expo (SEMIDE)	HYDRO3
9	Morocco	Municipality of Tiout (Souss-Massa)	HYDRO1+2
10	France	Parc National de Port Cros	HYDRO1

The detailed results for all sites are given in Annex A.

5. TRANSFERABILITY AND REPLICATION PLAN (TRP)

The Replication Plan (RP) will serve as a means for technology providers, project partners of HYDROUSA, and selected stakeholders to enhance the exploitation and dissemination of HYDRO solutions beyond the completion of the HYDROUSA project. To achieve this, it is essential to ensure that all the steps required for assessing the replicability of HYDROs and the information provided to stakeholders and potential clients are clear. This includes specifying the necessary data and outlining how to assess and score the information collected at the local site.

HYDROUSA TRP describes in detail which data is necessary and how to assess and score the information collected on the local sites to replicate HYDRO solutions in potential replicability regions in Europe and beyond.

This replication plan is based on the standard replicability assessment methodology for the HYDROs implementation introduced in D7.2, which makes it possible to objectively assess the feasibility of applying the proposed solutions in different regions and countries; as well as on the use of the Replicability tool described in Sections 2 and 3 of this D7.6.

It must be noted that TRP can have two levels of detail:

- RP for Basic Feasibility Assessment (with preliminary design and cost benefit analysis of the HYDROs).
- RP for Detailed Feasibility Assessment. This detailed level will contain the same information as the basic, together with extra documents regarding detailed design and cost benefit analysis of the HYDROs.

The TRP contains the following sections, which are divided into several sub-sections.

5.1 Selection of the HYDRO

To select the most suitable HYDRO solution in the local site, the documentation shown below will be provided to stakeholders. This documentation will act as informative sheets and templates that will allow to collect all the necessary information to select the HYDRO solution. More details can be found in Annex B (Section 9).

A1) HYDRO Brochures

Brochures contain brief description of the HYDROs, their block flow diagrams and main technical features (Section 9.1). These brochures aim to provide all the necessary information for local stakeholders to understand the HYDROs' approach.

A2) Site description

Characterization of the area where the replication of HYDRO will be located (Section 9.2).

A3) Environmental constraints

Table 9.1: List of possible environmental constraints for the local implementation of HYDRO solutions. (see Annex B. Section 9.3)

Table 9.2 : Summary of relevant plans/strategies in force in the replication site (see Annex B. Section 9.3)

The collected information from points A1, A2 and A3 provide quite detailed knowledge of the specificities of the local replication site. Hence, this information is useful to complete level 1 of the feasibility assessment tool described in Section 3.1 (Expert user). The result of level 1 will propose the most suitable HYDRO solution to be implemented in the site evaluated. It must be noted that this first step remains the same for the Basic and Detailed Feasibility Assessment.

5.2 Specific assessment

This section contains information about:

B1) Social analysis and Stakeholder identification

According to the feasibility assessment methodology developed in D7.2, social analysis of the replication sites depends on the following factors: i) stakeholder and public participation, ii) training and qualification; iii) public information programs; iv) monitoring systems for decentralized solutions; v) research projects; vi) assessments of decentralised systems and ecosystem services. The description of each social sub-factor is shown in Table 9.4 (Annex B, Section 9.4). After collecting and scoring the social sub-factors, the social feasibility assessment score can be obtained in the range 0-100.

B2) Legislative Analysis

Whereas social analysis can be quite similar for all the HYDRO solutions, the Legislative analysis will depend on the water sources and by-products obtained in the HYDROs. In this respect, Table 5.1 shows the list of inputs and outputs that are relevant for each HYDRO:

Table 5.1 Relevant inputs and outputs of HYDRO solutions

HYDRO	INPUTS	OUTPUTS
HYDRO1 and HYDRO2	– Municipal wastewater	– Reclaimed water for irrigation – Compost/biosolids (fertilizer/soil amendment) – Biogas/biomethane
HYDRO3 and HYDRO4	– Rainwater – Runoff/stormwater	– Water for irrigation – Aquifer recharge – Essential oils – Rainwater for domestic non-potable purposes
HYDRO5	– Seawater – Saltwater/brines	– Water for irrigation – Tropical fruits – Salts from brine
HYDRO6	– Rainwater – Domestic water (greywater) – Domestic water (blackwater) – Water vapor	– Water for irrigation (from rainwater). – Reclaimed water for irrigation (from greywater). – Compost – Vegetables/fruits – Drinking water from vapour – Rainwater for domestic purposes

As general template, Table 9.6 (Annex B, Section 9.5) shows the basic information needed to evaluate the national and local legislation regarding each of the HYDROs. Apart from this information, it is relevant to know locally the administrative bodies responsible for the authorization of the HYDROs' construction and/or the use of their by-products. This information can be collected in Table 9.7 (Annex B, Section 9.5). According to the feasibility assessment methodology developed in D7.2, legislative analysis of the replication sites depends on the following factors: i) planning laws or regulations; ii) strategies and action plans; iii) planning/zoning, iv) targets; v) standards; vi) bans; vii) permits/quotas; viii) environmental impact assessment; ix) public procurement. The description of each social sub-factor is shown in Table 9.4 (Annex B, Section 9.5), whereas their scoring criteria is explained in Table 9.5 (Annex B, Section 9.5). As a result, a total feasibility score in the range 0-100 will be obtained.

B3) Financial Strategies

Different economic pathways to manage the HYDRO replication need to be identified and described (e.g., subsidies, funds, water-sector tariff). Table 9.10 (Annex B, Section 9.6) can be used to collect relevant information on the possible economic instruments. For the basic feasibility assessment, evaluation of legislative and financial support of HYDRO solutions in the local site can be assessed by the feasibility assessment tool (Expert-user mode) (Section 3.2). The tool contains the same sub-factors as the feasibility assessment methodology, but they are evaluated qualitatively, which simplifies the evaluating step. For the detailed assessment, the criteria shown in Table 9.10 must be followed to obtain the quantitative score of the legislative assessment in the range 0-100. On the other hand, financial strategies are indirectly evaluated within the economic assessment (Section 3.2).

5.3 Techno-economic assessment

According to the level of detail of the assessment (Basic or Detailed), the information needed for the techno-economic assessment will differ significantly. For the basic feasibility assessment, only the information within Table 3.7 to Table 3.13 will be requested, depending on the HYDRO solution selected. On the other hand, if detailed techno-economic assessment is developed, design of the HYDRO must be done. In this case, technology providers should be contacted, as they have the expertise to adapt the HYDRO solution to the specificities of each site and provide detailed numbers on the amount of by-products and payback period. Table 9.11 (Annex B, Section 9.7) shows the list of technology providers of each HYDRO. In the case where detailed feasibility assessment is carried out, the technical assessment can be quantitatively assessed by the criteria displayed in Table 9.12 (which is based on the KPIs of the HYDROs), whereas the economic assessment scoring is provided according to the payback period of the HYDRO in Table 9.13 (Annex B, Section 9.8). The result of the overall feasibility assessment is a single number in the range 0-100 obtained from the weighted combination of the scores for each criterion: social feasibility: 30%; political feasibility: 30%; technical feasibility: 20%; economic feasibility: 20% (Table 5.2).

Table 5.2 Feasibility assessment methodology

FINAL RESULTS			
Feasibility Criteria	Main Feasibility Sub-Criteria	Weight	Score
Social Feasibility	Stakeholder and public participation, Social Benefits, Social Acceptance	30%	*Specific SCORE of the chosen HYDRO for the replication site*
Policy Feasibility	Strategies and Action plans, Targets and Quality standards, Permitting Pathway	30%	*Specific SCORE of the chosen HYDRO for the replication site*
Technical Feasibility	Efficiency	20%	*Specific SCORE of the chosen HYDRO for the replication site*
Economic Feasibility	Financial Pathway, Payback Period	20%	*Specific SCORE of the chosen HYDRO for the replication site*
OVERALL FEASIBILITY	-	**100%**	**FINAL SCORE from 1 to 100**

This result represents the degree of replicability that the selected HYDRO would be expected to achieve. In this way, it is possible to compare replicability in different regions, localities and/or communities.

6. CONCLUSIONS

The implementation of technical solutions to recover alternative sources of water (wastewater, rainwater, seawater, etc.) based on a modern, resource-efficient economy is essential to address the water scarcity problems resulting from climate change. For this purpose, the development of HYDROs allows the reuse of non-conventional water sources and promotes local economy. However, the implementation of these decentralized technical solutions commonly faces difficulties due to lack of comprehensive feasibility assessment in local context.

To overcome this, a methodology to assess the feasibility of the HYDROs was developed to evaluate social, political, technical and economic aspects (quantified by indicators) at local level, giving local stakeholders the opportunity to participate in final decisions. This methodology was used to evaluate the implementation of the HYDROs in 25 replication sites of Europe, MENA countries and non-European countries. The procedure of HYDRO replication is quite long (in terms of months of work) and requires extensive and specific data. For this reason, utilizing the aforementioned feasibility assessment methodology, a new open-access replication service tool has been developed. This tool enables different users to quickly evaluate the replicability of the solutions proposed in the HYDROUSA project based on the information available for the specific area being studied. This tool provides an initial indication of the most suitable HYDRO solution to be further developed through a more detailed study.

Moreover, a Transferability and Replication Plan has been elaborated to provide HYDROUSA partners and stakeholders with all the necessary steps and information to develop replication assessment studies, both at basic (focusing on the use of the replication service tool) and detailed level (focusing more on the feasibility assessment methodology).

7. REFERENCES

HYDROUSA_Deliverable 7.2 - Guidance methodology for replication assessment

HYDROUSA_Deliverable 7.3. Feasibility studies in European replication sites

HYDROUSA_Deliverable 7.4. Feasibility studies in MENA replication sites

HYDROUSA_Deliverable 7.5. Feasibility studies in non-European replication sites

Designing Buildings, 2020 URL: https://www.designingbuildings.co.uk/wiki/Constraints_on_construction_projects (accessed: 17.05.2020)

Environmental Feasibility, 2020 URL: https://ppp-certification.com/ppp-certification-guide/131-process-assessing-environmental-feasibility (accessed: 17.05.2020)

8. ANNEX A: TECHNICAL RESULTS OF DISSEMINATION TOOL

The technical results obtained by the different stakeholders in the application of the tool are presented in the Tables and Figures below.

Table 8.1 Result HYDRO1+2 – CHINA (Research Organization - University)

PARAMETERS HYDRO1+2	
Total PE (PE)	500
Flowrate (m^3/d)	208
Irrigation land (m^2)	1’186.67
Electricity price in your country (€/kWh)	0.06
Cost for personnel (€/d)	291
RESULTS HYDRO1+2	
Energy Footprint (kWh/y)	70’667.3
Land Footprint (m^2)	2’201.7
CAPEX (€)	541’884.65
OPEX (€/y)	508’862.37

Table 8.2 Result HYDRO6 – CHINA (Research Organization - University)

PARAMETERS HYDRO6	
Total guests	25
Cost for personnel (€/d)	20
RESULT HYDRO6	
Energy Footprint (kWh/y)	0
Land Footprint (m^2)	187.5
CAPEX (€)	116’572.92
OPEX (€/y)	4’250

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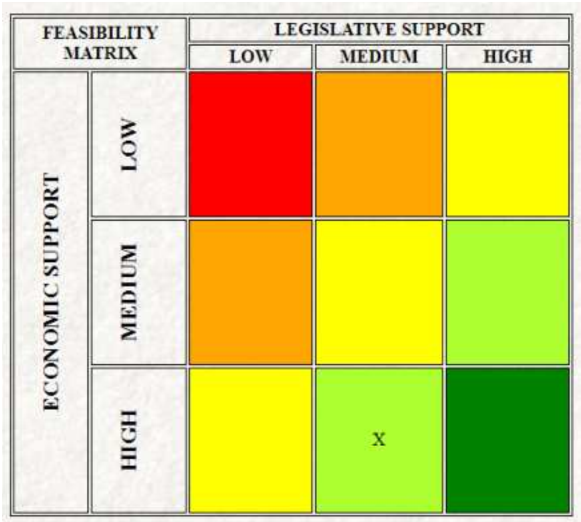

Figure 8.1 Result Level 2 (HYDRO6) – CHINA (Research Organization - University)

Table 8.3 Result HYDRO1+2 – SPAIN (BETA Tech Centre – Research organization)

PARAMETERS HYDRO1+2	
Total PE (PE)	500
Flowrate (m^3/d)	70
Irrigation land (m^2)	1000
Electricity price in your country (€/kWh)	0.5
Cost for personnel (€/d)	80
RESULT HYDRO1+2	
Energy Footprint (kWh/y)	23’748
Land Footprint (m^2)	2’015
CAPEX (€)	541’707.3
OPEX (€/y)	110’434

Table 8.4 Result HYDRO4 – ISRAEL (MEKOROT – Water utility)

PARAMETERS HYDRO4	
Average annual rainfall (mm)	500
Electricity price in your country (€/kWh)	0.12
Surface catchment area (m^2)	350
Cost for personnel (€/d)	55
RESULT HYDRO4	
Water collected (m^3/y)	175
Energy Footprint (kWh/y)	16

Land Footprint (m^2)	548.6
CAPEX (€)	21’786.83
OPEX (€/y)	3’508.86

Table 8.5 Result HYDRO3 – NETHERLANDS (Health and Environmental Protection Agency)

PARAMETERS HYDRO3	
Average annual rainfall (mm)	700
Electricity price in your country (€/kWh)	0.5
Catchment area (m^2)	200
Cost for personnel (€/d)	80
RESULT HYDRO3	
Water collected (m^3/y)	140
Energy Footprint (kWh/y)	37.1
Land Footprint (m^2)	450.2
CAPEX (€)	56’112.54
OPEX (€/y)	12’796.82

Table 8.6 Result HYDRO5 – NETHERLANDS (Delftland – Water utility)

PARAMETERS HYDRO5	
Freshwater flow (L/d)	125
Electricity price in your country (€/kWh)	0.5
Cost for personnel (€/d)	120
RESULT HYDRO5	
Energy Footprint (kWh/y)	0
Land Footprint (m^2)	125
CAPEX (€)	20’937.5
OPEX (€/y)	4’053.75

Table 8.7 Result HYDRO1+2 – SPAIN (Bioazul – SME)

PARAMETERS HYDRO1+2	
Total PE (PE)	24’000
Flowrate (m^3/d)	6’000
Irrigation land (m^2)	1000
Electricity price in your country (€/kWh)	0.1
Cost for personnel (€/d)	160
RESULT HYDRO1+2	

Energy Footprint (kWh/y)	2’035’542.9
Land Footprint (m^2)	49’720
CAPEX (€)	25’957’300.88
OPEX (€/y)	3’080’757.14

Table 8.8 Result HYDRO3 – MOROCCO

PARAMETERS HYDRO3	
Average annual rainfall (mm)	311
Electricity price in your country (€/kWh)	0.12
Catchment area (m^2)	200
Cost for personnel (€/d)	80
RESULT HYDRO3	
Water collected (m^3/y)	62.2
Energy Footprint (kWh/y)	16.5
Land Footprint (m^2)	200
CAPEX (€)	24’930
OPEX (€/y)	5’679

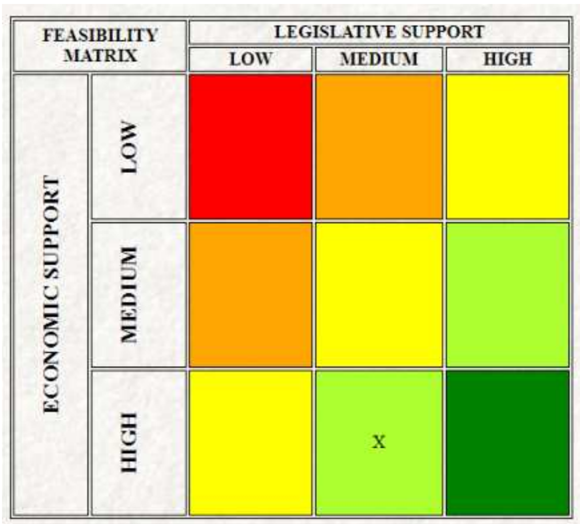

Figure 8.2 Result Level 2 (HYDRO3) – MOROCCO

Table 8.9 Result HYDRO1+2 – MOROCCO (Municipality of Tiout)

PARAMETERS HYDRO1+2	
Total PE (PE)	3’500
Flowrate (m^3/d)	135
Irrigation land (m^2)	6’000
Electricity price in your country (€/kWh)	0.14
Cost for personnel (€/d)	30

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RESULTS HYDRO1+2	
Energy Footprint (kWh/y)	45’799.7
Land Footprint (m^2)	13’105
CAPEX (€)	3’791’001.17
OPEX (€/y)	206’539.82

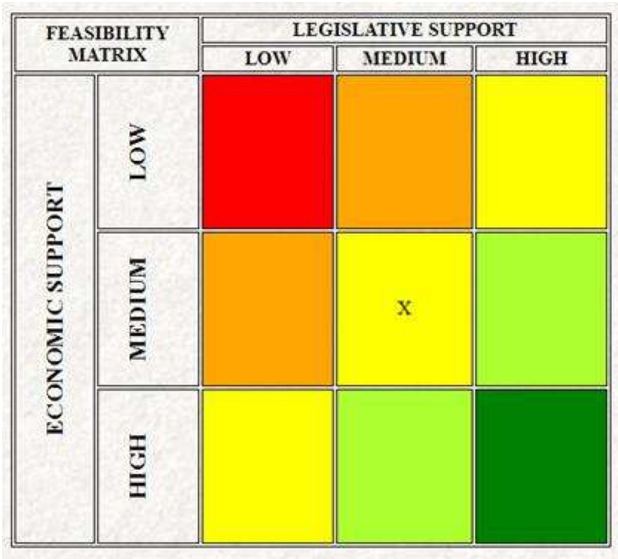


Figure 8.3 Result Level 2 (HYDRO1+2) – MOROCCO (Municipality of Tiout)

Table 8.10 Result HYDRO1 – FRANCE

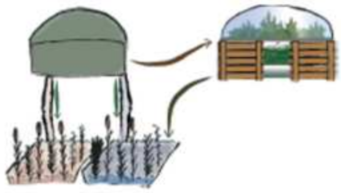
PARAMETERS HYDRO1+2	
Total PE (PE)	4’500
Flowrate (m^3/d)	230
Electricity price in your country (€/kWh)	0.2
Cost for personnel (€/d)	80
RESULTS HYDRO1+2	
Energy Footprint (kWh/y)	78’029.1
Land Footprint (m^2)	9’135
CAPEX (€)	4’866’815.79
OPEX (€/y)	33’208.69

9. ANNEX B: TRANSFERABILITY AND REPLICATION PLAN

9.1 HYDRO brochures

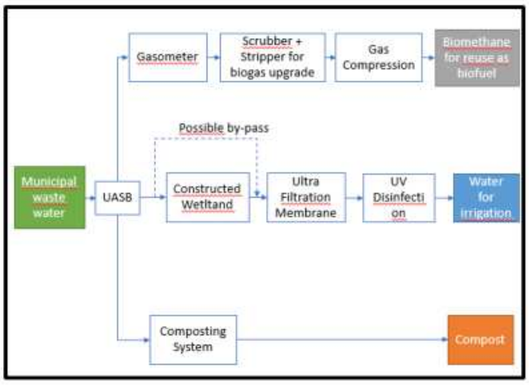
HYDRO 1

a sewage treatment system applied in decentralised areas with high seasonal loads to recover energy and recycle water and nutrients



System Description

HYDRO1 consists of a sewage treatment system applied in decentralised areas with high seasonal loads. HYDRO1 combines anaerobic processes (Upflow Anaerobic Sludge Blanket (UASB) reactor) with constructed wetlands and disinfection to treat domestic wastewater as a completely circular solution, where water, nutrients and the produced sludge are going to be reused. Furthermore, the anaerobic process recovers energy in the form of biogas.



HYDROUSA establishes the optimal operating conditions under which organic load removal and biogas production are maximized. The excess sludge from the UASB gets mixed with biomass and co-composted in an innovative in-vessel composting system, coupled with a novel plant biofilter to treat the odours. According to legal constraints the UASB effluent will be either treated in a series of saturated and unsaturated constructed wetlands (CWs), filtered and disinfected for reuse in agriculture, or will be directly used for fertigation after disinfection. The produced biogas may be used for energy production in CHP generators or can be upgraded to methane to be valorised as a fuel. A simplified layout of HYDRO 1 is shown in Figure 1.

Technical Specifications

UASB

Pretreatment requirements: grease and grit removal
Municipal wastewater temperature range = 15–35 °C
Hydraulic Residence Time = 7 – 10 h
Organic loading = 2 - 10 kgCOD/m^3/day
Area required = 0.25 m^2 per m^3/day of wastewater treated
Upflow velocity = 0.5–1 m h^{-1}
Organic pollution removal as COD = 70 – 80%
Solids removal as TSS = 70 – 80%
Biogas production = 0.24 m^3 biogas per m^3 of wastewater treated
Sludge production = 25 g DS per m^3 of wastewater

Post-treatment

Ultrafiltration membrane

TSS removal = 96 – 99%
Total and Fecal Coliforms reduction = 3 – 6 log
Rate of flux = 60 – 180 l m^{-2}h^{-1}
Energy consumption = 0.2 – 0.3 kWh m^{-3} of wastewater treated

UV Lamp

Estimated lamp life = 8000 – 12,000 hours
Max Energy consumption = 0.03 kWh m^{-3} of wastewater

Constructed Wetlands

Area required = 8.5 m^2 per m^3/day of wastewater treated
Organic pollution removal as COD = 90%
Solids removal as TSS = 75%
Nitrogen removal = 10-20% (one stage wetland);
50-70% (two-stage wetland)
E. coli removal = 90 – 99%
Sludge production = none

Benefits

No wastewater discharge into the sea at dry weather
High quality wastewater effluent that meets Directive 91/271 effluent criteria
Cheaper Production of reclaimed water for restricted and unrestricted irrigation
Recycling nutrients in agriculture
Low energy consumption < 0.3 kWh/m^3 of wastewater treated
Energy recovery from wastewater = 0.6 kW$_e$/ m^3 of wastewater treated
Low O&M costs < 0.5 €/m^3 of wastewater treated
Pay back period < 9 years

Figure 9.1 HYDRO1 Technical Brochure

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HYDRO 2

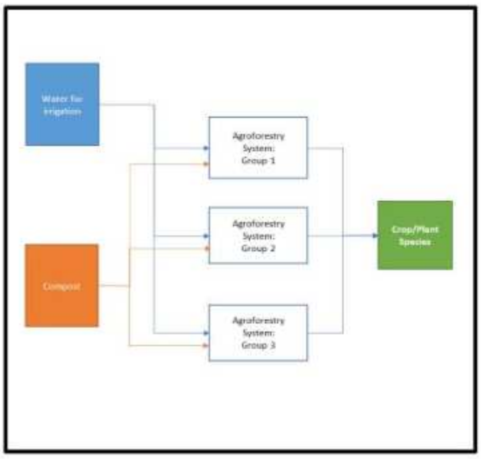
Reuse of nutrient-rich water and compost recovered in Hydro 1 to cultivate an agroforestry system

System Description

In HYDRO2 the nutrient-rich water from HYDRO1 is used to cultivate 1 ha of an agroforestry system that produces edible and non-edible trees, shrubs and herbs.

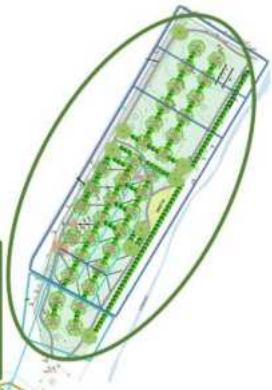
The agroforestry system is divided in 3 main groups: (1) forestry trees for fruit and timber production; (2) orchards/bushes; and (3) herbs and annual crops. The plant setup is co-creatively elaborated with the public for a definition of business cases and to form resilient ecosystems.

The agroforestry fertigation system combines traditional irrigation methods with precision irrigation and is carried out by applying both drip and channel irrigation, using treated wastewater of different quality: i. treated effluent from constructed wetlands which is filtered and disinfected, ii. treated effluent from constructed wetlands which is disinfected and iii. disinfected UASB effluent.



Approximately 1 ha with >5000 edible and non-edible trees and shrubs irrigated with:

- ❑ 100 m3/d Disinfected Wastewater from Costructed Wetlands using Drip Irrigation or Channel Irrigation



Benefits

- Savings of freshwater
- Wastewater reuse for fertigation
- Recycling nutrients in agriculture (no fertilizer import)
- Valorization of marketable products
- Annual production of > 0,7 tons of fruits, herbs, vegetables per 1000 m2 irrigated with reclaimed wastewater

Figure 9.2 HYDRO2 Technical Brochure

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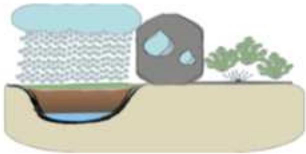
HYDRO 3

Remote and innovative rainwater harvesting system for irrigation

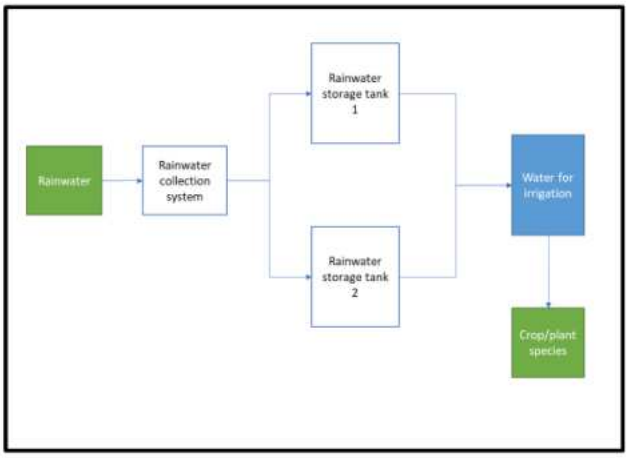


System Description

HYDRO3 consists of a low-cost, innovative rainwater harvesting system for remote areas, where house roofs are not available.

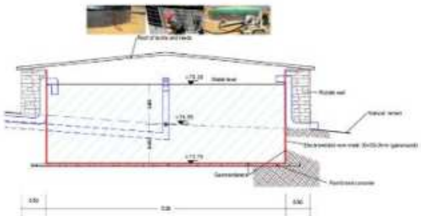
A shallow, subsurface water collection system is designed to collect rainwater by drainage, to transport it to storage tanks, and possibly to utilize water for agricultural irrigation. For instance, in Mykonos harvested water will be used to irrigate oregano which requires small amounts of water.

Online meteorological parameters e.g. rainfall, wind, humidity, pressure are monitored using a weather station in order to optimize the design of the system. Automated irrigation is performed using soil humidity sensors coupled to dripline irrigation systems.



Technical Specifications for Mykonos

- Average annual rainfall = 319 mm
- Subsurface rainwater collector of approximately 280 m2 and depth of 60cm.
- Two flexible cylindrical tanks of structural grid with total cumulative capacity of 60m3
- Total water harvesting capacity > 60 m3 / year
- Automated system of drip irrigation in oregano crops of 4000m2



Expected Results:

- > 60 m3/year of harvested water
- Expected production of oregano> 800 kg/year per ha
- Energy consumption <0.5 kWh/m3 of harvested water
- 0.4 ha irrigated area

Benefits

Cheap water supply at remote areas without other water supply

Savings of freshwater

Create business case with little input

Minimization of construction and operation costs to create an economically viable and profitable water collection and irrigation system

Payback period < 3 years

Figure 9.3 HYDRO3 Technical Brochure

This project has received funding from
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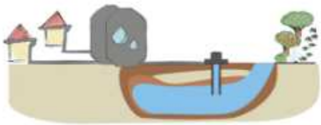
HYDRO 4

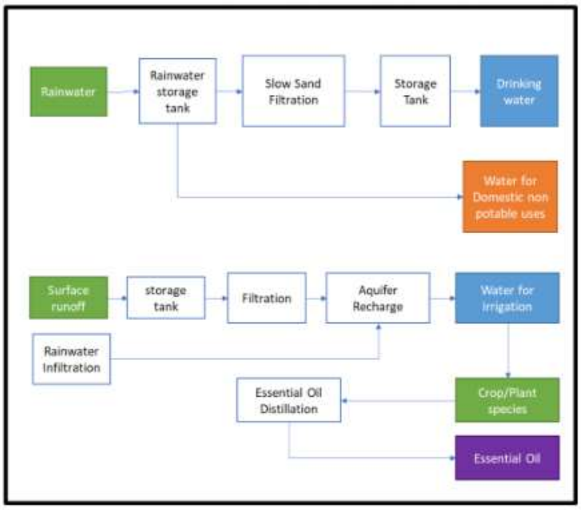
Rainwater harvesting and treatment system for the production of irrigation and potable water and for aquifer recharge

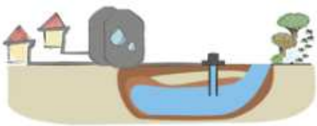


System Description

HYDRO4 is a rainwater harvesting system that can be applied to domestic residences to reclaim water for multiple purposes. Rainwater is collected and used for domestic non-potable uses. Part of the collected rainwater is treated by a slow sand filter (SSF) which is populated by microorganisms. The system is structured by layers of sand and gravel to enable different processes to purify the water for potable use.

Surface runoff is collected using a novel bioswale system, filtered and stored into the aquifer. The water will be used to cultivate 0.2 ha lavender. Lavender was chosen to produce high added value essential oil. Nutrients will be provided through composting of greens available on-site.





Technical Specifications for Average Rainfall of 319 mm/year

Rainwater Collection Systems

Roof Rainwater Collection Area = 438 m2
Total Rainwater Harvesting Capacity = 126 m3/year
Surface Runoff Area = 350 m2
Total Surface Runoff Water Harvesting Capacity = 133 m3/year

Slow Sand Filter for Potable Water

Target filtration rate of 0.12 m/h
Filter Area = 0.2 m2
Flow rate of Potable Water after Installation: 0.4 L/min
Volume of Potable Water = 27 m3/year

Agricultural Production

Lavender Dried Floral Stems = 280 kg/year
Essential oil distillation = 3,3 l/year

Benefits

Decentralized solution to increase water supply in drought emergency situations

Water recovery for domestic non potable uses

Production of drinking water > 10 m³ /year

Aquifer recharge to store water and improve the ecological status of groundwater, 200 m³ of stored water/year

Fresh water recovered to irrigate 0.2 ha of crops, corresponding to 1000 kg/year lavender for essential oil production.

Figure 9.4 HYDRO4 Technical Brochure

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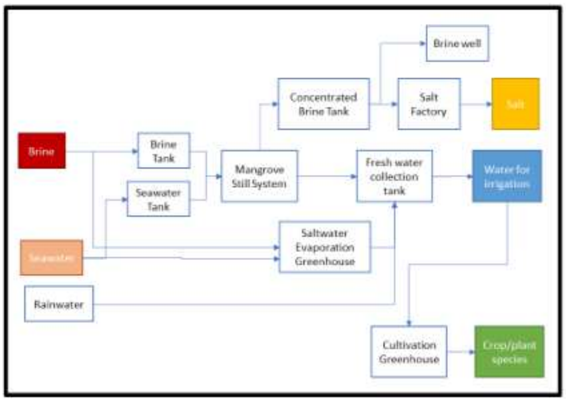
HYDRO 5

Mangrove Still Desalination System and Saltwater Evaporation Greenhouse

System Description

HYDRO5 consists of a nature-inspired, low-cost desalination system. Seawater and brine from the existing desalination plant is treated in by the Mangrove still process to produce fresh water via evaporation and condensation and edible salt.
The desalination system is composed of a series of interconnected desalination panels where evaporation and condensation processes occur. The outputs of each unit are distilled water and brine. In addition, each unit can gather occasional rainwater falling on its external surface. Once the feed water is pumped into the tank, the hydraulic circuit works by gravity.
The distilled water produced by the panels, together with the rainwater, are collected and pumped to a cultivation greenhouse while the brine is pumped to a salt factory. In this unit salt is produced by evaporation and ventilation of the brine. The produced water is used to irrigate a greenhouse and produce tropical fruits.

Furthermore a Saltwater Evaporation Greenhouse (SEG) is developed. In this system the combination of evaporation and transpiration is intended to generate atmospheric moisture, which is converted into usable fresh water by means of condensation. In the greenhouse halophytes and mangroves are planted in order to optimize the evaporation. Fresh water will be used to improve productivity of the tropical fruits cultivation greenhouse.

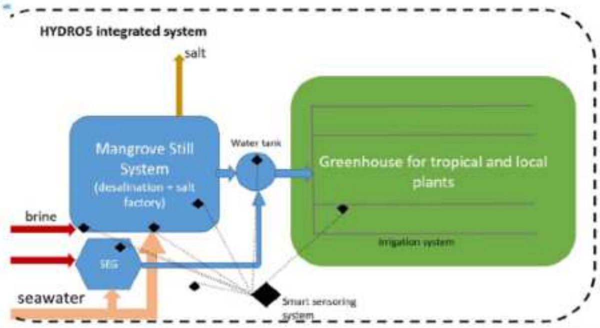


Technical Specifications

Mangrove Still System
Mangrove Area requirement = 0.23 m2/l of seawater treated/d
Seawater influent = 770 l/d
Expected Fresh water production = 200 l/d
Mangrove Still System Area = 162 m2
Yearly average = 3.3-3.7 l/m2 d
N° of Cascade-wick solar still panels = 76 units

Salt Factory
Area requirement = 30 m2
N° of salt production panels = 10 units
Expected salt production = 2 kg/d

Saltwater Evaporation Greenhouse (SEG)
Area Requirements = 30 m2
Pineapple Production = 145 kg/year
Papaya Production = 563 kg/year



Benefits
HYDRO 5 offers a low cost solution to the treatment of seawater and brine to recover salt and water
Production of sweet water from saltwater and/or brine
Production of salt
Operates a greenhouse to grow tropical fruits and thus decreases the need for importing tropical fruits

Figure 9.5 HYDRO5 Technical Brochure

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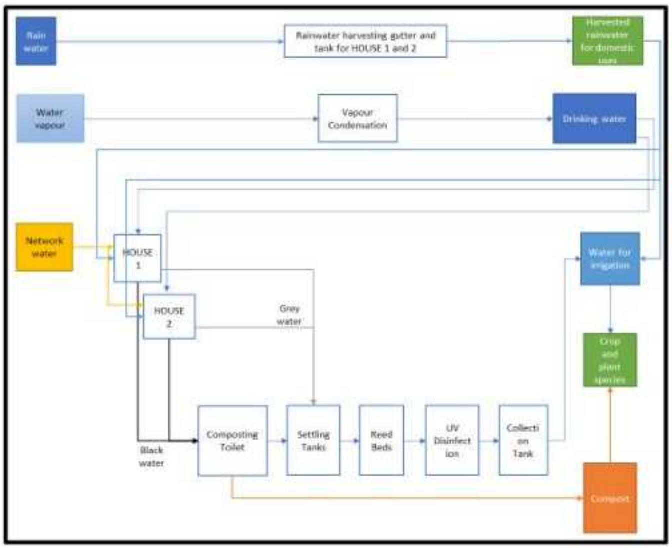
HYDRO 6

Tinos Ecolodge - Water loops in an ecotourist facility
Moving towards water, energy and food self-sufficiency

System Description

HYDRO6 consists of an eco-tourist resort at Tinos (ELT) where the principles of water, energy and food self-sufficiently are demonstrated at a local level. The eco-tourist facility implements rainwater and vapour water recovery systems as well as wastewater reclamation systems. A closed cistern was developed to collect rainwater from the roof of an existing stable, which has been transformed into a small lodge.
A 60 m2 greenhouse was built to increase productivity for a variety of crops. The expected rainwater to be harvested is about 50 m3/year. To increase water recovery, low-energy vapour condensation systems will be installed to condense water from air.
Also, solar-driven vapour condensation units, which work with absorption and condensation chambers will be installed to recover drinking water from water vapour to compare the systems.
Grey Wastewater from the Ecolodge will be treated by means of settling tanks, reed beds and UV disinfection to produce reclaimed water for the irrigation of 0.15 ha of local crops.
Further compost will be produced in a composting toilet system in order to produce a valuable fertilizer for the cultivation of plants and crops. The ecolodge is completely energy autonomous and all activities are powered by PV panels.



Water Management Loops in an Ecotourist Unit accommodating approximately 8-10 persons/day consisting of

- ❑ Rainwater harvesting
- ❑ Condensed Vapor Water Catchment
- ❑ Wastewater Treatment and Reclamation
- ❑ Solids Waste Composting

Benefits

- ➢ Ecotourist facilities are self-sufficient in terms of water, energy and food production
- ➢ Rainwater harvesting > 50 m3/day
- ➢ Water recovery from condensed water vapor to sustain domestic water needs, >20 m^3 /year
- ➢ Reclaimed water production (20 – 30m^3 /year) to irrigate 0.15ha of crops for food production.

Figure 9.6 HYDRO6 Technical Brochure

9.2 Site description

This section aims to collect the required information to characterise the area where the replicated HYDRO shall be located. It should contain the main relevant information in terms of:

- Extension of the area (available m^2 for HYDRO implementation)
- Orographic (e.g., slopes and altitude) and hydro-geological characteristics
- Climatic conditions if relevant for the project (e.g., solar irradiation, temperatures, rainfalls, etc)
- Description of nearby existing infrastructures – if it is relevant to the project (e.g., wastewater treatment plant, sewer systems, industrial complex etc) – and close end-users
- Characteristics of the water to be treated or collected.
- If possible, a (Google) map extraction of the future replication site with GPS coordinates and/or a .dwg file of the area(s).

9.3 Environmental constraints

Once the area for the replication site is identified, the possible environmental constraints are assessed:

- **possible restrictions due to local legislation** (e.g., the presence of sensitive or specially protected water bodies, specific noise, vibration and dust emission levels),
- **hydrogeological constraints**, to ensure a good water regime in terms of flood prevention and land stability.
- **forestry restrictions**, for the protection and conservation of the forests to ensure a high quality of life and biodiversity.
- **constraints related to protection of water bodies** ecological status against pollution.
- **natural/wildlife constraints**, for the protection of ecological, geological, biological and aesthetic values (e.g., natural parks and protected areas)

This can help to: i) highlight possible "environmental fragilities" in terms of water, soil, flora and/or fauna (Environmental Feasibility, 2020) and ii) identify any potential risks connected to the project (Designing Buildings, 2020).
This information can be collected by filling the yellow cells of Table 9.1 and Table 9.2.

Table 9.1 List of possible environmental constraints for the local implementation of HYDRO solutions

Area protected under the National/Regional Law	Results		Notes (in terms of procedures and documents to be presented for the construction of HYDRO solutions)
Seaside area	Yes	No	
Area bordering lakes	Yes	No	
River, streams, watercourses	Yes	No	
Mountains	Yes	No	
Glacial cirques	Yes	No	
Natural Parks (National/Regional)	Yes	No	
Area covered by forests and woods	Yes	No	
Area destined to public uses	Yes	No	

Humid area	Yes	No	
Archaeological interest	Yes	No	
Real estate and areas of significant public interest	Yes	No	
Verification of archaeological interest (Risk)	Yes	No	
None	Yes	No	
Low	Yes	No	
Medium	Yes	No	
High	Yes	No	
Activation of verification procedure	Yes	No	
Archaeological report	Yes	No	
Hydrogeological constraint	Yes	No	
Hydrogeological plan	Yes	No	
Hydrogeological plan (risk and hazard)	Yes	No	
None	Yes	No	
Low	Yes	No	
Medium	Yes	No	
High	Yes	No	
Earthquake Risk	Yes	No	
None	Yes	No	
Low	Yes	No	
Medium	Yes	No	
High	Yes	No	
Flood Risk	Yes	No	
None	Yes	No	
Low	Yes	No	
Medium	Yes	No	
High	Yes	No	
Existence of buffer-zone (express how many metres)	Yes	No	
Protection areas	Yes	No	
Natura 2000 site	Yes	No	
National parks and State reserves	Yes	No	
Parks and Regional reserves	Yes	No	
Provincial parks	Yes	No	
Protected marine areas	Yes	No	
Protected natural areas of local interest	Yes	No	
Special areas of conservation	Yes	No	
Special protected zones	Yes	No	
Special areas of conservation and special protection zones	Yes	No	
Regional interest area	Yes	No	

In addition, the alignment of local environmental and water-related plans (national, regional and local) with the goals of the HYDROs must be assessed, as it can imply significant support of barriers for their implementation. Table 9.2 can serve as template to collect this information that will be further evaluated in the social analysis.

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Table 9.2 Summary of relevant plans/strategies in force in the replication site

PLAN	LEVEL	DESCRIPTION	TARGETS AND CONSTRAINS FOR THE SITE	EVALUATION
Indicate the name	Municipal, Provincial, Regional, National	Description of what the plan includes	Please report here targets and constraints for the future HYDROs	Indicate if local environmental targets and/or plans are completely in line; not clearly stated or against the goals of the HYDRO solutions.

9.4 Social analysis and stakeholder identification

The first step to carry out the social analysis of the site should be to identify the local and national stakeholders that would be relevant for the implementation of the HYDRO. Table 9.3 shows a template that facilitates this identification and can help to group them.

Table 9.3 Relevant Stakeholders identification

RELEVANT STAKEHOLDERS		CATEGORY	NEEDS AND EXPECTATIONS
Stakeholders' group	**Actors**	**P/S/E**	
At National authorities			
At Regional/Local authorities			
Decentralized government services (Health, Education, Water, Environment etc.)			
Education (e.g., universities, training centre, schools)			
Communication (e.g., Media)			
Water authority			
Civil society (e.g., users, private citizens etc.)			
Water utility			

After stakeholder identification, the second column of

Table 9.4 must be filled to carry out the scoring of the social assessment (third column). According to the feasibility assessment methodology, to score each social sub-factor, the criteria of

Table 9.4 will be followed.

Table 9.4 Information and score for social assessment of the replication site

Feasibility Criteria	SOCIAL FEASIBILITY	
Type of instrument	**Example**	**SCORE**
Trainings and qualifications	Training and qualifications (obtaining certificates or proof of qualification) related to sustainable urban development, (socially inclusive) urban regeneration, closing loop infrastructure, nature-based solutions planning. Design, implementation and maintenance.	**From 0 to 16**
Public information programmes	A series of activities geared toward raising the amount of information available and people's awareness about sustainable urban development, (socially inclusive) urban regeneration, green and blue infrastructure, nature-based solutions etc.	**From 0 to 16**

	and its benefits (brochure, factsheets, events, campaigns, videos.)	
Stakeholder and public participation	Decision-making processes or knowledge-building consultations by policy makers which involve stakeholders with a direct interest in or practical knowledge of the issue being discussed, e.g., Townhall meetings, citizen councils, workshops for stakeholders, stakeholder advisory groups, multi-criteria analysis, household surveys	**From 0 to 20**
Monitoring systems for decentralized systems	Manual or automatic system (technological or by hand) which collects data about activities, products used, timing, etc.	**From 0 to 16**
	Monitoring and reporting of infrastructure areas	
	Monitoring and mapping of activities relevant to sustainable urban development, (socially inclusive) urban regeneration, green and blue infrastructure	
Research projects	Research related solutions for sustainable urban development, (socially inclusive) urban regeneration, green and blue infrastructure, including development of more efficient solutions (e.g., green roofs and facades)	**From 0 to 16**
Assessments of decentralized system status/ ecosystem services	E.g., national overviews on the status of sustainable urban development, (socially inclusive) urban regeneration, green and blue infrastructure and related ecosystem services including mapping (e.g., Mapping and Assessment of Ecosystem Services - MAES)	**From 0 to 16**
OVERALL SCORE		**From 0 to 100**

For evaluating the score of each sub-criteria, the criteria displayed in Table 9.5 must be followed:

Table 9.5 Social Analysis score attribution sub-criteria

SCORE			
Feasibility Sub-Criteria	**LOW (1-6)**	**MEDIUM (7-13)**	**HIGH (14-20)**
Stakeholder and public participation	Low level of social interest (policymakers and stakeholder engagement) (e.g., low Institutions engagement and low citizen interest)	Partial level of social interest and stakeholder engagement (e.g., high Institutions engagement but low citizen interest or vice versa)	High level of social interest and stakeholder engagement (e.g., high Institutions engagement and high citizen interest)
Feasibility Sub-Criteria	**LOW (1-5)**	**MEDIUM (6-10)**	**HIGH (11-16)**
Trainings and qualifications	Low level of training	Medium level of training	High level of training

Public information programmes	Low level of information activities	Medium level of information activities	High level of information activities
Monitoring systems for decentralized systems	Low frequency of monitoring activities	Medium frequency of monitoring activities	High frequency of monitoring activities
Research projects	Low interest in research	Medium interest in research	High interest in research
Assessments of decentralized system status/ ecosystem services	Low level of ecosystem mapping	Medium level of ecosystem mapping	High level of ecosystem mapping

9.5 Legislative analysis

Table 9.6 shows the basic information needed to evaluate the national and local legislation regarding the inputs and outputs of the HYDROs. It must be noted that one of these templates should be filled in for each resource or by-product that would be evaluated in the site.

Table 9.6 Legislative information on the use of water resources or by-products

Legislative References (e.g., Law/Decree/Regulation/Standard n° of __/__/___) on (water resource and or by-product)			**PERMITTING PATHWAY FOR UTILIZATION OF THE BY-PRODUCT**	**Notes/ Improvements/ Lack of actual legislation**
Quality of the water	**Prescriptions on the use**	**Minimum required treatments**		
Chemical and Microbiological Parameters (unit and values) to be respected as limits for reuse	Descriptions of: 1- specific conditions for utilization of the fertigation liquid	Processes and treatment (i.e., primary treatments, secondary treatments, disinfection etc…) needed to ensure compliance with reclaimed water with quality, according to the reuse	For example: 1-Need to certify the product (i.e. labelling or certification etc…); 2-Need to identify end-users; 3-Need to involve authorities/get authorized by legislative bodies.	

Table 9.7 aims to collect all the information regarding the administrative bodies responsible for the authorization of the HYDROs' construction and/or the use of their by-products:

Table 9.7 List of Administrative Body/Relevant Institution responsible for authorization

List of Administrative Body/Relevant Institution responsible for authorization		Remarks about the authorization (e.g., Purpose, procedures, approval conditions etc…)
n°	Name of the Administration	
1	Administration "……"	
2	Administration "……"	
3	Administration "……"	…
4	Administration "……"	…
5	Administration "……"	…
6	Administration "……"	…
…….	Administration "……"	…
n	Administration "……"	…

Table 9.8 Regulatory Instruments. Laws, action plans and quality standards

Feasibility Criteria	POLICY FEASIBILITY	
Type of instrument	**Example**	**SCORE**
National/Regional planning law or regulations	Spatial planning law, environmental regulation and/or law, Directives focusing on water cycle.	**From 0 to 12**
National/Regional strategies and action plans	National strategies for sustainable development, water cycle wastewater treatment, green and blue infrastructure etc.	**From 0 to 11**
Planning/Zoning	Comprehensive planning of the different uses to be conducted in areas of an urban settlement designated by certain categories (e.g., residential, commercial, industrial, green areas), e.g., Comprehensive land use plans, zoning applications, non-conforming use applications, eminent domain	**From 0 to 11**
Targets	Targets focused on decentralised systems, water loop cycle, recovery resource, sustainable urban development, (socially inclusive) urban regeneration, green and blue infrastructure etc., e.g., targets to establish green and blue areas (in ha, in specific areas, type of areas; budget spent etc.). Targets focused on these could be part of sustainable development strategies or action plans, strategies or similar	**From 0 to 11**
Standards	Legal or regulatory requirements for all persons or businesses to whom it applies to maintain a certain level of environmental quality, confine actions to a certain type of practice or limit, or to rehabilitate resources. e.g., a certain area of private homes must be green area, in a certain area	**From 0 to 11**

	the effluent from WWTP should satisfy certain limits, by-products (fertilizer) for reuse should have certain characteristics, etc. Legal or regulatory requirement for the utility to maintain a certain level of environmental quality, limits, or to rehabilitate resources. e.g. **Mandatory:** Environmental standards by law, directives, plans, etc. **Voluntary:** Agreements between private citizens and Municipality regarding the management and reuse of the HYDRO by-products.	
Bans	A legal or regulatory prohibition of a certain type of activity or use of a material/ product.	**From 0 to 11**
Permits / quotas	A license or authorization issued by a competent Authority allowing the utility to perform certain activity or to have a certain portion / amount of a product. e.g., Authorizations for water reuse, for biomethane production, plant construction, sludge reuse, soil fertilizer use, etc. Requirements such as maintenance of pre-development hydrology or pollutant loading reduction requirements are tied to stormwater permits.	**From 0 to 11**
Environmental impact assessments	Legal or regulatory process which an individual or business must undergo before application for approval to perform a certain action. Environmental Impact Assessment (EIA), audits, inspections	**From 0 to 11**
Public Procurement	Green Public Procurement (GPP)	**From 0 to 11**
OVERALL SCORE		**From 0 to 100**

Table 9.9 Policy Analysis score attribution sub-criteria

SCORE			
Feasibility Sub-Criteria	**LOW (1-4)**	**MEDIUM (5-8)**	**HIGH (9-12)**
National/Regional planning law or regulations	No ad-hoc regulation for small-systems is implemented in the context of HYDRO output	Regulation in the context of HYDRO output is implemented, but ad-hoc regulation for small-systems is not implemented	Ad-hoc regulation for small-systems is implemented in the context of HYDRO output
Feasibility Sub-Criteria	**LOW (1-4)**	**MEDIUM (5-8)**	**HIGH (9-11)**
National/Regional strategies and action plans	No Strategies to promote the management and reuse of HYDRO recoverable resources are implemented	Strategies promote the management and reuse of some HYDRO recoverable resources	Strategies promote the management and reuse of all HYDRO recoverable resources
Planning/zoning	Bans to HYDRO plants realisation in the chosen replication site	HYDRO plants realisation is subjected to	No restrictions to HYDRO plants realisation

		restrictions/limitations in the chosen replication site	in the chosen replication site
Targets	No targets are implemented in the context of HYDRO output	Targets are implemented in the context of some HYDRO outputs	Targets are implemented for all HYDRO outputs
Standards	Clear limits for the reuse of all HYDRO outputs	Limits for the reuse of some HYDRO outputs	Defined standards for the reuse of all HYDRO outputs
Bans	Legal barriers detected for all HYDRO output management/ HYDRO implementation	Legal barriers detected for some HYDRO output management	Legal barriers not detected for HYDRO output management
Permits/quotas	Simplified procedures to get permits for small HYDRO systems and reuse of recovered resources are not implemented	Simplified procedures to get permits for small HYDRO systems and reuse of recovered resources are implemented just for some aspects of HYDRO management	Simplified procedures to get permits for small HYDRO systems and reuse of recovered resources are implemented and cover all HYDRO management aspects
Environmental impact assessments	Simplified authorization procedure for small HYDRO systems and recovered resources management are not implemented	Simplified authorization procedure for small HYDRO systems and recovered resources management are implemented for some aspects (i.e., plants realisation but not for by-products reuse)	Simplified authorization procedure for small HYDRO systems and recovered resources management are implemented
Public Procurement	HYDRO system is not in line with objectives of Green Public Procurement (GPP)	HYDRO system is partially in line with objectives of (GPP)	HYDRO system is fully in line with objectives of (GPP)

9.6 Financial strategies

Table 9.10 Economic Instruments

Group of instruments	Type of instrument	Economic instrument
Pricing	**Taxes and charges/fees**: Compulsory payment to the fiscal authority for a service from a regulatory authority: e.g., charge for new development sites as a means of recovering costs for e.g., urban regeneration or green and blue infrastructure investments such as recreation programs ("fee in lieu")	
	Reduced taxes/charges e.g., if a landowner provides a certain (green/unsealed) area of his/her	

	property for water to infiltrate with reduced run-off of rainwater or stormwater drainage	
	Trading of permits for using a resource or trading (Building or development permits, etc.) of permits for pollution / emission levels	
	Tariffs: A price paid by users to a service provider for a given quantity of service or a schedule of rates or charges of a business or a public utility that provides a product or service which may affect the quality of green and blue areas	
Payments/ Subsidies	**Payments to landowners** or private actors for practices (e.g., installing green roofs of natural water retention areas)	
	Financing targeted research projects (e.g., developing more efficient urban sustainable solutions)	
	Payments for insurances which can cover the risk associated with the performance of newer green technologies	
Voluntary agreements/ Cooperation	**Individual voluntary agreements**: negotiated voluntary arrangement between parties to adopt agreed practices by governmental bodies in order to influence the development of products or the adoption of production processes that benefit the GI/reduce environmental degradation. These are not linked to payments. Voluntary agreements linked to subsidies are included under payments category.	
	Public-Private Partnerships: Contractual instruments between public and private actors that enhance the ability of the public sector to provide public services thanks to the involvement of the private sector. These are a sub-form of voluntary agreements and can include multiple public and private actors. E.g., flood protection projects, coastal defences. These can be structured in many different ways:	
	● Private sector has control over all assets, including investment, maintenance, and operations decisions, although some specific, strategic decisions remain subject to regulatory oversight;	
	● Concessions in the form of long-term contracts...[where] the private sector has full responsibility for the operation of the asset, usually recouping investment costs with service provision revenues (i.e., tariff collections);	

	In this case also solutions for taking into consideration the fragmented nature of land ownership and how this could be tackled through incentives such as the sharing of benefits (e.g., agroforestry cultivations) should be reported.	
	Management and lease agreements, the private sector takes control on operations for shorter time, but also bears lower financial risks, and initial capital investment is assured by the public.	
Private sector	**Loans** (from Investment and commercial banks) (especially low interest loans) to invest in green and blue infrastructure projects, such as green stormwater technologies or restoration projects or urban regeneration projects	
	Bonds (from Capital market) e.g., financing of adaptation measures via an investment instrument with returns, green bonds for investing in sustainable and nature-based adaptation solutions	
	Crowdfunding e.g., crowdfunding platform established by the city council that allows citizens to propose and finance their ideas for the city such as urban farming for residents of a social housing quarter, edible streets etc.	
Liability schemes	Offsetting schemes where liability for environmental degradation leads to payments of compensation for environmental damage (e.g., Eco-accounts, wetland destruction, brownfields funds, habitat banking)	

9.7 Technology providers

Table 9.11 Technology Providers List

DEMO SITES	TECH PROVIDERs	RESPONSIBLE
HYDRO1 + HYDRO2	AERIS IRIDRA ALCN AGENSO NTUA	O. Prado, R. Montes-Martínez F. Masi, A. Rizzo J. Kisser, P. Karlsson Z. Tsiropoulos, E. Anastasiou C. Noutsopoulos, C. Lytras
HYDRO3	DEL AGENSO	A. Eleftheriou, I. Vasilakos Z. Tsiropoulos, E. Anastasiou
HYDRO4	NTUA AGENSO	K. Monokrousou, A. Eleftheriou Z. Tsiropoulos, E. Anastasiou
HYDRO5	PLANET RANDKE ALCN AGENSO	A. Bianciardi, A. Villa M. Radtke J. Kisser, P. Karlsson Z. Tsiropoulos, E. Anastasiou

HYDRO6	ELT ALCN	N. Bedau J. Kisser

9.8 Techno-economic assessment

Table 9.12 Technical Analysis score attribution sub criteria

	SCORE				
HYDRO	**Feasibility Sub-Criteria**	**Definition of Sub-Criteria**	**LOW (1-33)**	**MEDIUM (34-66)**	**HIGH (67-100)**
1+2	Efficiency	Reuse wastewater with high nutrient content (m^3/y)	<5000	5000<x<10000	≥10000
		Compost production (tons/y)	<5	5<x<10	≥10
		Recovered energy from biogas (MWh/y)	<5	5<x<10	≥10
3	Efficiency	Rainwater harvested (m^3/y)	<25	25<x<50	≥50
4	Efficiency	Rainwater and run-off collected (m^3/y)	<125	125<x<250	≥250
		Water stored into the aquifer (m^3)	<250	250<x<500	≥500
		Drinking water production (m^3/y)	<5	5<x<10	≥10
5	Efficiency	Harvested rainwater (m^3/y)	<37.5	37.5<x<75	≥75
		Freshwater produced (l/d)	<100	100<x<200	≥200
		Salt produced (kg/d)	<1	1<x<2	≥2
6	Efficiency	Water recovered from atmospheric vapour (m^3/y)	<15	15<x<30	≥30
		Harvested rainwater	<25	25<x<50	≥50
		Reclaimed water	<15	15<x<30	≥30

Table 9.13 Economic Analysis score attribution criteria

SCORE			
Feasibility Sub-Criteria	**LOW (1-33)**	**MEDIUM (34-66)**	**HIGH (67-100)**
Payback Period (PP)	PP ≥ 9 years	9 years < PP ≤ 5 years	PP < 5 years