CONSEIL MONDIAL DE L'EAU

INSTITUT MÉDITERRANÉEN DE L'EAU IME

Global Observatory on Non-conventional Water Resources

and Associated Renewable Energies

FEASIBILITY STUDY

Final report of the study

Solar energy desalination plant – Ksar Ghilène (Tunisia)

(March 2022)

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FEASIBILITY STUDY FOR A GLOBAL OBSERVATORY OF non-conventional WATER RESOURCES AND ASSOCIATED RENEWABLE ENERGIES

FINAL REPORT

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1. Summary

Why study such an Observatory?

Being vigilant and anticipatory on the evolution of water resources and their use, the World Water Council highlighted contradictions caused by the dual need, on the one hand to mobilize new water resources, such as seawater to be desalinated or treated wastewater to be reused, and on the other hand to reduce various activities' carbon footprint. The WWC commissioned the Mediterranean Institute of Water (IME) to study the feasibility of an Observatory of NCWR and associated REs, starting with the Sahel area and the Mediterranean region.

The situations that each country will have to face in terms of water and energy resources by 2040 are relatively contrasting.

Indeed, all countries of the region aim for an energy consumption that will be renewable for up to 30 or 40% of the total, forcing them to multiply by 2 or sometimes up to 10 their share of renewable (except for Sahel countries where the currently higher share of renewable is likely to decrease as their consumption develops). As for meeting water needs, assuming all measures to reduce water demand are taken, some countries have sufficient sustainable natural resources, while others need to mobilize considerable resources: all countries where sanitation is developed have significant potential for reuse of treated wastewater; on the other hand, this will not be enough for countries that will have to scale up their water production to a proportion of 50% of NCWR (Malta, Tunisia, Israel, Jordan) or 70% (Algeria, Egypt), or even 90% in the case of Libya. These countries will have to significantly develop desalination and therefore their energy consumption, they will be faced with the gigantic challenge of having to master strong developments simultaneously in the two fields of NCWR and REs.

An Observatory can play a founding role

These challenges are to be met by multiple actions of studies or research, planning, investments and governance, which must be based on information that is particularly lacking at present.

- Expected by all kinds of actors

The consolidation of information and international exchanges on experiences related to the integration of NCWR and REs is eagerly awaited not only by a majority of official authorities from most countries in the study area, but also by very diverse potential users: NCWR project owners, in charge of drinking or industrial water supply, or wastewater treatment and irrigation; public and private managers of water treatment and irrigation; end users of treated water (cities, industrialists, irrigating farmers, consumer associations); private companies in the water sector (builders, engineering offices, professional organizations); researchers, universities, academic institutions, experts and training organizations; planners and regulators in the field of water or sustainable development (including energy); project financing organizations and regional or international cooperation organizations.

- Through access to information and facilitation of experience sharing

These actors want access to quality information on water resources, the environment, energy (food and carbon footprint), NCWR (existing or planned) facilities and contacts within all sorts of users. But above all, they expect international exchanges aimed at sharing feedback on desalination or REUT facilities, promoting joint R&D projects or positive cooperation with centers of excellence, international organizations or networks in the field of NCWR and REs, contributing to national and regional policies, upon consultation by the authorities or at the request of key decision-makers, supporting technical and vocational training programs and capacity building, to facilitate public awareness and to provide information that is realistic and understandable by all, in response to open questions from civil society.

The time has come to test the Observatory in full-scale in countries that commit.

To meet these expectations, the study recommends not to create databases or a new organization but to set up a light structure to moderate what already exists : the Observatory will have a website and a team following up requests that will be able to both (i) regularly collect and validate global information or direct applicants for specific data to other information systems and (ii) organize international working groups or trainings on topics of common interest.

Rather than conducting the feasibility study of the Observatory at the global level, the study recommends starting with a two-year project on the Sahel Mediterranean pilot area with voluntary countries and international organizations. Funding needs are estimated at 400,000 Euros that the project owners will have to mobilize both from stakeholders and from financing organizations in order to get it started soon.

Proposals are perfectly in line with the priorities for action expressed by the Chairman of the World Water Council at the Dakar Forum, with a view to achieving "less and better consumption". Indeed, the project will contribute directly to the priority of reasoned mobilization of NCWR and REs for better water security, in synergy with the other priorities i.e. the right to water, hybrid financing and hydro diplomacy.

2. Background and objectives of the study

For a long time now, there has been a considerable development of water supply projects for various needs not using common water resources (rivers, groundwater) but use either marine or brackish water or treated wastewater. These projects often require large amounts of energy, either to desalinate the water or to convey it to where needed.

In addition to demographic and economic changes, climate change will only exacerbate over time the need to use these non-conventional water resources at the same time as it will require reducing energy consumption. The authorities in charge of water and energy are therefore faced with a problem that is at least complex if not contradictory, not to mention the technical and socio-organizational problems inherent in any innovation, and are looking for information, skills or experiences on these topics.

The World Water Council (WWC) thought that an international Observatory of non-conventional water resources (NWRS) and associated renewable energies (REs) could be useful to stakeholders working in these areas. WWC therefore wishes to carry out a feasibility study to identify if such a tool is of interest to stakeholders, and in this case what are specifically their wishes or ideas regarding the role and form of the Observatory, to finally determine if the services that can be expected would be up to the efforts to be made for its establishment and operation. The terms of reference for the feasibility study are set out in *Annex A1* to this report.

The approach is intended to be objective, without prejudging the decision to set up such an Observatory or not, and moreover open insofar as the study will contribute to enriching and maturing the idea according to the stakeholders' proposals and expectations.

3. Study execution methods

3.1. Work organization

As soon as the agreement was signed, IME set up an internal steering committee for the study including IME's President, Alain Meyssonnier, the chair of IME's Scientific and Technical Council, Mokhtar Bzioui, the two vice-presidents, François Guerber and Nicolas Roche, and the project management officer, Malika Roussel. This committee offers a space for exchanges within IME in order to plan the work, set up necessary means and validate contents.

The steering committee carried out the task with its own expertise supported by contributions from network partners, namely the Sahara and Sahel Observatory, Plan bleu and FAO. In addition, IME has contracted two pairs of experts from the North and South, to conduct investigations in the fields of desalination (Enrique Cifres and Jauad El Kharraz) and the reuse of treated wastewater or REUT (Mohammed Khiyati and Nicolas Condom, from Ecofilae company, expert for the study, assisted by Rémi Declercq and Dimitri Pilenko). François Guerber led all the work.

This structure is summarized in the diagram in Annex A2.1 related to mobilized experts.

3.2. Scope of the study

The Sahelo-Mediterranean region includes twenty-one (21) countries or territories around the Mediterranean, to which Jordan is traditionally added for its proximity, and eight (8) Sahel countries. In agreement with the CME, few countries were excluded at the launch of the process due to special situations; the study covers 23 countries, 16 Mediterranean and 6 Sahel countries, shown in *Annex A2.2*.

3.3. Methodology applied

The collection of qualified information to assess the feasibility of a dedicated NCWR and REs Observatory was shared in the following way:

- Soliciting the opinion of authorities in each country of the pilot area (letter in *Annex A2.3*);
- Holding a series of webinars[1] on REUT in partnership with FAO on desalination and RE;
- Setting up NCWR working groups at the launch of the 4th Mediterranean Water Forum in Marseille on October 1, 2021;

[1] REUT webinar series organized by FAO and IME, two desalination webinars organized by IME in June and October 2021, and the REs webinar organized by IME in January 2022

- Organization of a side event dedicated to the Observatory as part of the Malta Mediterranean Forum in December 2021[2] ;
- Experts reaching out to national or regional organizations involved respectively in the field of desalination or REUT to identify existing initiatives and projects as well as expectations;
- OSS providing elements on the topic of information systems and on the issue of fossil fuels;
- Logistical support and facilitation of the Mediterranean Forum debates by the Malta Water and Energy Agency;
- Provision by the Plan bleu of cartographic analyses
- Facilitation of a special session on the Observatory project during the 9th World Water Forum held in Dakar on March 24, 2022;

The approach adopted for the collection of information and opinions was the following:

- Design and wide online dissemination of a survey questionnaire for REUT;
- Conducting interviews with key organizations, most often by videoconference;
- Collection of contributions during business meetings such as webinars or events;
- Bibliographic research on the web;

The online REUT questionnaire was reported by an introductory letter to the IME/CME focal points, the experts' personal contacts, and other local experts identified on the web in the different countries of the study area. It aims to collect information on the following topics :

- Contact details and expertise of the contact person,
- State of the art of water reuse in the country of contact,
- Regulatory framework in the country of contact,
- Knowledge of existing observatories or regional initiatives on water reuse,
- Interest of the contact for the creation of a Water Reuse Observatory.

The survey referred those who wish to a second questionnaire, developed to collect specific information on current water reuse projects: feedback on existing sites. *Annex A2.4* includes the two questionnaires and a table of answers received.

Interviews conducted on desalination are reported in fact sheets mentioning interviewees, names and objectives of the organization, their opinions and possible roles vis-à-vis the Observatory (*Annex A4.7*).

The analysis of the information collected was first conducted separately by each group of experts and then jointly synthesized, given the great similarities of the situations and the needs for information sharing in the two fields of REUT and desalination.

[2] Held on December 6-8, 2021.

4. Water resources, including non-conventional, and associated energies, including renewables, facing demands

This chapter analyzes the different situations of countries in the study area regarding their water and energy resources, so as to place the Observatory project in the concrete environmental and economic contexts of these countries.

Annex A3 puts together information on water and energy currently available on the web in the form of country sheets. We note that the fact sheet for Albania (*Annex A3.1*) is much more complete and up-to-date than others, thanks to the work carried out by the focal point designated by this country on the version produced by IME. This enrichment concretely illustrates the value that this Observatory can add with its network of professionals in relation to information accessible to the general public. The following analysis is also based on information produced by the UN on the SDGs, by IEA on energy and by FAO (Aquastat) on water.

4.1. Problems of the pilot area in terms of water resources, including NCWR

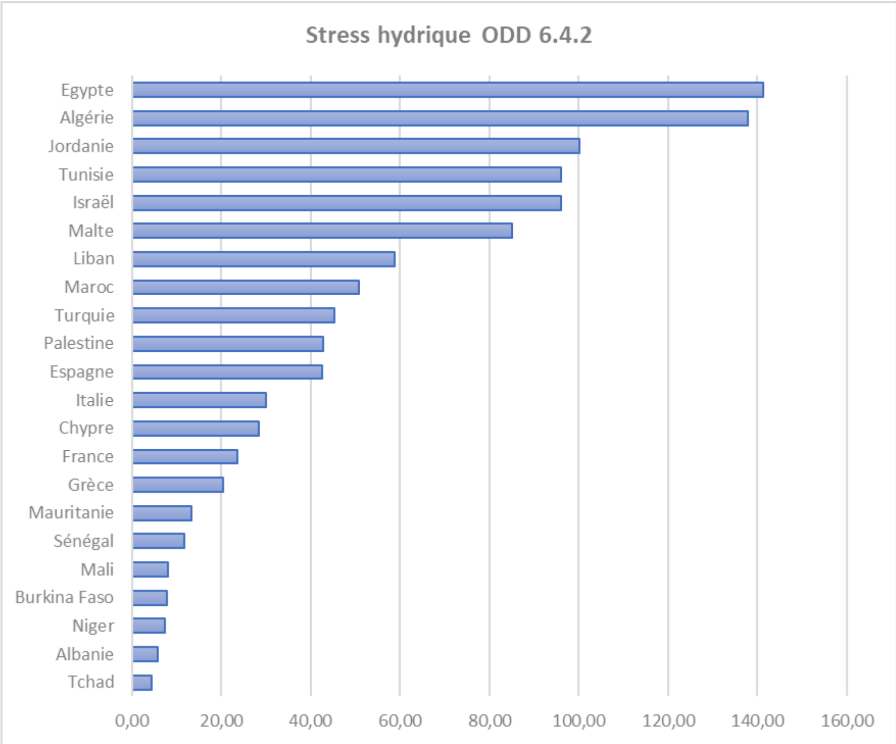
In many regions of the world, the increase and densification of populations as well as the development of economic activities[3] lead to increased withdrawals of fresh water from the natural environment, in surface or underground waters, by means of various hydraulic arrangements such as diversions, boreholes, pumping, storage tanks. The scarcity of water in a region has been characterized by the amount of renewable fresh water available to each person each year (Falkenmark index, 1989): when this ratio is less than 1,700 m3 per inhabitant per year, the country is in a water shortage situation; if this ratio drops below 1,000 m3 / inhabitant x year, there is water stress.

More recently, the United Nations defined a water stress indicator that more directly compares the volumes of water taken with the volumes of renewable water resources reduced by what is needed for environmental needs. This indicator is used to set and monitor the sustainable development goals (SDG 6.4.2).

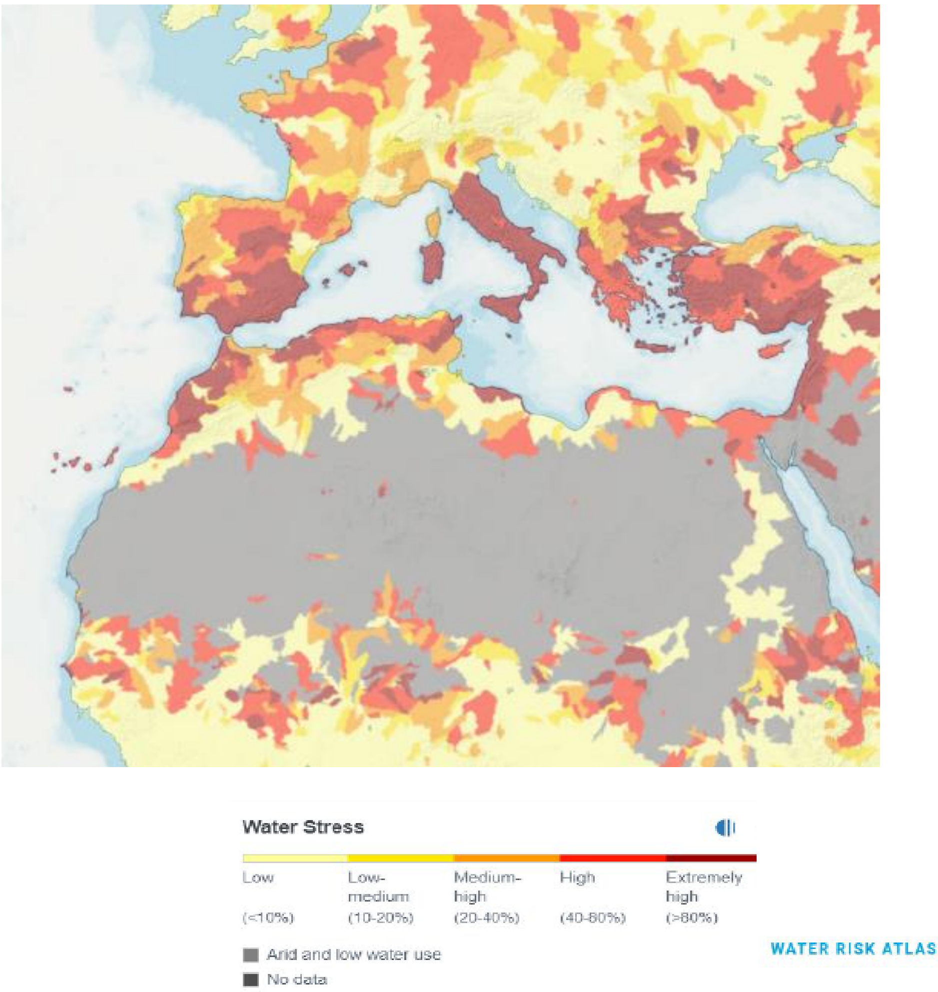
Taking into account the variability of these volumes depending on the seasons and within the country, it is estimated that water supply is guaranteed if this indicator calculated over a year does not exceed the threshold of 40%.

The graph below, in which Libya is not included for a reason of scale (so much its water stress is high, beyond 800%!), shows that more than half of the countries in the study area have water withdrawals that go beyond the desired threshold of 40%.

[3] Particularly the irrigation of agricultural lands, responsible for 80% of the total water withdrawals in the study area.

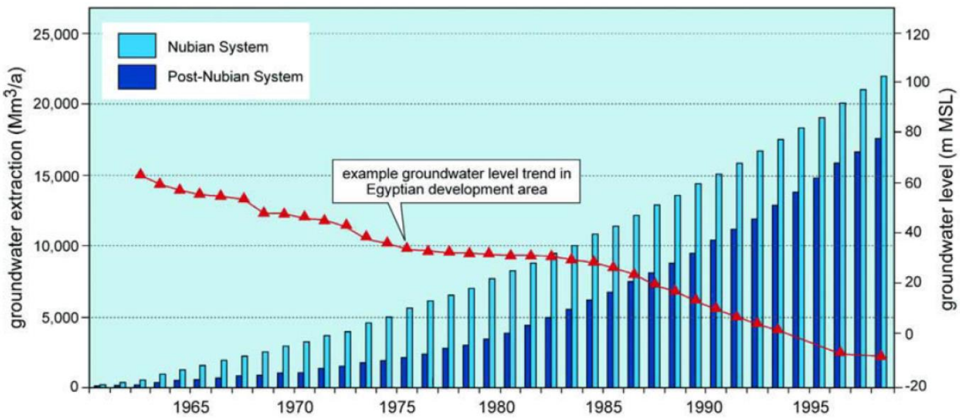


This is also the case for the yellow or orange watersheds on the map of the study area below, which also clearly shows the variability of the indicator within the same country.



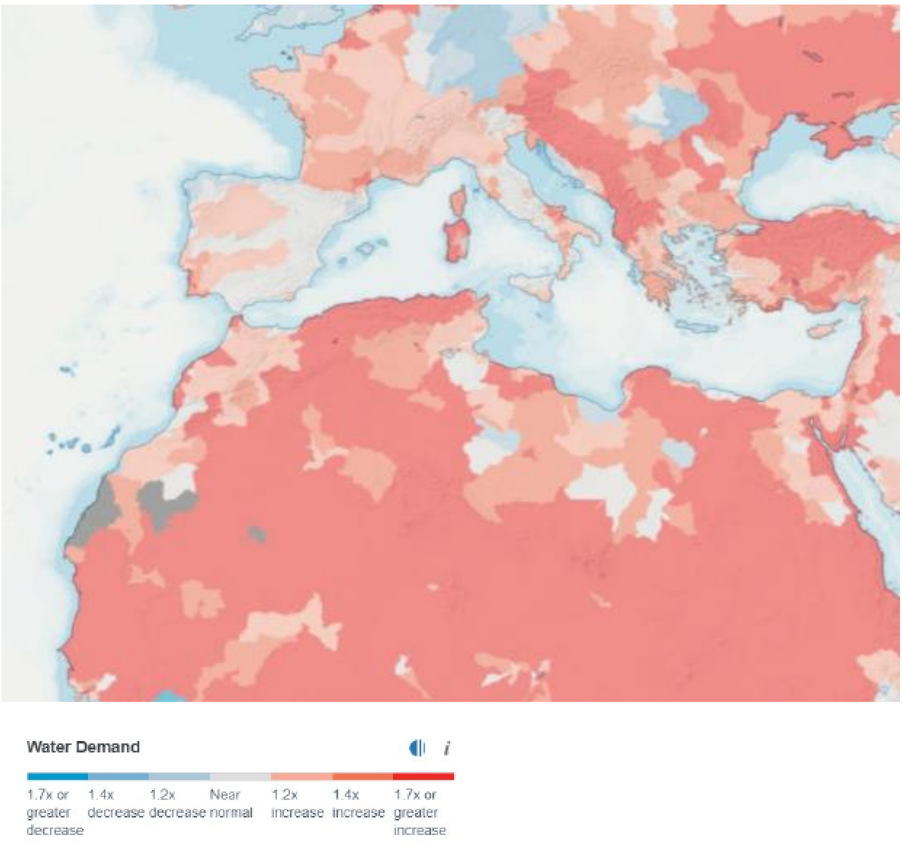
Source : Water resources institute, 2019

When withdrawals regularly reach and exceed the natural limits of the renewal of conventional water resources, there is an overexploitation of these resources resulting in a decrease of groundwater levels - as in the example below of the Nubian and post-Nubian aquifers - or by a reduction in the flow of rivers, until they are permanent dried up.



(D'après « Non-Renewable Groundwater Resources-A guide book on socially-sustainable Management for water- policy makers» Unesco-IAH- GW – MATE, World Bank)

In this case, water actors undertake a series of optimizations called "**water demand management**" or sometimes "**sustainable production and consumption**", combining the <u>reduction of water losses</u> (leaks from distribution networks for example) with <u>water savings</u> (change of industrial process, irrigation modes or crops for example). But in most countries of the study area, these optimizations will not be able to counterbalance the growth in water demand, resulting from the increase in population and, in the South, from the increase in living standards, as shown by the map below of water demand according to catchments that can be predicted for 2040:



Source : Water resources institute, 2019

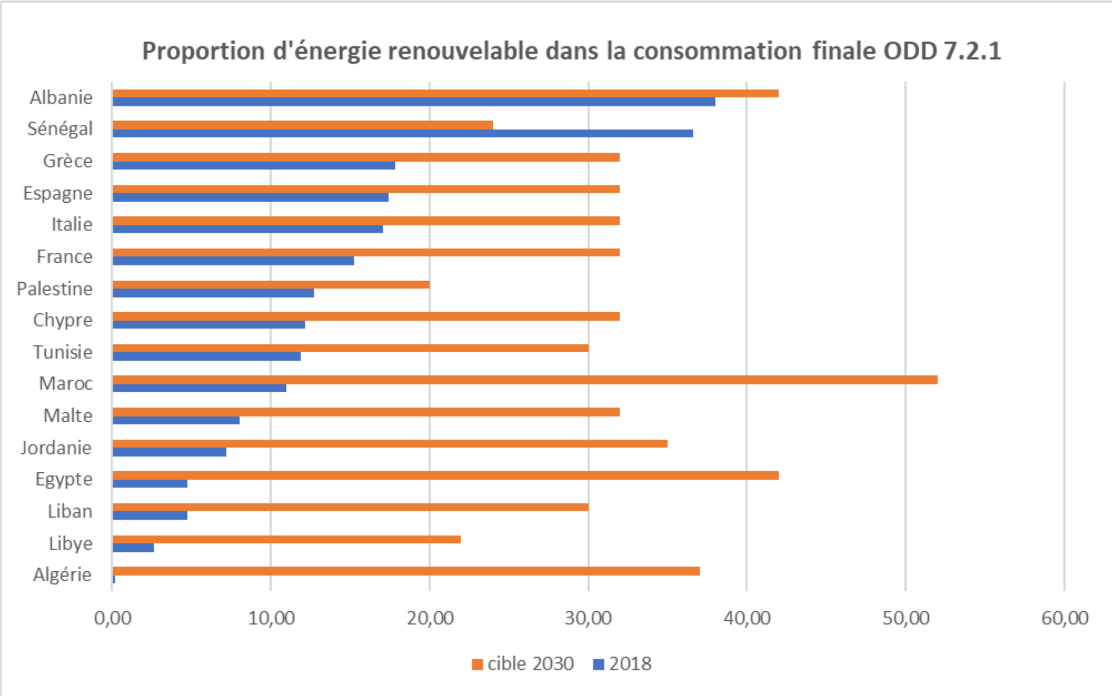
After deploying all water demand management measures, it is still possible to mobilize other, so-called non-conventional water resources, such as salt water or wastewater. It should be noted, however, that NCWR offer an additional volume of mobilized water that are foe now quite limited, since they do not exceed 3% of conventional water resources in countries of the study area, with the exception of Malta, Libya and Algeria.

4.2. Problems of the pilot zone in terms of energy, including RE

The exponential development of global energy consumption for almost a century is at the origin of climate change, currently still limited despite already visible disasters, but which devastating effects are more and more accurately predicted in the long term. As a result, the energy sector has now planned a deep transition to achieve more sustainable types of production and consumption levels, in the framework of the international climate agreements adopted in Paris.

As can be seen in the graph below, this translates into common objectives and voluntary contributions defined by each country, aimed at reducing greenhouse gas emissions produced by the energy sector itself but also by all other types of energy-consuming activities, even in the event of population or economic growth.

Proportion of renewable energy in the final consumption – SDG 7.2.1



The water use cycle needs energy in the various collection, production, distribution and treatment stages. If we can consider an average of 1.2 kWh/m3 in a conventional urban scheme, this need can be multiplied by a factor of 2 to 3 in the case of REUT with the addition of tertiary treatments or refining and transfer to irrigation perimeters or other uses, or by a factor of 4 to 5 in the case of seawater desalination or in the case of long-distance water transfer (200 to 500 km).

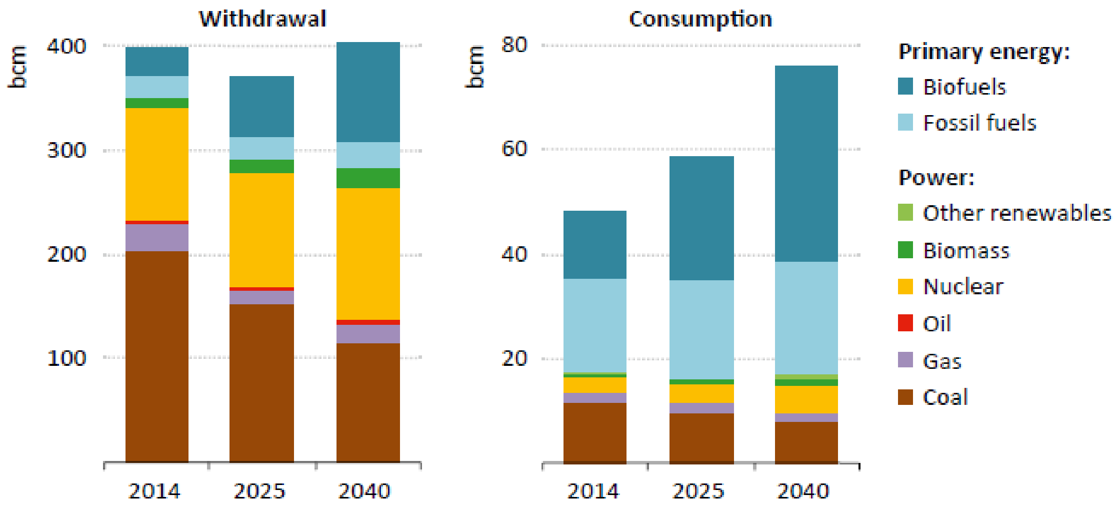
This is increasingly common in a large part of the study area. We note that these values include reinforcing purification performances and the transfer or distribution of water to places of use, but also technical advances such as reverse osmosis on membranes for desalination, which energy consumption can be reduced to 3.5 kWh/m3.

This essential energy need must be met either by generating new energy on site or by connecting facilities to the interconnected grid where available. Even in the case of a possible connection, this requires strengthening the electrical distribution network and sometimes its production.

REs associated with NCWR facilities, covered by this study, are therefore both those that specifically supply water treatment plants and those that supply an interconnected network serving energy to many other customers than just water plants.

Reciprocally, the energy sector is fully aware that its profound evolution necessary to face climate change will significantly develop its own water needs. Indeed, the consumption of water to cool electricity production plants varies greatly depending on the technology used (insignificant for wind turbines, less than 0.1 m3 per MWh for photovoltaics, from 1 to 10 m3 per MWh for concentrated solar plants or nuclear power plants depending on the cooling mode).

The evolution of production facilities will lead to stable water withdrawals at the global level by 2040 but to a consumption that will increase by almost 60% – that is the part not returned to the natural environment and is therefore unavailable for downstream uses:



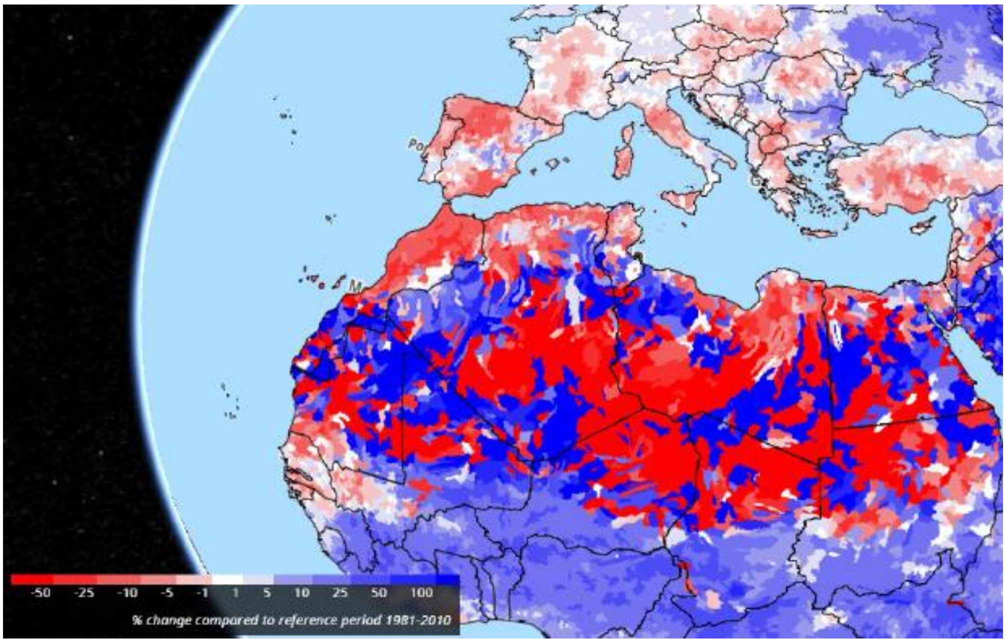
Source: IEA, World energy outlook 2016

In the study area, while the hydroelectric potential is already almost fully mobilized, renewable energies offer a very important development potential. In Morocco for example, the wind energy potential is estimated at 25,000 MW; even if this potential is not implemented due to various landscape or economic constraints, this represents 6 times more than the installed hydroelectric capacity.

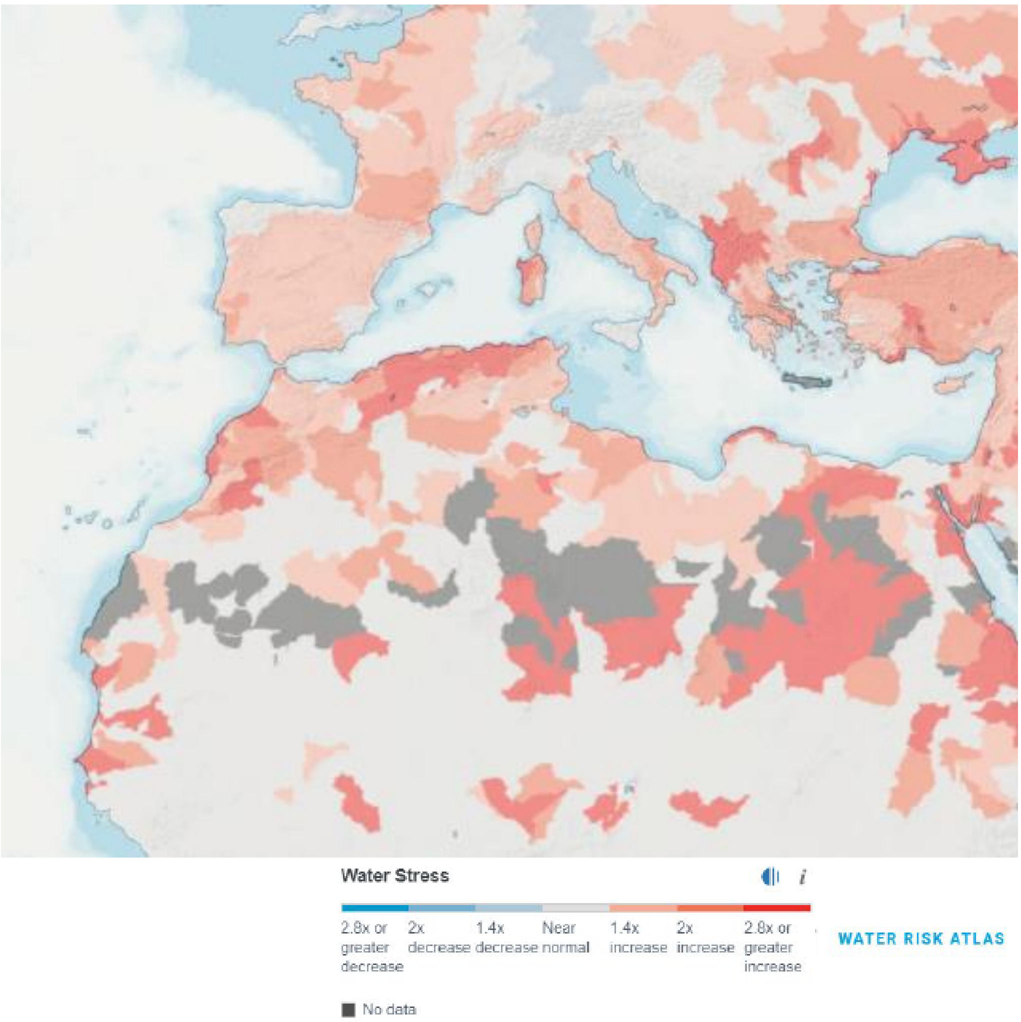
4.3. Prospective

The consequences of climate change on future water resources are not easy to estimate, first because the links between warming and rainfall on the one hand then between rainfall and surface and underground water resources on the other hand, must be analyzed according to the seasons and on a fine geographical scale, but also because the warming scenarios themselves are still very diverse

The assumption of the IPCC's RCP 4.5 scenario corresponds to a peak in carbon emissions around 2040 keeping an average increase in global temperature between 1.1 and 2.6 °C. In this optimistic hypothesis, the maps below show a very unfavorable evolution in the study area, both for surface water runoff which will be divided by 2 in some parts of Africa and for water stress which will be more than doubled in some basins of the Maghreb or Egypt.



Source : Climate information (WMO climate data access platform)



Source : Water resources institute, 2019

All countries are developing different planning of their water resources including NCWR or their energy resources including REs: *national water strategies, basin or aquifer plans in the field of water; energy supply strategies* including nationally determined[4] contributions and *climate change adaptation plans.* These plans are complex to develop because they cannot remain independent but must be designed jointly by the water sector and the energy sector[5], and often with other sectors such as agriculture. Unfortunately the corresponding documents are not easy to access, outside the European Union where regulations make them mandatory public.

The sustainable development goals and corresponding action plans promoted by the United Nations for 2030 should now facilitate such coordination, especially around the Mediterranean Basin, which is fortunate to have established a Mediterranean strategy for sustainable development, and renewed its monitoring within the framework of UNEP/MAP.

The study reveals that recent projects in the field of NCWR are more and more often the origin of new renewable energy production facilities. *Annex A3.13* provides examples of such facilities, where we find:

- *Standardized modular solutions autonomous in energy* thanks to solar panels, not requiring civil engineering, for isolated and small capacity facilities (up to 1.000 m3/d) ;
- *Renewable energy production plants* developed in the framework of important water supply projects, even if the energy service goes beyond these water installations: mainly wind turbine fields and solar power plants.

We note that even when technically possible NCWR and REs solutions are available, they still need to be economically and socially acceptable : **obstacles to projects exist when costs for the production or transportation of water become too high**, either because compensation for environmental impacts is actually incorporated into the projects (especially in the case of discharges into the sea from desalination plants), or that part of the water consumers (inhabitants, industrialists or farmers) no longer can pay the bill for the service.

In parallel, experimental platforms and multidisciplinary research programs are being set up specifically designed to progress in the field of NCWR and RE. This is particularly the case in Morocco with the Institute for Research in Solar Energy and New Energies (IRESEN), in Cyprus with the Cyprus institute or in France with SMEs such as Tergys.

Being able to store energy at a reasonable price is one of the key problems to be solved to develop renewable energies and technological developments in this regard are now expected faster than thought few years ago.

Some countries are going even further in the strategic commitment in the field of NCWR and REs, under the impetus of the European Union; or by national strategy, such as Morocco which has modified its institutions and launched the Moroccan Agency for Sustainable Energy (MASEN), operating in addition to the private sector, and ONEE which already brought together water and

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[4] Commitments made under the Paris Climate Agreements.

[5] On this subject, see the report published by IAEA in 2016 "World Energy Outlook"

energy services. The country has just adopted a new development model that includes a target of 40% renewable energy in 2030 simultaneously with a target of 15% of the water consumed to come from wastewater reuse and desalination.

4.4. Typology of situations

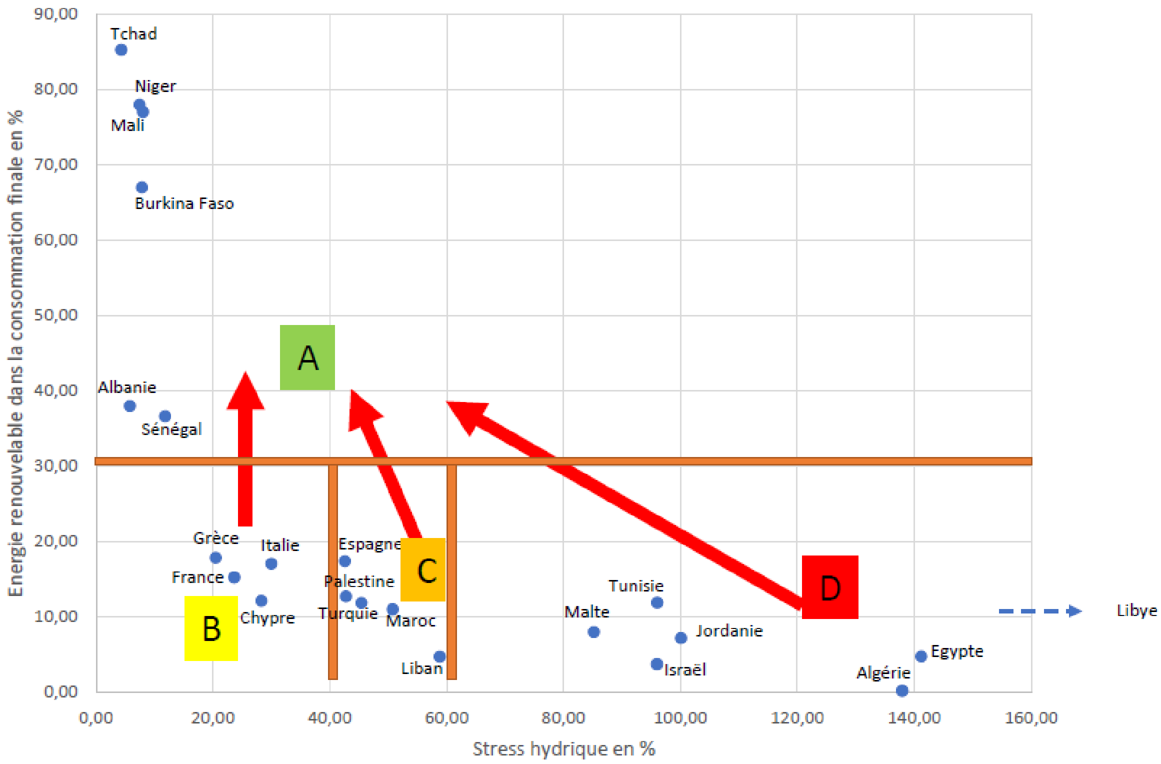
Countries and their various internal territories are far from being in a homogeneous situation with regard to the sustainability of their water resources (qualified by their water stress, *SDG 6.4.2*) and their energy (qualified by their proportion of renewable energy in their final consumption, *SDG 7.2.1*).

The table below, which crosses the current values of these two indicators for countries in the study area, shows four typical situations, namely :

- Zone A is the one where water stress is manageable and the share of renewable energy in line with global goals to limit global warming. This is the situation towards which all countries must strive. Currently in the study area, this is the case only for Albania due to its hydroelectric resources and for the countries of sub-Saharan Africa due to the limited consumption of their resources. By 2040, the challenge for these countries is to be able to support their population growth by developing economically without increasing the carbon footprint per capita.
- Zone B brings together countries with satisfactory water resources but which, in parallel with low population growth, must carry out an important energy transition to achieve the objectives of combating warming, a transition symbolized by the vertical arrow. These are European countries such as Italy or Greece.
- Zone C includes countries that have to carry out energy transition efforts similar to those in Zone B, but with additional efforts to make their water supply sustainable as well. Hence a trajectory towards 2040 symbolized by the slightly inclined arrow from C to A. Apart from Spain, these are also countries that still have to assume a significant demographic and economic growth, such as Morocco, Turkey or Lebanon.
- Zone D countries with **very high water stress (> 60%) and with a low renewable energy mix (< 10%),** such as Jordan or Egypt. These countries are already planning very significant efforts to contribute to the climate goals, but also have no other solution than to make significant use of renewables in the future, which will make it necessary to achieve an even more renewable energy mix than other countries, according to the strongly inclined trajectory of the arrow

In the study area, it is therefore normal to find a difference in sensitivity to the Observatory project with, on the one hand, countries - zones A and B - **that will mobilize NCWR only locally or of the REUT type only** (less energy consuming than desalination), while, on the other hand, other countries **will have to resort to all types of NCWR in all inhabited areas**.

This also shows how essential it is to plan the future of water resources and the energy mix within a single approach.



Typology of countries in the study area: crossing SDGs 6.4.2 and 7.2.1
Current situation in blue and necessary evolution in red
IME design; UN SDGs and FAO Aquastat sources-2018 values

5. Expectations towards an Observatory for NCWR and associated REs

5.1. Political Will

The solicitation of the authorities of each country of the study area (*see Annex A2.3*) defines the Observatory's objective in a few words: to enable the pooling of information and international exchanges on experiences in integrating non-conventional water resources and their energy needs (mainly the use of renewable energies); it asks countries to agree in principle with this initiative and also to designate an interlocutor who will be contacted by IME's experts.

The solicitation is aimed at the highest level (Ministry or Directorate General) and was addressed (for follow-up) to IME's focal point in the country. To date, two thirds of requested countries have responded positively (15 out of 23 countries) and most have appointed an interlocutor, even if 3 of them announced it during public meetings without having yet confirmed it in writing. These are Albania, Cyprus, Egypt, Spain, Greece, Jordan, Lebanon, Mali, Malta, Morocco, Niger, Palestine, Chad, Tunisia and Turkey as detailed in the table below:

Country	Solicited authority	Answer	Interlocutor
Albania	DG of the Water Resources Management Agency	Yes	Director of the Strategy
Algeria	Minister of Water Resources and Water Security		
Burkina Faso	DG of Water Resources		
Cyprus	Director of Water Development	Yes	Technical Director of the Nicosia Water Company
Egypt	Minister of Water Resources and Irrigation	Oral Yes	Director of Cooperation
Spain	Minister of Ecological Transition and Demographic Challenge	Yes	International Coordinator for water issues, DG Water
France	Minister of Ecological Transition		
Greece	Minister of the Environment, Energy and Climate Change	Yes	Director of Water Services Planning and Management
Italy	Minister of Ecological Transition		
Jordan	Minister of Water and Irrigation	Yes	Technical Secretary of the AWWEENA association
Lebanon	Minister of Energy and Water	Oral Yes	Director of Water
Libya	Minister of Water Resources		
Mali	National Director of Hydraulics	Yes	
Malta	Minister of Energy, Businesses and Sustainable Development	Yes	CEO of the Energy and Water Agency
Morocco	Minister of Equipment, Transport, Logistics and Water	Oral yes	Loukos Water Basin Agency
Mauritania	Director of the National Center for Water Resources		

Monaco	Minister of State		
Niger[6]	DG of Water Resources	Yes	
Palestine	Minister of the Palestinian Water Authority	Yes	Engineering Director of the Jerusalem Water Company
Senegal	Director of Water Resources Management and Planning		
Chad	Director of Water Resources	Yes	
Tunisia	Minister of Agriculture, Water Resources and Fisheries	Yes	Directors of Desalination and Energy Control, SONEDE
Turkey	Minister of Energy and Natural Resources	Yes	Water Institute

It should be emphasized that some countries are objectively less concerned than others (see § 3.3) or that may have been reluctant to agree in principle on a very unclear request (but it was the wish of the CME to leave the possibilities of content very open, and thus allow co-construction in the future). On the other hand, some countries have already specified what they could bring to the Observatory: for example, Spain offers its feedback from installations that really work at their full capacity, Jordan wants to share its institutional reform to both manage water demand and mobilize NCWR in a "rainless" country, Morocco is ready to report on the acceleration and intensification of its use of NCWR and REs, while Tunisia offers to share its REUT regulations. Although not part of the study area, the representative of the Israel Water Authority at the Dakar Forum said that his country is ready to share its experience in integrating different types of water resources (conventional and NCWR), innovative technologies, and regulations in the field of REUT, intended for irrigation and drinking water.

The support of these countries to the Observatory is consistent with the support expressed by the Union for the Mediterranean at the Dakar Forum, with the commitment to the NCWR and REs of many organizations that have recently launched multiple studies on this area :

- either regional organizations ("sustainable desalination in the Mediterranean", by the UNEP Blue Plan; "Mapping water reuse capacity and institutional development in the MENA region: case studies in Egypt, Jordan, Lebanon, Tunisia and Saudi Arabia", by IWMI; or the "prototype Barrel", by Veolia);
- or international financial institutions ("Institutional and regulatory frameworks for desalination and wastewater reuse", by the World Bank; "eligibility criteria in an approach to

[6] Interested only in RE

the transition to a green economy", by EBRD; "State of desalination in several countries of the study area", entrusted to the OSS by AFD).

All studies find serious gaps in the available information at the outset and devote significant funds to address them on an ad hoc basis, with no guarantee for continuity.

5.2. Expectations vis-à-vis an Observatory for NCWR and associated REs

5.2.1. Types of potential users

The surveys (questionnaires, interviews, webinars/meetings) highlight the strong interest in an Observatory initiative, both regarding desalination and REUT, according to the following order of priority:

- **The project owners of NCWR projects**, which may differ depending on the country, and even vary within a country according to the organizations, private or public, in charge of drinking or industrial water supply for desalination, or in charge of wastewater treatment and irrigation or other uses of REUT;
- **Public and private bodies managing water treatment and irrigation** (and to a lesser extent hydrology) including operators of water production or distribution bodies;
- **The end users of treated water**: cities, industrialists, irrigating farmers, consumer associations;
- **Private companies in the water sector**: builders, engineering offices, professional organizations;
- **Researchers**, universities, academic institutions, experts, training organizations ;
- **Planners and regulators in the field of water or sustainable development** (including energy): various ministries in charge of water, energy or agriculture, public basin or aquifer agencies, public regulatory and standardization bodies, public environmental monitoring authorities ;
- **Project financing organizations** (water agencies, local authorities, European Union, international financial institutions) ;
- Regional or international **cooperation organizations.**

These users expect this Observatory to set up a shared space for the benefit of actors in the study area with responsibilities in water management, in order to :

(i) improve <u>knowledge</u> about NCWR and RE that is necessary for their role (performance and cost of works for example for builders, good management practices for operators, new technologies for researchers etc.) as <u>key tools</u> to meet their common environmental, economic or social challenges that are reinforced by future climate change scenarios;

(ii) create <u>a forum</u> where members can exchange information, ideas, experiences and research, to benefit from each other's synergies in the face of common problems[7].

[7] For example, Mediterranean countries share a common sea that must be protected from the environmental impacts of wastewater discharges from cities or brines from desalination plants. Improving knowledge, sharing data and procedures to mitigate these impacts are also a goal for agencies with responsibilities in sanitation or desalination projects.

This should lead to a better capacity to provide solutions not only from a technological point of view but also for public awareness and enrichment of integrated water resources management, as well as water security.

5.2.2. Services of the Observatory

The Observatory will therefore play a proactive role in helping decision-makers in the countries concerned, governments and experts to stay at the forefront or develop their expertise in the field of NCWR and REs.

To do this, it will have to provide two main types of services: (a) access to quality information and (b) facilitation of international exchanges.

a) Access to quality information

The most important types of information to feed the Observatory can be classified into five groups:

- Information on water resources ;
- Environmental information ;
- Energy information (food and carbon footprint) ;
- NCWR facilities (existing or planned)
- Contacts among the various users above.

The following *§ 4.3* shows that a lot of information is already available in existing platforms, but incomplete and each covering only part of the needs. It is therefore necessary to facilitate access to information either by aggregating dispersed and difficult-to-access data or by offering elaborate information, such as indicators, and not just raw data.

This is why the Observatory should not seek to build its own databases but rather to develop a response to user requests, organized according to the following three types of questions:

FAQ: answers to frequently asked questions. These are standard answers to the main questions regularly asked about desalination or REUT and for which there is already a simple and clear answer. This may concern in particular global and regional indicators that have been precisely defined by research bodies or international institutions, or an exhaustive library of reports and studies related to the subject.

ASQ: answers to selected questions. In view of the development of important events in this area, the Observatory may raise certain issues for which it considers necessary to publish an independent and neutral clarification report. This may in particular concern data collected from other platforms but which deserve to be validated. Another example would be to synthesize the current REUT standards and regulations with links to download those of each country or to propose definitions and a clear common and validated terminology.

NOR: notice on request. Some national or international users, institutions or organizations may request the Observatory for an opinion on a question. The Observatory decides whether it is appropriate to respond, and in this case, it asks to draft a response in the form of a short report.

b) Facilitation of international exchanges

Many topics were mentioned during interviews or meetings as being great topics for very useful exchanges between water actors exercising the same functions but in different countries. Indeed, these are subjects with a very rapid evolving know-how or which are mastered in a heterogeneous way due to the variety of contexts and the history of NCWR and REs from one country to another.

The summary of questions asked by participants at the June 2021 conference featuring desalination experiments in Morocco, Spain and Malta is included in *Annex A4.1* and illustrates well this great interest in sharing ideas, experiences, case studies or data.

This type of exchange is expected on the following themes and objectives:

- SHARE feedback on desalination or REUT plants:
  - Identify high-performance treatment solutions adapted to different contexts based on detailed descriptions of the remarkable facilities, as well as difficulties faced by plants at the time of their construction or after operation;
  - Promote best practices;
  - Provide independent scientific advice to project owners on the best technology choices and the financial set-up of their projects

Annexes A4.2 and A4.3 provide descriptive sheets of facilities collected during the study. These fact sheets show the relatively limited content of the information currently available, compared to the level of detail desirable for comparative analyses, as indicated in *Annex A4.4* and which would allow the real transfer of experiences from the most "advanced" countries to less advanced ones, according to different contexts or geographical locations.

The most important topics of progress are undoubtedly costs, energy consumption, and CO2 emissions as well as, specifically for REUT, sanitary standards and specifically for desalination, the environmental impact of discharges into the marine environment.

- **PROMOTE joint R&D projects** in connection with the above point, or supplement results based on the positive cooperation with centers of excellence, international organizations or networks and renowned universities in the field of NCWR and REs, up to the creation of a regional innovation hub. Encourage the use of renewable energies (solar, wind...).
- **INITIATE or SUPPORT technical and professional training programs and capacity building**[8] in the field of REUT or desalination (e-learning, webinars), in particular on recurring issues of

[8] This was highlighted in particular by CIHEAM during the Dakar Forum

project management, investment or operating costs associated with projects[9] or monitoring the environmental or health impacts of projects.

In case of success of the first achievements, exchanges could be extended in a second stage to the following themes :

- **CONTRIBUTE to national and regional policies** regarding NCWR and associated REs, upon consultation by the authorities. Assess their potential, including the economic, environmental and social cost, optimizing in particular contribution to SDGs of the water and energy fields. Assist key decision-makers on request in the planning of these policies or in their regulation.
- **FACILITATE public awareness and provide realistic and understandable information to all**, in response to open questions from civil society such as the role - complementary or alternative - played by existing facilities in IWRM, the real expected costs, the really known impacts of desalination on the Mediterranean or REUT on health.

Other services may also be considered, such as the organization of a periodic stakeholder forum in order to share ideas about **current** issues but also to prioritize and facilitate knowledge exchange and capacity-building activities.

5.3. Inventory of the study area initiatives concerning NCWR and associated REs

There is no institution in the study area that supports the collection or sharing of information and the pooling of experiences on the whole issue of dedicated NCWR and REs. Nevertheless, there are regional initiatives focused on part of the theme and/or on a few countries.

The ones described here involve a significant and continuous part of efforts in favor of the development of quality information and are not limited to technical exchanges or ad hoc studies.

In terms of REUT:

- The only observatory dedicated to this theme on a global scale is **HotspotReuse®:** it is an open and cartographic collaborative platform to share feedback on water reuse projects (http://hotspotreuse.com/). The platform supported by Ecofilae (France), currently relatively sparse in terms of the number of projects (234), is presented in more detail in *Annex A4.9*.
- **COSTEA** is an **Agriculture and Water Scientific and Technical Committee** (https://www.comite-costea.fr/), an initiative funded by AFD and supported by AFEID to capitalize and share the experiences and expertise in order to improve the irrigation policies and projects in countries where AFD operates for the realization of sustainable irrigated systems.

It started a REUT project in 2021 on 5 countries of the study area (Algeria, Morocco, Palestine, Senegal and Tunisia) which aims to :

[9] *Annex A4.5* contains a specific proposal to build a tool to answer this question in the case of desalination projects

- conduct consultation and training workshops in these countries ;
- capitalize on feedback by identifying pilot projects ;
- network national and regional actors, and create opportunities for exchanges between COSTEA members with expertise in REUT.

The creation of an Observatory is currently not planned in the REUT project implemented by COSTEA. However, a strong connection between the Observatory and COSTEA' activities would make it possible to feed it with knowledge and networks of contacts for further dissemination.

- **FAO** has long been conducting studies and training on the topic of REUT in favor of countries that could benefit for their agriculture. Recently and in particular, a series of 8 webinars was organized in partnership with IME on all aspects of REUT between September 2020 and April 2021; a project targeting Algeria, Libya, Mauritania, Morocco and Tunisia made it possible to develop the state of the art on the reuse of treated wastewater or drainage as well as cost-benefit analyses on pilot sites.

This project will continue under the name of IMENCO (Maghreb initiative for non-conventional waters) with the joint support of FAO and the Arab Maghreb Union. It will develop the monitoring of pilot sites and exchanges between the relevant bodies in the 5 countries.

In terms of desalination :

- Global Water Intelligence (GWI), through a magazine and a web portal www.desaldata.com, manages a tracking system of more than 1,000 live projects worldwide and is updated daily. For a fee and subject to confidentiality, it provides clients with information on water supply, wastewater, desalination and reuse projects, from design to financial set-ups. Clients are usually companies or investors but sometimes also research organizations. They can also have access to a simulation tool to calculate the OPEX, CAPEX and per m3 costs of desalination projects, as well as a summary of all companies, desalination and reuse operators in the world.
- The Sahara and Sahel Observatory (OSS), http://www.oss-online.org/) is an international organization operating in the Sahelo-Saharan region and represents a platform for North-South-South partnerships offered to its members, which also contributes to regional strategic reflections carried out on innovative solutions for the sustainable and concerted management of groundwater resources, mainly the management of large transboundary aquifers of North Africa and the Sahel.

OSS is currently developing a national synthesis on the issues and solutions related to desalination in each of the following countries: Morocco, Algeria, Tunisia, Libya and Egypt.

In terms of water or energy resources:

- The FAO AQUASTAT portal (https://www.fao.org/aquastat/fr/) provides access to the main database of country statistics, focusing on water resources, water uses and agricultural water management. At the same time, other information on water is available in the form of complementary databases, such as irrigation crop calendars, the sub-national database on irrigation areas, the detailed database on dams and reservoirs and the database on water and agriculture-related institutions. Aquastat plans in the coming years to expand its international database to also cover REUT related subjects.

- The UNESCO IHP intergovernmental program on research, water management and capacity building in hydrology has evolved since 1975 to facilitate an interdisciplinary and integrated approach to watershed and aquifer management.
- The mission of Plan bleu, the regional action center of UNEP Mediterranean Action Plan (MAP), is to provide Mediterranean riparian countries with information featuring the relationship between environment and development, and in particular indicators related to the Mediterranean sustainable development strategy 2016 – 2025, via a dedicated website www.obs.planbleu.org. It is based on the technologies of UNEP's open source data sharing platform-World Environment Situation Room (WESR) and the MapX geospatial data platform, which promise great ease of access and sharing of environmental data.
- European Water Information System (WISE) https://water.europa.eu/), from the European Environment Agency, which provides detailed information on compliance with European directives by Member States and planning documents.
- The Euro-Mediterranean Information System on know-how in the field of water (SEMIDE) offers a platform for the exchange of information and know-how in the field of water between countries of the Euro-Mediterranean Partnership. It has carried out projects to help Mediterranean partner countries organize their water data according to common repositories to facilitate access or international comparisons and to derive the knowledge necessary for good management.
- The Regional Center for Renewable Energy and Energy Efficiency (RCREEE) is an intergovernmental organization with diplomatic status that aims to enable and increase the adoption of renewable energy and energy efficiency practices in pan-Arab countries. It plays an important role in collecting data on renewable energy and energy efficiency, and publishes every year the Arab future energy index (AFEX): https://taqaway.net, as well as a tool for monitoring NDC, nationally determined contributions.
- The International Energy Agency (IEA) offers its 31 member countries (5 of which are part of the study area) advice on the full range of energy issues.

For its analysis and to provide global energy information to governments and other external users, the IEA's Energy Data Center (EDC) processes a large amount of quantitative information. It collects data on a number of energy topics, such as oil, gas, coal, renewable energy, electricity, energy efficiency, energy prices and energy technology R&D budgets through questionnaires, submitted by national administrations of member countries and beyond, as well as through research using official national sources and secondary sources. Based on collected data, it produces analytical results, such as energy balance statements at the global level. More particularly, as of September 2021, the IEA EDC has been updating detailed energy time series for more than 150 countries starting from 1971 onwards. Further information on the sources, methodologies and results of the IEA energy statistics can be found at: https://www.iea.org/areas-of-work/data-and-statistics

- The Mediterranean Energy Observatory (MEO) is a gathering platform and a reference think tank making energy an instrument of regional integration. Since its creation 30 years ago, the MEO has conducted regional studies on all energy topics thanks to an original and unique cooperation between experts of member companies, its own Technical Committees and its staff. MEO is a pioneer in the organization of conferences, workshops and high-level trainings on various issues related to the energy sector in the Mediterranean countries.

- The Intergovernmental Panel on Climate Change (IPCC) was established in 1988 to facilitate comprehensive assessments of the state of scientific, technical and socio-economic knowledge on climate change, its causes, potential impacts and response strategies. It is the source of forward-looking and periodically updated information in these areas.

Activities similar to international initiatives exist in some countries however for the benefit of the water actors of that country and without international exchanges. Other initiatives consist of studies that provide a lot of information on a theme or a region but without a regular update expected from an observatory. The examples in the field of REUT are detailed in a table in *Annex A4.6*, while more examples in the field of desalination are presented in the form of interview summaries in *Annex A4.7*.

This clearly stresses the need for information and exchange on the topics of water or energy resources, desalination and REUT. But existing resources are still very far from offering services that are expected from an International Observatory. Indeed, most initiatives, and in particular one-off studies or projects, produce data or contacts but do not store them in open databases and therefore do not ensure their continuity or sustainability, apart from synthetic reports that end up becoming obsolete. Their geographical scope is often limited to a few countries and their objectives are focused on specific subjects. This does not allow for the richness of wider international comparisons on a geographical or thematic level. Access to information is difficult either because the data is scattered in many different systems, or because the very existence of the information is not known, or because its acquisition is paid and subject to restrictions on use (case of Desaldata). There is no guarantee of the quality of information. Finally, there is nothing that allows data and analysis to be crossed between separate professional sectors: between water and energy, of course, but also, for example, between sanitation, REUT and irrigation or between conventional water resources and marine or brackish water resources[10].

6. Deep or fossil waters

This feasibility study should show whether the monitoring of deep or fossil groundwater should be integrated into the activities of the non-conventional water observatory.

The examination of the exploitation conditions of water resources shows that the Sahel-Mediterranean region, an area characterized by an arid and semi-arid climate, are very dependent on water resources contained in deep or fossil water tables. These often offer a recourse for development and adaptation to climate change in addition to non-conventional waters. But these water resources are poorly renewable and generally stored in sedimentary or crystalline aquifers of large basins for the most part shared by several countries.

[10] The water stress indicator tracked under SDG 6 for example should be calculated differently to include the volume of water mobilized by desalination.

According to several concordant estimates, the hydraulic potential of these aquifers is considerable (at least 600,000 billion m3). Thick in some areas of more than a thousand meters, they are captured by deep boreholes, for the most part Artesian. Refills, of which the most important date back mainly to the wet periods of the Quaternary (Pleistocene, Holocene), are increasingly insignificant or even non-existent due in particular to climate change.

In addition to the inherent complexity of the systems, there is the absence or insufficiency of in-depth studies and/or knowledge encompassing the natural limits of each of the systems. Indeed, the studies, when they exist, focus on some basins but have remained, for the most part, confined within the limits of national borders without taking into account the transnational parts of reservoirs. The resulting development plans are thus heavily limited by ignorance or underestimation of the mutual effects of intensive exploitation of this stock.

Shared aquifers are a strategic resource that will play a decisive role in the economic and social development of the countries that exploit them. Low-renewable and easily degradable, these resources require joint management. In a situation of shortage, inability to satisfy an ever-increasing demand or even potential degradation of their quality, it is necessary to prevent these resources from being the subject of competition and their exploitation going so far as to defeat the rationalization of their management in the long term.

The joint management of shared aquifers requires scientific and technical consultation between the countries concerned in order to promote the concept of basin awareness and to consider with stakeholders the establishment of solid foundations for the governance of these strategic resources.

The joint management of shared aquifers aims, above all, to preserve them against alteration and depletion in order to ensure their sustainable and equitable use for the benefit of populations and "riparian" countries, with a view to sustainable development and poverty reduction.

This joint exploitation requires a global water governance that must ensure the interaction between institutional, regulatory and socio-economic aspects and basic scientific knowledge, governance based on an approach based on the development and consolidation of scientific and technical knowledge both at the hydraulic, hydrological, environmental and socio-economic levels, which promote the establishment of institutional frameworks to perpetuate the consultation on the joint management of water resources (both underground and surface in areas where they are present and interconnected). The implementation of this approach will clearly show that the joint management of shared water resources of transboundary aquifer systems requires a good knowledge of the resource, compromises, a climate of mutual trust and understanding and must be based on a permanent dialogue.

The Sahara and Sahel Observatory (OSS) is mandated to help the southern countries of the Sahelo-Mediterranean region to develop the management of water resources in the framework of the global approach described above. The scope of its operation, defined on the map of *Annex A5*, is the large part of the Sahelo-Mediterranean area where resources of the deep groundwater are exploited. OSS actually conducts in this area activities that one would like to assign to the non-conventional waters Observatory.

Moreover, deep aquifers are contained in complex aquifer systems that are multilayer, most of the time captive, with rising levels often gushing; that is to say that their exploitation does not differ from that of non-deep aquifers. For this reason they should not be classified as non-conventional water resources. For some aquifers with considerable volumes of water in stock but practically not renewed, located in countries sorely lacking other water resources, it was decided to consume part of in an unsustainable way. Such choices are the result of political assessments much more than exchanges on NCWR and REs.

In conclusion, for the two reasons explained in the previous two paragraphs, it is not recommended to integrate the deep layers into the Observatory's activities. On the other hand, the Observatory should be able in the framework of global water resources analyses to draw up a complete panorama of water resources: conventional, non-conventional and non-renewable.

7. Strategic analysis of the feasibility of an Observatory

An Observatory project aims at **improving information to the benefit of field of activity that will use this information**. Its interest must therefore be assessed in relation to the foreseeable evolution of this field of activity. This is why this chapter describes in a first paragraph the challenges of NCWR and REs field of activity, then identifies in a second step the role that could play or the benefits that could be provided by a possible Observatory in the field of NCWR and REs, before weighing the constraints or risks of such a project to conclude with its pertinence.

7.1. Main upcoming issues of NCWR and REs in the study area

Non-conventional water resources should be further integrated into water policies, provided however, that demand-driven water management is well initiated, either in advance or in parallel. Some countries in the study area already have significant desalination capacity, up to 1% of all natural water resources, and other countries are planning to go far beyond. The reuse of water, in the study area heavily impacted by water stress, represents a major lever in the face of present and future water deficits to guarantee food security, in a global agricultural market expanding by 15% per year.

The mobilization of NCWRS should not prevent the water sector from reducing its carbon footprint, like any activity due to climate goals. This is complex because both desalination and REUT require large amounts of energy, and higher than other types of water production: about 3.5 kWh per m3 of desalinated water and often almost as much for REUT, to which we add the energy necessary for further treatment, disinfection of wastewater, and the energy necessary for the transfer of water to users, especially when it comes to irrigated plots located in areas thar are higher than the wastewater treatment plant.

Reducing the carbon footprint is therefore difficult but possible, first of all by renewable energy production either on a NCWR mobilization site or on a wider territory via the energy transmission network. But also by complex means covering all the water installations of a territory which combine the technological performances of water treatment and pumping, the recovery of waste water heat or the methanization of sewage sludge. This can only be achieved in the framework of joint planning of water resources and energy resources.

The main difficulties encountered during desalination or REUT projects concern the control of investment and operating costs with regard to water and energy tariffs, the choice of the right project management procedures, the regulations to be applied and the absence or reduction of environmental impacts.

For example, despite the recent publication of European texts on REUT water quality standards, not all countries in the study area have a complete legal framework to ensure the healthy use of purified wastewater, without risk to farmers and allowing the products to be marketed internationally. Even if this legislation is available, it turns out to be difficult to apply due to lack of technical and financial means. Another barrier for reuse is the associated cost: even if in some countries state subsidies make it possible to build wastewater treatment plants, the cost of operating these plants and transporting purified water to reuse sites must often be borne by farmers who prefer to resort to illicit and free indirect reuse.

On the other hand, the existence of a long-term global vision that encompasses all uses can allow the establishment of synergies between uses and partially solve financing problems, as is the case in Morocco with the OCP which invests for its water needs in wastewater treatment projects and thus meets the needs of the relevant municipalities.

7.2. Added value or spin-offs brought to these issues by improving information

Currently, the water sector independently plans the use of its resources and takes it for granted that the energy sector will be able to supply it. In the same way, the energy sector independently plans the use of its resources and takes it for granted that the water sector will be able to supply it. The Observatory will be able to raise awareness and alert with a view to coordination between these sectors on objective bases and further upstream of projects, which is likely to avoid investment errors and additional costs or delays in their implementation.

Achievements in the field of NCWR and REs are at very heterogeneous stages of progress between the different countries. The sharing of information from the most experienced to the least advanced is therefore easy to organize and likely to provide significant gains for investors or managers of water or energy production facilities.

Finally, the creation of common repositories and new functionalities accessible to a set of countries certainly brings a cost reduction to information systems compared to the case where each country develops this independently of the others. In addition, the existence of an Observatory guarantees a regular and more reliable update of the information which is therefore both cheaper to produce and used more frequently and more widely.

In the case of a similar international action - the harmonization of geographical information within the European Union via the INSPIRE directive - the European Commission has shown that benefits received by users have been about 7 to 8 times the expenses.

7.3. Opinion on the feasibility of an Observatory for NCWR and associated REs in the study area

The study showed that the current context of the study area is favorable for the mobilization of actors at all levels:

- There is a strong regional demand for desalination or REUT projects with a sustainable character (especially from the energy point of view) and for an entity that could reliably guide actors in this

field and strengthen their capacities, as well as provide contrasting and neutral information on these projects on a regular basis with access to comparable aggregated data between countries,
- There is no entity offering all such services for the entire study area, apart from the Desaldata tool but which is designed to support commercial approaches. Faced with this lack, several studies or thematic networks have been launched in recent months by major international or regional institutions in the field of desalination and REUT,
- Countries on both shores of the Mediterranean or the Sahel are mobilizing for the development of National Water Information Systems (NWIS), some of which with regional integration (see the efforts of SEMIDE labeled by the UfM, OSS or UNEP in this direction), but the field of NCWR remains outside these developments and the link with Energy Information Systems is practically non-existent.

However, the development of such an Observatory must take into account the Mediterranean and Sahel context where diplomatic disagreements between certain countries, and differences between them in governance or sensitivity to desalination or REUT, make the implementation of the project complicated and complex. The project will have to act against the following difficulties :

- Absence, outside the European Union, of a legal framework for reporting obligations, or data sharing on the part of ministries or private operators; there is therefore a big risk of an "empty shell" without a prior assured or motivated commitment from the various agencies and countries or without interoperable communication tools;
- Intervention of multiple actors, in all or part of the Mediterranean region and the Sahel, in the context of very diverse political or socio-economic processes, which often seek to enhance their own activities;
- The notion of international "observation" is often perceived as intrusive at the national level and adds to the frequent sectoral or hierarchical blockages to the flow of information.

In the rest of the world, we will probably find regions or countries as interested – such as the Middle East or the Gulf countries - but also other areas less motivated because of the situation of their water and energy resources.

In conclusion, the potentials and expectations around an Observatory for NCWR and associated REs are great in the study area and the return on investment of information sharing and good practices is high.

The study therefore recommends implementing this project in the Mediterranean and Sahel region.

But a strategy must be clearly defined, which presupposes strong support from the authorities granted from the upstream phases as well as cooperation agreements with many actors in the area to avoid duplicates and, on the contrary, bring synergies. These two prerequisites cannot be guaranteed or even simply specified by a feasibility study. That is why, rather than continuing the feasibility analysis on the rest of the world – which was envisaged as a second phase in the terms of reference – IME recommends starting the launch of an Observatory with a first operational phase targeted at countries that show a real interest in engaging in the project (particularly by providing their own information), including the development and testing of cooperation agreements, financial support and operating modalities to be used in the later phase.

Despite the difficulty of gathering funding for this first implementation phase, activities already undertaken by many actors on NCWR and REs in the pilot region suggest great chances of success for the Observatory: it will be able from the outset to rely on these actors to federate their activities and develop them in synergy.

7.4. Activities already undertaken

Sessions dedicated to the NCWR and REs Observatory, prepared by IME and held during the Mediterranean Water Forum on December 6, 2021 in Malta and then the World Water Forum on March 24, 2022 in Dakar, indeed made it possible to present the results of the feasibility study but also various actions already undertaken in the Mediterranean and the Sahel by a core of water and energy actors, pioneering actions that correspond to the expected activities of the future Observatory. They therefore constitute a prototype:

- Coupling of conventional water resources and NCWR, planned and monitored at the level of river basins with databases on all origins and uses of water, by the Ministry of ecological transition and demographic challenge of Spain;
- Methodological guide for the implementation of REUT pilot projects, developed with the participation of field actors in Tunisia, by IME with SCP, SEM and various Tunisian organizations;
- Good practices, often amended compared to provisions projected throughout experience, in terms of REUT or recovery of salt after desalination, by the water actors of Spain;
- Coordination of the water and energy sectors by the Malta Water and Energy Agency ;
- Public consultation ahead of a desalination project by the Société des Eaux du Sénégal;
- Energy savings and planning NCWR by the National Water Distribution Company of Tunisia;
- Carbon neutrality goal by the Cherifian Phosphate Office;
- Exchange of REUT experiences between southern Mediterranean countries by the FAO Water Department;
- Experimental platforms on REs for water installations by research institutes in Cyprus and Morocco;
- State of the art with innovative maps on desalination and methodology to monitor the impact of brines by Plan bleu.

8. Short-term action plan: project phase start-up

A two-year action plan is proposed, representing a first phase in order to initiate this Observatory in project mode, taking into account recommendations collected during the study, as summarized in the following §. At the end of this first operational phase covering two years, it will be possible to decide on the continuation and/or extension of the Observatory by having defined on the basis of experienced and precise elements, the institutional orientations, the statutes and legal documents, the costs and financing modalities of a sustainable Observatory.

8.1. General and specific recommendations for the creation of an Observatory

According to the recommendations raised by various surveys and meetings, it will be necessary to ensure the proper establishment of the Observatory.

- Overcome institutional problems by ensuring that the focal points (= entry points per country) have an institutional anchor that will allow them to have and share reliable data and/or information (depending on the level of commitment desired), validated by various stakeholders.
- Clearly highlight the interest of the Observatory project for partner countries, benefits to be derived, and clearly explain how and by whom the data can be used.
- Set up a local monitoring system by region/country, an annual report on performance indicators and a network around focal points.

The Observatory will then be able to:

- Contribute to the mobilization for the development and deployment of sustainable and cost-effective NCWR simply by supplementing or consolidating existing databases and facilitation networks, rather than creating new ones. It is particularly important to link the Observatory to the impacts of climate change and associated scenarios on water or energy resources.
- Associate entities/organizations from various sectors by country: users (agriculture and irrigation, drinking water, energy distribution networks ...), deposits and treatment (communities in charge of wastewater management and treatment, industries ...), the environment…
- Disseminate and enrich training elements, such as those adapted to the Mediterranean context in the field of REUT presented in the **Blue Plan n ° 11 of 2011** as well as in the methodological guide developed by the IME/SCP/SEM JV aimed at reproducing the technical assistance approach to other perimeters irrigated by treated wastewater.
- Provide associative-type actors with solutions for those who develop small-scale projects or objective arguments for those who simply want to inform civil society.

In addition to these general recommendations, the following recommendations specific to the **REUT**:

- Define a clear, common and consensus-building terminology, which has not been the case so far between countries and between experts.
- Deal with all water uses: drinking water, water for industry, environment, urban uses, green areas ... (without focusing only on agricultural irrigation) because the deployment of REUT will require multi-use solutions, and even often by solutions offering more added value than agricultural irrigation (ex: indirect production of drinking water).

The following recommendations specific to **desalination**[11] are added to these general recommendations:

[11] *Recommendations raised in particular during the two webinars organized by IME:*

On June 3, 2021 to feature desalination projects in Morocco, Spain and Malta, shown as proven and safe solutions for the mobilization of additional water resources ;

On October 28, 2021 on the theme: "Towards a regional desalination observatory: case studies from Senegal, Jordan and Tunisia" to shed light on desalination projects in these countries, but also discuss to what extent the Observatory would add value to them, and whether they would share data and contribute to it. Participants

- Compare the mobilization of desalination to meet water demand with measures to improve water management or to moderate the future growth of this water demand in the context of integrated water resources management.
- Develop good practices to address environmental controversies related to energy consumption and (brine) discharges to marine ecosystems.

8.2. Organization and methods of operation

The project leader during this first phase will have to be decided by CME. One solution would be to entrust this project to IME, which would set up a partnership with some key actors, such as OSS, FAO, Plan bleu, OME or RCREEE, with the political support of the UfM.

IME will propose to the other actors a membership to the Observatory which will recover, in a similar way to what was requested during the feasibility study - an agreement in principle and the appointment of a focal point - but which can go beyond by specifying the information made available to the Observatory by the member as well as its contributions, either in the form of work, the provision of experts, or funding. Membership will be aimed primarily at national authorities but will also be open to regional or international institutions and local actors such as local authorities, industrialists, agricultural groups or private actors. This project will of course be open to the countries of the study area that have given their consent during the feasibility study, but will be able to accommodate from the outset a few countries from the Middle East or the Gulf, Southern Europe or tropical Africa, which would make it possible to rely on a pilot area comprising about twenty countries.

IME will have to ensure funding for this first phase in the form of a grant[12] covering all the project's monetary expenses, i.e. excluding in-kind contributions from members (which will nevertheless have to be valued in monetary terms to know the real full cost of the project). This implies a specific follow-up of the project through semi-annual reports to the funders. The European Commission seems to be a body to be solicited in priority in connection with the EIB, as well as the World Bank, the AfDB and the EBRD or GIZ, AFD, ACEID and SIDA given their recent work in the field of NCWR, and several Arab funds such as IsDB as well as some foundations (Prince Albert II, Prima ...) because of their interest in the geographical area and in the topic. Part of the funding could also come from member countries (research or training organizations, regional authorities, water or energy agencies, companies ...).

8.3. Objectives and content of this phase

The objectives of this first phase are threefold:

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expect the Observatory to provide aggregated information and credible reports on desalination technology choices and related strategic decisions.

[12] It is difficult for international financial institutions to finance projects entirely dedicated to information because they do not generate monetary income but simply avoid additional costs, while their costs are recurrent and of a significant level, intermediate between infrastructure projects and studies. The holders of information projects therefore do not have the capacity to repay loans and have to mobilize relatively large grants, which often leads to enrolling either in the "support" component of infrastructure projects of a high amount, or in calls for projects.

i) Start a concrete activity including the collection and sharing of information as well as facilitation with a core of actors located in the pilot area;
ii) Negotiate agreements of collaboration or non-competition with other stakeholders in the information on the NCWR and REs, including GWI in the first place concerning Desaldata and Ecofilae concerning HotspotReuse ® ;
iii) Promote the Observatory in order to raise the interest of new members, to follow precisely activities carried out, and to develop the necessary recommendations with a view to continue the project or extend its geographical scope.

Priority actions in terms of information sharing are:

- Set up links to the information made available by partners and members, and create a repository including a data dictionary (metadata) and the common constraints to be respected in terms of geographical information ;
- Negotiate with GWI and Ecofilae to evaluate the quality of their data and collect pricing offers and corresponding usage rights for data from their Desaldata and HotspotReuse® databases ; in these databases or other Information Systems, identify the indicators or maps that it would be possible and relevant to produce periodically from certain data, identify possible synergies.

Priority actions in terms of facilitation are :

- Develop a list of experts in the fields of NCWR and associated REs and the main actors in these fields in the pilot area, and mobilize them according to needs ;
- Identify good practices or "success stories" in countries of the pilot area on the topics of brine discharge management, standards for reuse of wastewater, financing of desalination or REUT projects (PPP /BOT, BOO, etc.) and carbon footprint, and their publication in communication documents;
- Develop a standard model to calculate costs (CAPEX, OPEX) of desalination projects.

Priority actions in terms of promotion and recommendation with a view to the geographical extension and continuation of the project are :

- Develop a website including the presentation of the Observatory and its services, the online membership process, access to information and activities that differentiates between members and the rest of the public, with at least a weekly news update;
- Thoroughly follow activities, recording for each activity resources allocated and evaluation of their impact ;
- Develop specific recommendations for the continuation of the project in terms of organization and operation, human and material resources to be mobilized, partnerships and financing. *Annex A7* shows modalities that the project can adopt in each of these areas as soon as it starts, but which will be tested, enriched or amended for two years in order to define provisions well adapted to the extension or sustainability of such an Observatory.

8.4. Cost and timeline of the project

Resources to put in place to carry out actions and achieve objectives mentioned in § 7.3 are as follows :

- The online platform, including a website providing access to the information mentioned above for members and allowing to collect requests from others. An administrator will ensure the necessary IT developments via standard tools to be configured and their updates.
- Facilitation will be entrusted on a half-time basis to a senior generalist (10 to 15 years of experience in the field of the environment) capable of understanding various themes in the field of water or energy within working groups mobilizing the Observatory's experts and countries, as well as evaluating and promoting achievements.
- The involvement of youth in this project is feasible; two young professionals (less than 4 years of experience) shall be recruited to work under the part-time supervision of the generalist and in connection with the experts; they shall be fluent in several languages including Arabic, and both having a technical profile in the field of water and energy, but one of them should be particularly skilled in computer tools[13].
- Experts in desalination, REUT and renewable energies will be mobilized from time to time for specific methodological or technical support, data validation, etc.

As a consequence, the financing requirement for this first phase amounts to € 400k for a period of two years, distributed as follows :

- €160k for the remuneration of young professionals;
- €75k for the remuneration of the half-time facilitator;
- €40 k for the mobilization of experts;
- € 75k for IME's remuneration including the project engineering and the project management, its own expertise, secretariat fees and operating expenses (travel, translation, etc.) as well as a provision for inflation, miscellaneous and unforeseen events.
- 50 k€ for computer or data purchases.

This need for funding may be covered in part by unpaid support provided by partners or some members of the Observatory.

[13] A committed partnership with CMI in this direction would be in line with the recommendations of the Malta Mediterranean Water Forum

9. Glossary

Abbreviation or acronym	Meaning
ACEID	Spanish Agency for international development cooperation
AFD	French Development Agency
AFEID	French association for water, irrigation and drainage
AIE - EDC	International Energy Agency - Energy data center
AWWEENA	Arab associative network for women, water, energy and the environment
ADB	African Development Bank
EIB	European Investment Bank
EBRD	European Bank for Reconstruction and development
CIHEAM	International Center for Advanced Mediterranean Agronomic Studies
NDC	Nationally determined contributions
WWC	World Water Council
CMI	Mediterranean Integration Center
CO_2	Carbon dioxide
COSTEA	Scientific and technical committee agricultural water
REs	Renewable energy
FAO	Food and Agriculture Organization
IPCC	Intergovernmental Panel on climate change
IWRM	Integrated water resources management
GIZ	German association for international cooperation
GWI	Global Water Intelligence

IME	Mediterranean Water Institute
IMENCO	Maghreb initiative for non-conventional waters
IWMI	International Institute of Water Management
MENA	Middle East and North Africa
OCDE	Organization for Economic co-operation and Development
OCP	Cherifian phosphate office
ODD	Sustainable Development Goals
OME	Mediterranean Energy Observatory
WMO	World Meteorological Organization
OPEX, CAPEX	Operating expenses, capital expenditures
OSS	Sahara and Sahel Observatory
UNEP	United Nations Environment Program
PPP/BOT, BOO	Public private partnership /Build operate transfer, build operate own
R&D	Research and development
RCREEE	Regional center for renewable energy and energy efficiency
NCWR	non-conventional water resource
REUT	Reuse of treated wastewater
SCP	The Society of the Canal de Provence
SEM	Water Company of Marseille
SEMIDE	Euro-Mediterranean information system on know-how in the field of water
SIDA	Swedish Agency for Development and International Cooperation
SONEDE	National society for the study and distribution of water of Tunisia

ToR	Terms of reference
UNESCO	United Nations Educational, Scientific and Cultural Organization
UfM	Union for the Mediterranean
UV	Ultra-violets
WISE	European water information system

10. Annexes

11.

11.1. A1 Terms of reference of the feasibility study

WORLD OBSERVATORY FOR non-conventional WATER RESOURCES

AND DEDICATED RENEWABLE ENERGIES

Terms of reference: Feasibility study

Sahel-Mediterranean area

I. GENERAL CONTEXT

During the meeting of their Board held online on April 1, 2021, Governors of the World Water Council adopted the idea of launching an International Observatory for non-conventional Water Resources and associated Renewable Energies, in a first pilot area located within the Mediterranean - Sahel Region, before extending it at the global level.

As was developed in a concept note, this Observatory will be intended to monitor the use of non-conventional water resources and renewable energies dedicated to them.

These terms of reference concern the feasibility study of the observatory for the pilot area.

The follow-up could concern :

- Main types of non-conventional water resources, namely:
    - Reuse of treated wastewater
    - Desalination of seawater and brackish water
    - The use of brackish water in its natural state

Country surveys will indicate whether deep or fossil waters should be included in the monitoring task.

- The main renewable energies dedicated to the production of water and produced from the water resource, namely:
    - Hydraulic
    - Solar
    - Wind Turbine
    - Geothermal
    - ……

These specific themes will be addressed with cross-cutting themes such as:

- Financing
- Governance
- The institutional and functional organization
- The impact of climate change and other disturbances
- Impacts on the environment and biodiversity
- The right to water
- Legislation

II. OUTLINES OF THE FEASIBILITY STUDY

The feasibility study, which is entrusted to IME, the Mediterranean Water Institute (also referred to as "the Consultant") will have to define conditions to set up the Observatory and will revolve around three components:

- Inventory of initiatives and structures currently in place in the Mediterranean -Sahel region, acting in connection with the themes selected for the Observatory;
- Definition of the expected outputs of the Observatory and proposal of a pilot area;
- Proposals for an institutional and financial set-up.

A. COMPONENT 1: INVENTORY OF EXISTING INITIATIVES

This component will allow:

- To identify for the entire Mediterranean-Sahel region (probably about fifteen countries) all (local, regional or international) structures and entities in charge of monitoring non-conventional waters and associated renewable energies;
- To identify their nature, their thematic field of action, as well as their jurisdiction, the quality of data or information available to them;
- To also assess their possible and future capacity to collaborate with a structure (the Observatory) whose action could be complementary to theirs;
- To find out about studies and initiatives carried out by different donors (at the international level of cooperation) or by the countries themselves, in the areas concerned by the study;
- To make an inventory of existing observatories related to the topics concerned, and difficulties encountered during their establishment.

This mission will be carried out by informing as widely as possible all various ministerial structures in the relevant countries and various partners concerned, about the initiative that is being carried out and to collect their comments and appreciations.

The feasibility study will also have to determine how the Observatory can or should be integrated into the already existing systems and make proposals on the collaborations to be developed between the Observatory and these structures. It should also make it possible to identify countries with reliable databases and possibly willing to share them within the Observatory's database, under terms that have yet to be specified.

B. COMPOSNENT 2: DEFINITION OF THE EXPECTED OUTPUTS OF THE OBSERVATORY AND A PILOT INTERVENTION AREA

The inventory conducted during Phase 1 should lead to:

- A catalog of products currently available (data, information, experiences) from various sources identified and/or contacted,
- One or more proposals for the precise geographical definition of the pilot area (to be extracted from the study area according to criteria of relevance or availability of differentiated cooperation);
- A suggested catalog for services that the Observatory will be able to provide, and topics that it will be able to deal with (various databases to be fed, qualitative and quantitative monitoring indicators, cartographic supports, exchange platforms ...);
- Synergies to be promoted between the different structures, and therefore a proposal for the role of the Observatory as a catalyst or aggregator.

One of the major difficulties of the exercise is likely to be access to data. The consultant will therefore carefully study the availability of international and national databases or information and the possibilities of accessing them, for the themes to be studied by the Observatory, this may, moreover, constitute a criterion of choice when defining the pilot area.

C. COMPONENT 3 : INSTITUTIONAL, TECHNICAL AND FINANCIAL SET-UP

The feasibility study will have to propose one or more variants of the institutional and financial set-up of the observatory, capable of guaranteeing its sustainability.

Proposals may, among other things, consider the creation of a totally independent Observatory, or a structure attached to an existing entity, depending on the various contacts and the various preliminary agreements that may have been obtained during the course of Component 1.

Options regarding the status of the Observatory will have to be formulated, including a proposal for organization, and legal status.

The feasibility study shall also include a preliminary assessment of the human and material resources to be mobilized by the Observatory.

With regard to the financial feasibility, it will have to include an evaluation of the financial resources to be mobilized both for the initial establishment of the Observatory, but also for its annual sustainable operation.

It will also propose several hypotheses as to the mobilization of necessary funds, if necessary after contacts with potential funders (including those recommended by CME) on their interest in principle for participation in the project.

III. PHASING OF THE STUDY

This first phase, which concerns a Sahelo-Mediterranean area to be specified, will span between **May to December 2021**.

The second phase of the feasibility study, which concerns an extension at the global level, could start after the presentation of the results of the first phase at the Dakar Forum, i.e. in April 2022. Building on the difficulties encountered during the first phase, it will have to propose a model for the gradual deployment of the Observatory at the global level, update the nature of the information and data to be collected and define the necessary human and material resources to be mobilized.

IV. PLANNING

A schedule of the various stages of the feasibility study is suggested below :

- **April 1, 2021**: Agreement of the CME BOG on the principle of the Observatory;
- April 2021: Finalization of the CME-IME agreement for the execution of the feasibility study;
- **May 2021-December 2021**: first stage of the feasibility study;
- **December 2021:** Presentation of the first results of the feasibility study on the occasion of the 4th Mediterranean Water Forum in MALTA (December 6-8, 2021).
- **March 2022:** Presentation of the results of the final feasibility study on the occasion of the world water forum in Dakar (March 21-25, 2022).

A detailed schedule of the feasibility study, including a list of validation steps to be planned, will be provided by IME as of the second week after the launch of the study.

V. MONITORING THE PROJECT BY CME

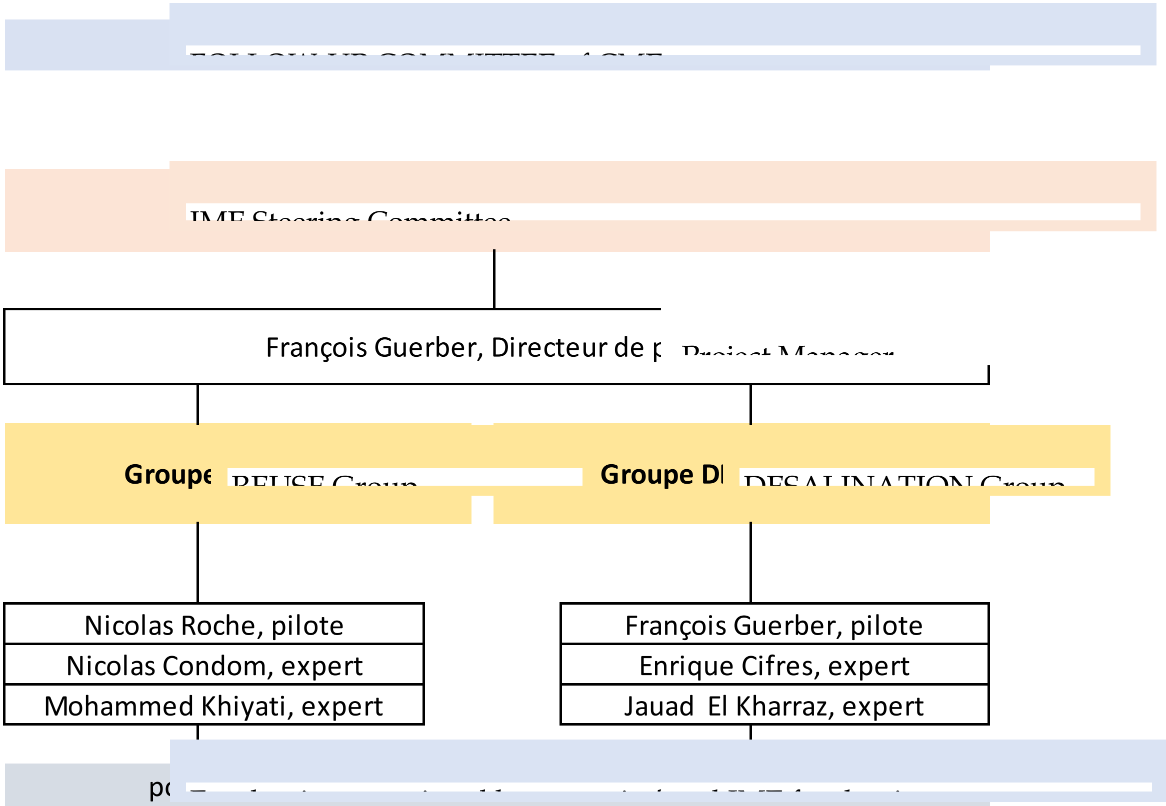
The project can be monitored within the World Water Council, by a working group coordinated by a sitting governor.

This group may consist of :

- One or two members representing the countries of the region;
- One or two members representing international organizations;
- One or two members representing international financial institutions;
- One or two members chosen for their special skills.

11.2. A2 Scope and organization of the study

A2_1 Expertise mobilized



A2_2 Map of the study area

A2_3 Solicitation mail

On 23 July, IME sent the following letter to each national authority of the pilot region countries:

Excellency, Minister,

The World Water Council has recently made a commitment to invest in the identification and dissemination of concrete experiences in the field of non-conventional water resources through the creation of a dedicated International Observatory.

Such an Observatory aims to collect and pool information and international exchanges on the experiences of integrating non-conventional water resources and their energy needs (mainly the use of renewable energies). The creation of this Observatory will be conditioned by the results of the feasibility study entrusted by the World Water Council to the Mediterranean Water Institute for the next World Water Forum in Dakar due to be held in March 2022 (see attached the mission letter signed by Mr. Loïc Fauchon, Chair of CME).

As the governmental authority responsible for the management of the water resources of your country, which is part of the pilot area of this study, we would like to ask for your support to collect and provide information related to non-conventional water resources and associated renewable energies.

If you agree to support this initiative, we would be grateful if you could designate a focal point or several interlocutors mandated for this purpose, who will later be contacted by IME and its experts with your permission.

We hope to receive a favorable response to our request. We remain at your disposal for any additional information,

Please accept, Your Excellency, Minister, our highest consideration.

To which was attached the following letter from the CME :

WORLD WATER COUNCIL

World Water Council
Office of the President

Lettre de Mission
Pour l'Institut Méditerranéen de l'Eau

Pour l' étude de faisabilité de l'Observatoire Mondial des Ressources en eau non conventionnelles et énergies renouvelables dédiées

Mesdames, Messieurs,

Du fait de la pollution ou de la surexploitation des ressources en eau conventionnelles, aggravées par les impacts des évolutions climatiques, le recours aux ressources en eau non conventionnelles est devenu une nécessité, voire dans certaines régions du monde, une obligation. Dans le même temps, la mobilisation de ces ressources fait parfois appel à de grandes quantités d'énergie, qui à long terme ne pourront être que renouvelables.

Lors de la Semaine Internationale de l'Eau du Caire (octobre 2019, Egypte), le Conseil Mondial de l'Eau (CME) avait annoncé son intention d'approfondir la thématique des ressources en eau non conventionnelles et des énergies renouvelables associées, par la création d'un Observatoire international.

Un tel Observatoire devrait permettre la mise en commun d'informations ainsi que des échanges sur les expériences d'intégration des ressources en eau non conventionnelles et de leurs besoins en énergie, principalement l'utilisation des énergies renouvelables.

Une étude de faisabilité vient d'être confiée par le Conseil Mondial de l'Eau à l'Institut Méditerranéen de l'Eau (IME) en vue d' une présentation de ses résultats au prochain Forum mondial de l'eau de Dakar (mars 2022).

La première phase de cette étude concernera la zone Sahélo-Méditerranéenne, et portera essentiellement sur les deux ressources non conventionnelles les plus importantes, à savoir le dessalement et la réutilisation des eaux usées. Ses conclusions préliminaires seront partagées lors du Forum méditerranéen de l'eau qui se tiendra à Malte du 6 au 8 décembre prochain. Elle s'appuiera sur les initiatives de « monitoring » développées par des institutions ou organisations internationales œuvrant dans le domaine de l'eau, ainsi que sur les données que chaque pays de la zone pilote considérée pourra partager.

Vous trouverez en pièce jointe la liste des pays constituant la zone d' étude, d'où sera extraite, à l' issue d'une première phase, une zone pilote.

L'Institut Méditerranéen de l'Eau va vous contacter, pour, d'une part, recueillir votre appréciation et vos commentaires sur cette initiative, et, d' autre part étudier avec vous les modalités de mise à disposition d'informations dans le domaine des ressources en eau non conventionnelles et des énergies renouvelables dédiées.

Au nom du Conseil et en mon nom personnel, je vous remercie par avance de votre soutien, et vous prie d'agréer l'expression de ma haute considération.

Loïc Fauchon.

Le Président du Conseil Mondial de l'Eau
Loic Fauchon

WORLD WATER COUNCIL – CONSEIL MONDIAL DE L'EAU
Espace Gaymard - 2-4 Place d'Arvieux - 13002 Marseille - France - Phone: +33 (0) 4 91 99 41 00 - Fax: +33 (0) 4 91 99 41 01
www.worldwatercouncil.org

A2_4 REUT Questionnaires

Contact form:https://docs.google.com/forms/d/e/1FAIpQLSf4s5tDEwaCrz1SSwDyeHCxV_-PWSSiSKChbTAc2VdnJcEpsg/viewform

Contact details	Name of your organisation
	Type
	Website (organisation)
	Your Name
	Your Forname
	Your Position
	Your Email
	Your Phone/Cell/Skype
Your expertise	What is your country of work expertise ?
	Please precise if you have also work expertise in other countries
	How do you assess your level of expertise in WATER REUSE
	Please explain your field of knowledge and expertise in WATER MANAGEMENT and/or WATER REUSE
Water reuse in your country (general)	How would you characterize/assess the level of developpment of WATER REUSE in your country ?
	Precise below the definition of direct and controlled water reuse
	What is the approximate percentage of wastewater reclaimed and reused in your country (direct and planned water reuse) ?
	What are the impediments/breaks to WATER REUSE in your country?
	Please precise the main organisations involved and in charge of WATER REUSE management in your country

Regulatory framework	Is there a regulatory framework for WATER REUSE in you country?
	If yes, please precise the references of this regulatory framework
	If yes, please precise which end-uses are concerned by a regulatory framework. E.g. : crops irrigation, street cleaning...
Water reuse projects in your country	How many WATER REUSE projects are on-going in your country?
	If you know **on-going key water reuse projects** in your area please fullfill the following questionnary to describre them
	Insert the general definition of an OBSERVATORY + Exemples *An observatory provides access to WATER REUSE DATA, shares knowledge between various water REUSE stakeholders and dessiminates information.*
Existing WATER REUSE OBSERVATORIES	Do you know of any WATER REUSE observatories?
	In your opinion, what are some of the benefits to an observatory and challenges to creating one?
INTEREST for the creation of a WATER REUSE OBSERVATORY	*IME plans to build a regional (across several countries) WATER REUSE OBSERVATORY*
	In your opinion, what are some of the benefits to an observatory and challenges to creating one?
	What information/data would you expect to find in this WATER REUSE OBSERVATORY
	Are you interested in being involved in this WATER REUSE OBSERVATORY initiative as a local officent/referent?
FINALLY	Is there anyone else you could refer us to to fill in this questionnaire (contact name, organisation and email)?
	Additional information you would like to share or comments

Feedback form REUT:https://docs.google.com/forms/d/e/1FAIpQLSf4s5tDEwaCrz1SSwDyeHCxV_-PWSSiSKChbTAc2VdnJcEpsg/viewform

Country	
Minimal Core	Site
	In which country I the site located?
	What is the name of the site? What are the geographic coordinates of the site?
	What is the commissioning year of the site?
	What is the body responsible for the operation and maintenance of the plant?
	Treatment
	For which treatment level was the plant designed?
	What are the components of the implemented sanitation synthesis ? Please indicate the type of pre-treatment – treatment – disinfection
	What is the source of wastewater treated by the plant?
	What is the treatment capacity installed in the plant? (m^3/d)
	Is the total volume of wastewaters treated to be reused?
	What is the volume of reused treated wastewaters (m^3/d)?
	Are the treated wastewaters stored before their reuse?
	What types of usages are targeted by treated wastewaters?
	Energy
	What are the plant's needs for energy?
	What is the proportion of renewable energies?

PAYS	
Noyau Minimal	Site
	Dans quel pays se situe le site ?
	Quel est le nom du site ?
	Quelles sont les coordonnées géographiques du site ?
	Quelle est l'année de mise en service du site ?
	Qui est l'organisme responsable de l'opération et de la maintenance de la station ?
	Traitement
	Pour quel niveau de traitements la station a été conçue ?
	Quelles sont les composantes de la synthèse d'assainissement mis en œuvre ? Veuillez préciser le type de prétraitement – traitement – désinfection.
	Quelle est la source des eaux usées traitées par la station ?
	Quelle est la capacité de traitement installée de la station (m3/jour)
	Est-ce que le volume total des eaux usées est traité pour être réutilisé ?
	Quel est le volume des eaux usées réutilisé (m3/j)
	Est-ce que les eaux usées traitées sont stockées avant réutilisation ?
	À quel Type d'usages sont destinées les eaux usées traitées ?
	Energie
	À combien sont estimés les besoins en énergies de la station ?
	Quelle est la proportion en Énergie renouvelable ?

Country	Number of replies	Type d'organisme ayant répondu
Albania	1	Institution gouvernementale
Algeria	1	Institution gouvernementale
Burkina Faso	1	Entreprise privée
France	1	Entreprise privée
Italy	3	Centre de recherche + Porteur de projet REUSE
Lebanon	1	Institution gouvernementale
Malta	1	Agence publique
Maroc	5	Entreprise privée + Centre de recherche
Palestine	4	Institution gouvernementale
Spain	2	Centre de recherche
TCHAD	1	Institution gouvernementale
Tunisia	4	ONG + Ministère

11.3. A3 Contexts by country

A3_1 Albania

Population: 2,9[14] million inhabitants; Area: 28 784 km^2; GDP/capita: 5.50[15] US $

Total renewable water resources:

41.70 10^9 m^3/year

Of which 65% originate within the country and 30% are groundwater

Quantity of fresh water: 8,700 m^3/capita/year

80% of drinking water in the country is provided by the use of natural and groundwater resources, except the area the metropolitan area of Tirana which receives part of the supply from mountain water resources that are diverted to create a

Total primary energy supply: 23,412 GWh/year

Electricity generation, Year 2020: 5,313 GWh

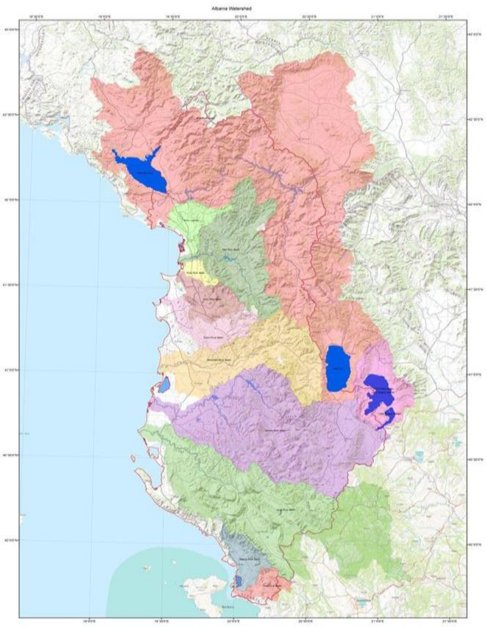
Share of renewable final energy consumption (SDG 7.2.1): 38 %

Electricity production capacity: 2.011 MW

Of which 50 % of its hydropower potential and

[14] Albanian National Statistical Authority (INSTAT), January 2019

[15] World Bank World Development Indicators (WDI): Albanian GDP per capita adjusted for purchasing power parity (PPP) and at constant 2011 dollars increased from USD 3,229 in 1991 to 11,802 in 2017. The equivalent EU figure increased from USD 25,066 in 1991 to USD 37,331 in 2017. The poverty rate is stated for income adjusted by PPP in constant 2011 dollars. Albania's poverty headcount ratio ($5.50 a day at 2011 PPP) fell from 51.5 % of the population at its first measurement in 1996 to 39.1 % of the population at its currently latest measurement in 2012.



Hydrographic boundaries of basin catchment

<u>Coverage with sewerage system</u> 52.4% (in urban areas 82.2% and rural areas 15%)

Water supply and Sewerage services:

Reorganized in 58 WSS companies serving 61 municipalities.

Coverage with ITUN through sewers:98.63 %

Coverage with ITUN between septic tanks:1.37%

Coverage with wastewater treatment plants 13.8% (2005-2020)

Institutions:

-Agency of Water Resources Management

4 Water Resources Management Offices

-Ministry of Energy and Infrastructure

Agency of Water Supply, Sewerage and Waste

Infrastructure

National Agency of Natural Resources

Energy Regulatory Entity and Electricity Distribution Operator

National policies:

National Strategy of Integrated Management of Water Resources – Approved in 2018

Sources FAO Aquastat database and IRENA statistics – values of 2018

Sources: Report No: PIDC196452 of the World Bank Albania National Water Supply and Sanitation Sector Modernization Program

Sources: ALBANIA 2030 NATIONAL PROGRAM WATER SECTOR

http://ambu.gov.al/public/PROGRAMI%20KOMB%C3%8BTAR%20SEKTORIAL%20I%20UJIT%202018-2030.pdf

Sources: National Strategy for Integrated Management of Water Resources http://ambu.gov.al/public/STRATEGJIA%20KOMB%C3%8BTARE%20P%C3%8BR%20MENAXHIMIN%20E%20INTEGRUAR%20T%C3%8B%20BURIMEVE%20UJORE.pdf

Sources: ANNUAL REPORT State of the Energy Sector and ERE activity during the year 2020 https://ere.gov.al/doc/Raporti%20vjetor%202020.pdf

Sources: National Strategy of the Water Supply and Sewerage Sector, 2020-2030

https://www.infrastruktura.gov.al/wp-content/uploads/2020/01/Strategjia-UK-2020-2030.pdf

Sources: ALBANIA 2030 NATIONAL ENERGY STRATEGY 2018-2030 https://administrata.al/Documents/strategjia%20doc/23.Strategjia%20Komb%C3%ABtare%20e%20Energjis%C3%AB%20p%C3%ABr%20periudh%C3%ABn%202018%20-%202030.pdf

Sources: Annual report of the Water Regulatory Authority (Year 2017) (ERE)

A3_2 Algeria

Population : 42,23 million inhabitants ; Area: 42.229 km² ; GDP/capita: 3.815 US$

Total renewable water resources: 11,25 10^9 m^3/year Of which 88% is surface water, and 3.6% is of external origin Available water: 276 m3 per inhabitant per year	Total primary energy supply: 119.465 GWh/year Of which 2.1% renewable Electricity generation: 80.681 GWh/year Of which 1% renewable (solar 0.85%) Access to electricity: 100 %

Ressources en eau et en énergie

Water demand / exploitable resources: 132 % Water use efficiency: 14,5 US $ / m^3 (ODD 6.4.1) Desalination: 631 10^6 m^3 produced per year in @@ facilities Reuse of waste water: Waste water produced: 1.500 10^6 m^3/ year	Institutions : Ministry of Water resources Watershed agencies, national agency for hydraulic resources, national agency for dams and inter-basin transfers Regulation : Water services regulatory authority Participation of the private sector: Management contracts in Algiers, Oran and Constantine

Sources FAO Aquastat database and IRENA statistics –2018 values

A3_3 Cyprus

Water and energy resources

Population : 1,19 millions inhabitants ; Area: 9.250 km² ; GDP/Cap.: 26.623 US$

Total renewable water resources:

780 10^6 m^3/year

including 58 % surface water, and 0 % external origins

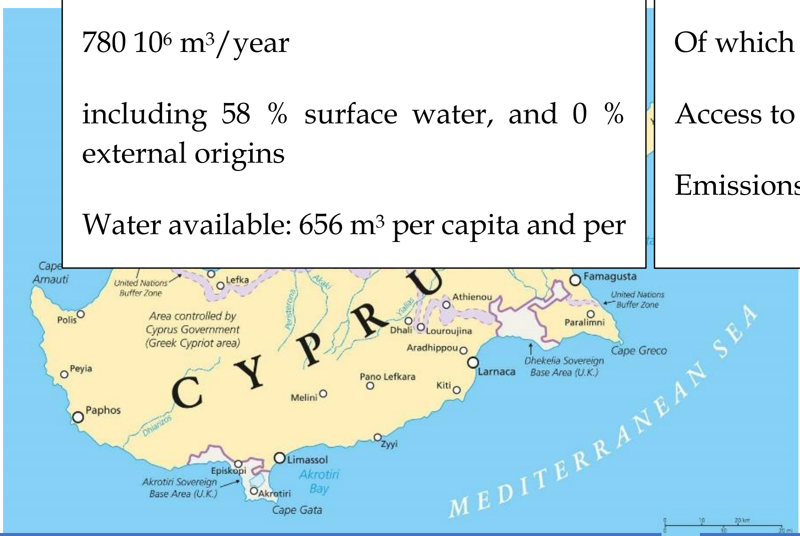
Water available: 656 m^3 per capita and per

Total primary energy supply: 25,5 GWh/year

Of which 12,1 % renewable (SDG 7.2.1)

Access to electrical power: 100 %

Emissions from the energy sector: 7,4 MT CO_2



Ressources en eau et en energie

Water demand / exploitable resources: 53 %

Water use efficiency: 59,4 US $ / m^3

(SDG 6.4.1)

Desalination:

Production : 70 10^6 m^3/ year

Reuse of waste water:

Waste water produced: 34,9 10^6 m^3/ year

Institutions :

Ministry of Agriculture, Natural Resources and Environment

Water companies

Participation of the private sector:

BOOT desalination of Dhekelia, Larnaca and Limassol

S

Sources FAO Aquastat database and IRENA statistics –2018 values

A3_4 Egypt

Population : 98,42 million inhabitants ; Surface : 1.001.450 km² ; GDP/cap. : 3.548 US $$

Water and Energy resources

211

Res

Total renewable water resources:

57,5 10^9 m³/year

Of which 97 % surface water, and 98 % from external origin

Available water: 584 m³ per inhabitant and per year

Total primary energy supply: 1037 GWh/year *of which 4,7 % renewable*

Access to electricity: 100 %

D

Water demand / exploitable resources: 156 %

Water use efficiency: 4,58 US $ / m³

5

(SDG 6.4.1)

Desalination:

Institutional and regulatory framework

Institutions:

Egyptian Environmental Affairs Agency (EEAA)

Ministry of Water Supply and Sanitation Facilities

Holding Company for Water and Wastewater

Regulation:

Sources FAO Aquastat database and

IRENA statistics – 2018 values

A3_5 Spain

Population : 47,35 million inhabitants ; Area: 505.957 km^2 ; GDP/Cap. : 24.943 US $

Water resources	Energy
Total renewable water resources: 111,5 10^9 m^3/year Of which 78 % in surface water, and 11 % of external origin Water available: 2.388 m^3 per capita/per year	Total primary energy supply: 1.264 GWh/an including 17,4 % renewable (ODD 7.2.1) Access to electricity: 100 % Emissions from the energy sector: 355 MT CO_2

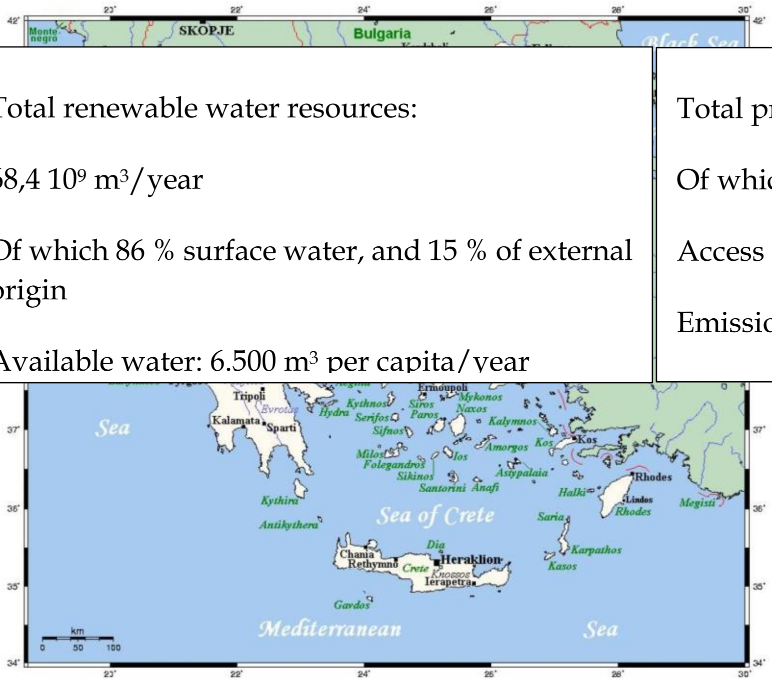
Mapa de cuencas y vertientes hidrográficas.

Water demand / exploitable resources: 67 % Water use efficiency: 36,9 US $ / m^3 (SDG 6.4.1) Desalination: Production : 364 10^6 m^3/ year Reuse of waste water: Waste water produced: 5,21 10^9 m^3/ year	Institutions : Ministry of Agriculture and Fisheries, Food and Environment Hydrographic confederations National water council Private sector participation: @@

Sources FAO Aquastat database and IRENA statistics – 2018 values

A3_6 Greece

Population: 10,52 million inhabitants ; Area: 131.960 km^2 ; GDP/Cap.: 16.676 **US $**



Total renewable water resources: 68,4 10^9 m^3/year Of which 86 % surface water, and 15 % of external origin Available water: 6.500 m^3 per capita/year	Total primary energy supply: 25,5 GWh/year Of which 12,1 % renewable (SDG 7.2.1) Access to electricity: 100 % Emissions from the energy sector: 7,4 MT CO_2

Ressources en eau et en énergie

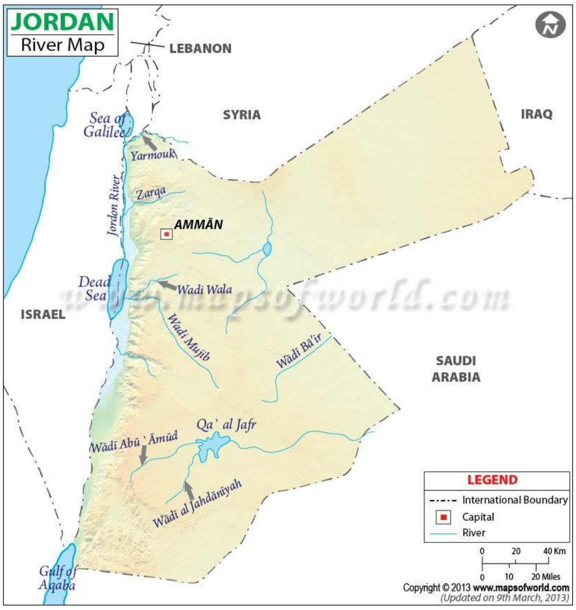
Water demand / exploitable resources: 35 % (SDG 6.4.1)	Institutions : National water council Participation of the private sector: ??

Sources FAO Aquastat database and IRENA statistics –2018 Values

A3_7 Jordan

Population : 9,97 million inhabitants ; Area: 89.320 km² ; GDP/Cap. : 4.283 US $

Total renewable water resources: 937 10^6 m^3/year Of which 55 % surface water and 27 % of external origin	Total primary energy supply: 107 GWh/an Of which 7,2 % renewable Access to electrical power: 100 % Emissions from the energy sector: 29 MT CO_2



Water demand / exploitable resources: 122 %	Institutions:
Water use efficiency: 35,4 US $ / m^3	Ministry of Water and irrigation
(SDG 6.4.1)	Jordan water Authority
Desalination:	Jordan Valley Authority
Production : 136 10^6 m^3/ year	Regulation:
Reuse of waste water:	Water services regulatory authority
Waste water produced: 180 10^6 m^3/ year	Private sector participation:
Treated wastewater: 147 10^6 m^3/ year	Aqaba Water Company ; BOOT desalination &

Sources FAO Aquastat database and IRENA statistics – 2018 Values

A3_8 Lebanon

Population : 6,86 million inhabitants ; Area: 10.450 km²; GDP/Cap. : 4.891 US $

Total renewable water resources: 4,5 10^9 m^3/year of which 54 % surface water, and 0 % from external origin	Total primary energy supply: 97 GWh/year of which 4,7 % renewable Access to electricity: 100 % Emissions of the Energy sector: 28 MT CO_2

211,6

Ressources en et en énergie

Water demand / exploitable resources: 88 % Water use efficiency: 25,8 US $ / m^3 (SDG 6.4.1) Desalination: Production: 47 10^6 m^3/ year Reuse of treated wastewaters: Waste waters produced: 310 10^6 m^3/ year Waste waters treated: 56 10^6 m^3/ year	Institutions: Ministry of Energy and Water (MEW) Council for Development and Reconstruction (CDR) Public Water and Sanitation Establishments (WSE) Regulation: ?? Private Sector Participation: Higher Council for Privatization (HCP)

Sources FAO Aquastat database and IRENA statistics – 2018 values

A3_9 Malta

Population : 0,44 million inhabitants ; Area: 320 km^2 ; GDP/Cap. : 27.885 US $

Total renewable water resources: 51 10^6 m^3/year Of which 2 % surface waters, and 0 % of external origin Available water: 115 m^3 per capita/per year	Total primary energy supply: 7,8 GWh/year Of which 7,5 % renewable (SDG 7.2.1) Access to electricity: 100 % Emissions of the energy sector: 1 MT CO_2

211,6 

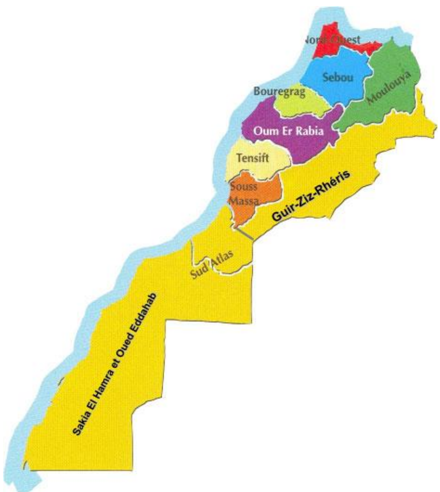
Water demand / exploitable resources: 427 % Water use efficiency: 174 US $ / m³ (SDG 6.4.1) Desalination: Production: 20,3 10^6 m^3/ year Reuse of waste water:	Institutions: Ministry of Water and Energy Management Energy and water agency Regulation : Regulator of energy and water services

Sources FAO Aquastat database and IRENA statistics –2018 Values

A3_10 MOROCCO

Population: 36,03 million inhabitants ; Area: 446.550 km^2 ; GDP/Cap.: 3.059 US $

Total renewable water resources: 29 10^9 m^3/year Of which 69 % surface water, and 0 % of external origin	Total primary energy supply: 243 GWh/year Of which 10,8 % renewable (SDG 7.2.1) Access to electrical power: 98 % Emissions from the energy sector: 75 MT CO_2

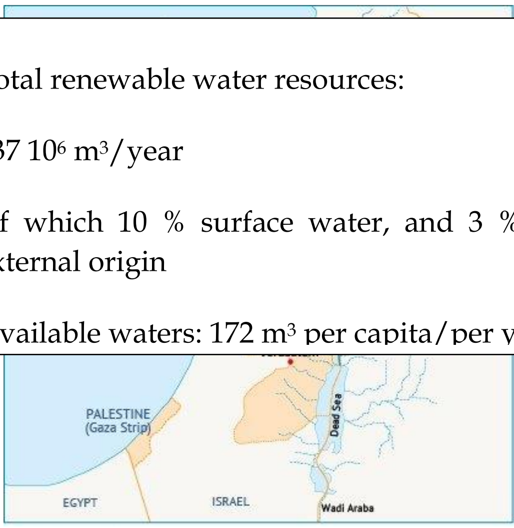


	Institutional and regulatory framework
Water demand / exploitable resources: 52 % Water use efficiency: 8,7 US $ / m^3 (SDG 6.4.1) Desalination: Production : 7 10^6 m^3/ year Reuse of waste water: Waste water produced: 700 10^6 m^3/ year Treated wastewater: 166 10^6 m^3/ year	Institutions : Ministry of energy, mines, water and environment National Office of electricity and drinking water (ONEE) Participation of the private sector : Law n°86-12 on public-private partnership contracts (December 24, 2014) and implementing decree n° 2-15-45 (May 13, 2015) Department of state-owned enterprises and privatization, Ministry of Economy and Finance Interdepartmental PPP Committee to the Minister of Finance National Policy:

Sources FAO Aquastat database and IRENA statistics –2018 Values

A3_11 Palestine

Population: 4,86 million inhabitants ; Area : 6.020 km^2 ; GDP/Cap. : 3.240 US $



Total renewable water resources:

837 10^6 m^3/year

Of which 10 % surface water, and 3 % of external origin

Available waters: 172 m^3 per capita/per year

211,6

Total primary energy supply: 19 GWh/year

Of which 12,7 % renewable (SDG 7.2.1)

Access to electrical power: 100 %

Emissions from the energy sector: ?? MT CO_2

Water demand / exploitable resources: 55 %

Water use efficiency: 34,1 US $ / m^3

(SDG 6.4.1)

Desalination:

Production : 4 10^6 m^3/ year

Reuse of waste water:

Waste water produced: 180 10^6 m^3/ year

Treated wastewater: 147 10^6 m^3/ year

Institutions :

Palestinian water authority

Wholesale water production and distribution in the West Bank (West Bank Water Department)

Ministry of Environment and Ministry of Agriculture

Regional operators (CMWU, JWU and WSSA)

Regulation :

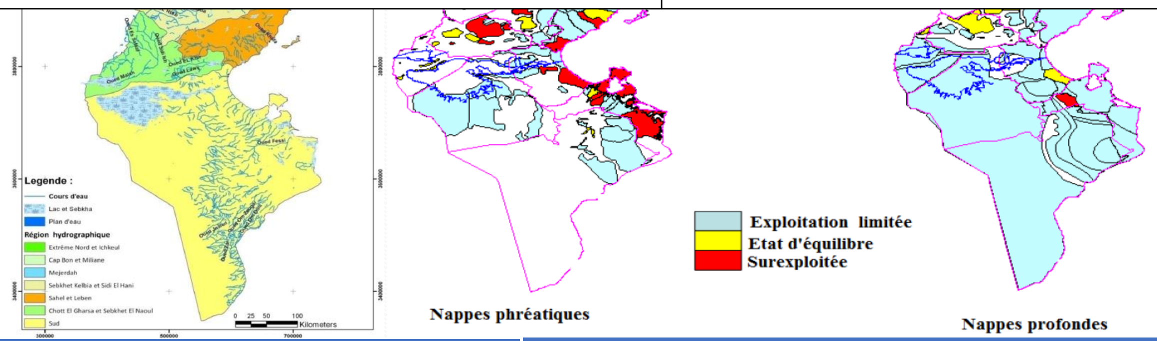
So

Sources FAO Aquastat database and IRENA statistics –2018 Values

A3_12 Tunisia

Population: 11,57 million inhabitants ; Area: 163.610 km^2 ; GDP/Cap.: 3.522 US $

Total renewable water resources: 4,6 10^9 m^3/year of which 68 % surface waters, and 9 % of external origin	Total primary energy supply: 131 GWh/year Of which 11,9 % renewable (SDG 7.2.1) Access to electricity: 100 %



Ressources en eau et en énergie

Water demand / exploitable resources: 106 % Water use efficiency: 10, 2US $ / m^3 (SDG 6.4.1) Desalination: Production: 42,7 10^6 m^3/ year	Institutions : National company for the exploitation and distribution of waters (SONEDE) National Sanitation Agency (ONAS) Northern Water Canal and Supply Company National water council

So

Sources FAO Aquastat database and IRENA Statistics –2018 Values

A3_13 Desalination plants or REUT supplied with REs

In Algeria, the Semiconductor Technology Research Center for Energy (CRTSE) is developing small brackish water desalination plants powered by solar panels.

In Spain, several REUT projects are powered in part by photovoltaics at the treatment plant; the center for energy, environmental and technological research (CIEMAT) in Madrid has carried out a 5 year-long demonstration and pilot brackish water desalination project generating its own energy by making use of a wind turbine.

In France, the Libourne composting platform recycles 90% of its wastewater thanks to solar panels, an investment not increasing carbon footprint reimbursed in 5 years.

In Greece, the Hydrousa project (Lesbos Island) is considering implementing REUT solutions powered by an energy mix integrating wind and geothermal energies.

In Mali, the laundry of La lavandière in Bamako is powered by photovoltaic panels equipped with the intelligent controller of Tysilio.

In Morocco, the Tiznit wastewater treatment plant is equipped with photovoltaic panels that power the complementary ultrafiltration and UV treatment; upgrade works currently carried out at the Oujda plant include a photovoltaic facility to power the complementary ultrafiltration and UV treatment. The Agadir desalination plant (275,000 m3/d, expandable to 450,000) is supplied with high voltage by the Ouarzazate Nour solar power plant. IRESEN offers a mobile and modular Aquasolar unit for the desalination of brackish water using solar thermal and photovoltaic energy, studies the potential to desalinate brackish water in the Dessol project based on the solar energy from the extreme south and has developed robots to clean solar panels.

In Tunisia, the 300 inhabitants of the village of Ksar Ghilène are supplied with water by a brackish water desalination plant that is fully autonomous in terms of energy thanks to its photovoltaic panels although located 150 km from the interconnected network. The Ben Guerdane desalination plant (1,800 m3/d of brackish water) is powered by photovoltaic panels for up to 40% of its peak needs.

11.4. A4 Observatories: existing and needs

A4_1 Questions raised during the conference held on June 3, 2021

Summary of the desalination experiments in Morocco, Spain and Malta

i) Operation:
   a. Actual annual total production/nominal installed capacity?
   b. What is the average lifespan of membranes?
   c. What happens to membranes after their use? Are there any recycling methods?
   d. What interventions are needed on desalination units for agricultural use that are turned off during the winter period?
   e. Which drinking water standards are applied: European, WHO or national? Are micropollutants monitored?

ii) Costs :
   a. What is the cost per m3 of desalinated seawater?
   b. The cost of the m3 produced being around € 1 and the selling price of 1 m3 is € 0.2, who pays the difference?
   c. Which agricultural productions with irrigation bear such a processing cost?
   d. Does the advertised price take into account the treatment or recycling of brines?
   e. What would be the treatment cost for brackish water (about 4g/liter)?
   f. What has been the evolution of costs and how are they covered by tariffs (3Q)?

iii) Planning investments:
   a. What proportion of total drinking water consumption comes from desalination?
   b. Is desalination mainly oriented to domestic and/or industrial use while renewable resources are reserved for agriculture?
   c. Is the use of desalination for agriculture sustainable?
   d. Why not promote REUT instead of desalination?
   e. What is the proportion of desalinated water for agricultural use in the three countries?
   f. Who finances this type of investment in Morocco?
   g. Why are we so late in France?

iv) Environmental and societal impact:
   a. Does the impact on the environment impede the desalination technique?
   b. What is the fate of brines discharged into the sea? What are the possibilities of salt reuse and/or brine recovery?
   c. Does the monitoring of the impact of brines include the monitoring of other parameters such as NH4, Boron, heavy metals?
   d. Is there a study of impact on the natural environment?
   e. Do the terms of reference for this type of projects provide for environmental sustainability and impact criteria?
   f. Are we used to measuring the social acceptability of desalination solutions?
   g. What is the level of acceptability of desalination versus REUT in Spain?

v) Energy:
   a. What is the experience of involving RE in desalination projects in the three countries and what is the policy in this regard?

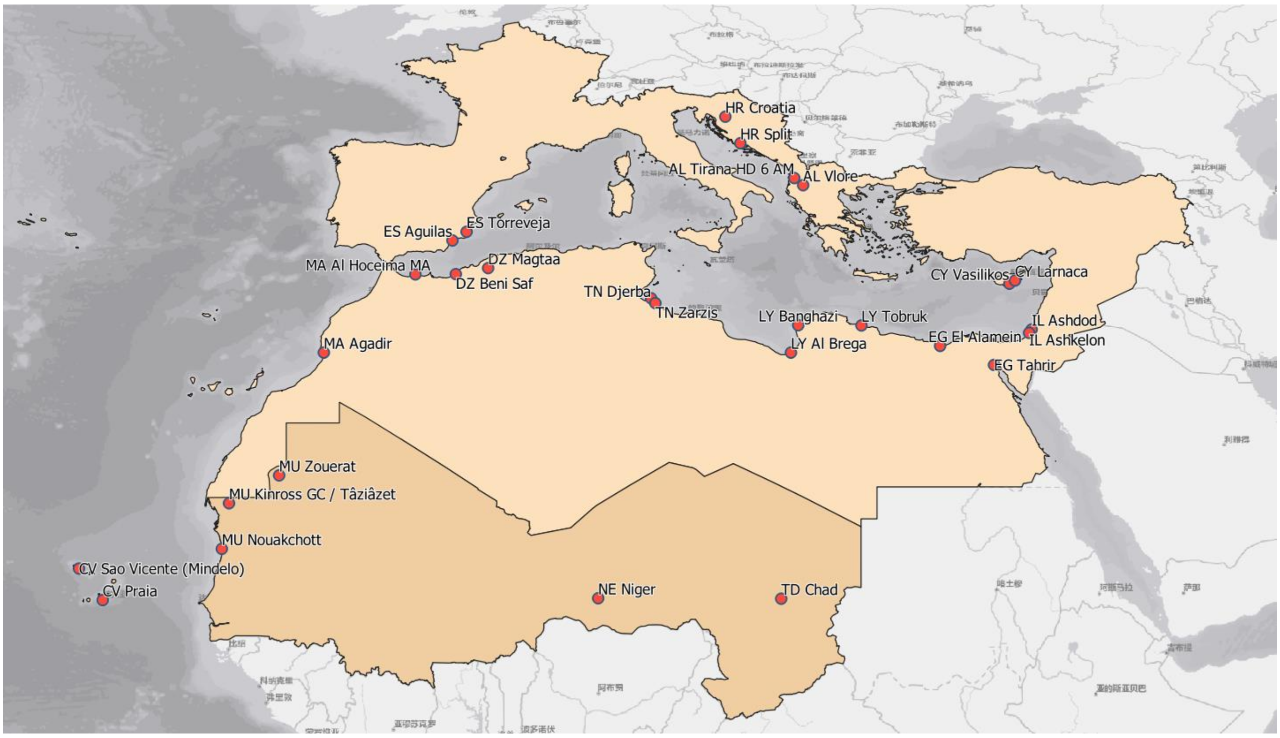
b. What are the measures taken during the project with regard to the impact on the energy grid which most of the time is not foreseen for such an energy demand at a point P?
c. Is the use of solar energy to dry the brines before their return to the sea or their reuse a viable solution?

DESALINATION PLANTS				
COUNTRY	Albania			
Site				
Geographical coordinates	41.328	40.880	40.880	20.373
Name of the plant	OSMO 12 AM		Vlore power plant	
Year of operation (commissioning)	2013		2008	
Type of technology	RO		RO	
Installed capacity (m3/day)	400		1272	
Type of resource	Brackish water or inland water		Seawater	
The company responsible for O&M/ Operator	Caramondani Group - Osmo Sistemi Srl		Maire Tecnimont	
Annual collection and production (m3)				
CAPEX (EUR)				
OPEX (EUR)				
EPC Cost (EUR)				
Water cost (EUR)				
Thermal design				
Type of RO membranes	Spiral Wound Membrane			
Electricity prices for OPEX (EUR/kWh)				
Energy consumption (kWh/m3)				

Utilization rate (%)		
Type of pretreatment		
Population served		
Type of receiving natural environment		
Treatment of permeates		
Salt concentration of the final discharge		
Type of power supply (specific or interconnected)		
Proportion of REs in the power supply		
Project type		
Client		
Components of the plant		
Funding		
Cumulative water production at the end of December 2020		

A4_2 Description sheets of desalination plants

Feedback from desalination plants



Desalination Plants						
COUNTRY	Algeria					
Site						
Geographical coordinates	35.691	0.642	35.317	-1.382		
Name of the plant	Magtaa		Beni Saf		Beni Saf	
Year of operation (commissioning)	2014		19 October 2010		19 October 2010	
Type of technology	RO		RO		RO	
Installed capacity (m3/day)	500000		200,000		200,000	
Type of resource	Seawater		seawater		seawater	
The company responsible for O&M/ Operator	Hyflux OMA		TEDADUA, UTE Desaladora Beni Saf O&M		TEDADUA, UTE Desaladora Beni Saf O&M	
Annual collection and production (m3)						
CAPEX (EUR)						
OPEX (EUR)	170,112,000 (OMR) 443.000.000 USD					
EPC Cost (EUR)	0.215 OMR		56,832,000 OMR		56,832,000 OMR	
Water cost (EUR)			240.000.000 USD		240.000.000 USD	
Thermal design	Spiral Wound Membrane - Toray Industries, Inc.		0.269 OMR		0.269 OMR	

Type of RO membranes			
Electricity prices for OPEX (EUR/kWh)	3.2 kWh/m3		
Energy consumption (kWh/m3)			
Utilization rate (%)	Ultrafiltration - Kristal UF membranes		
Type of pretreatment			
Population served			
Type of receiving natural environment			
Treatment of permeates			
Salt concentration of the final discharge	Turbo Charger		
Type of power supply (specific or interconnected)			
Proportion of REs in the power supply			
Project type	BOT 25 y		
Client	Contract of sale and purchase of water: TMM – SONATRACH – SIOR (jointly)	686.862.624 m3	686.862.624 m3
Components of the plant	25 modules of 21,000 m3/d unit production, 24 modules in production, and 1 on standby 288 units PX energy interchanges	Own funds 20% 48 MUSD Bank loan (BEA) 80% 192 MUSD	Own funds 20% 48 MUSD Bank loan (BEA) 80% 192 MUSD

Funding			
Cumulative water production at the end of December 2020			

DESALINATION PLANTS				
COUNTRY	Cape Verde Islands			
Site				
Geographical coordinates	14.913255°	23.500546°	16.886	-24.988
Name of the plant	Praia		Sao Vicente (Mindelo)	
Year of operation (commissioning)	2017		2017	
Type of technology	RO		RO	
Installed capacity (m3/day)	10000		5000	
Type of resource	Seawater		Seawater	
The company responsible for O&M/ Operator	UNIHA Wasser Technologie Gmbh		Acciona Agua / SADE-CGTH	
Annual collection and production (m3)				
CAPEX (EUR)				
OPEX (EUR)				
EPC Cost (EUR)			8,000,000 EUR	
Water cost (EUR)				
Thermal design				
Type of RO membranes				
Electricity prices for OPEX (EUR/kWh)				
Energy consumption (kWh/m3)				
Utilization rate (%)				

Type of pretreatment		
Population served		
Type of receiving natural environment		
Treatment of permeates		
Salt concentration of the final discharge		
Type of power supply (specific or interconnected)		
Proportion of REs in the power supply		
Project type		
Client		
Components of the plant		
Funding		
Cumulative water production at the end of December 2020		

DESALINATION PLANTS				
COUNTRY	Croatia			
Site				
Geographical coordinates	45.167	15.500	43.508	16.440
Name of the plant	Croatia		Split Osmo S HR 10 AM	
Year of operation (commissioning)	2000		2016	
Type of technology	RO		RO	
Installed capacity (m3/day)	432		120	
Type of resource	Brackish water or inland water		Seawater	
The company responsible for O&M/ Operator	ProMinent / ProMaqua GmbH		Caramondani Group / Osmo Sistemi Srl	
Annual collection and production (m3)				
CAPEX (EUR)				
OPEX (EUR)				
EPC Cost (EUR)				
Water cost (EUR)				
Thermal design				
Type of RO membranes				
Electricity prices for OPEX (EUR/kWh)				
Energy consumption (kWh/m3)				

Utilization rate (%)		
Type of pretreatment		
Population served		
Type of receiving natural environment		
Treatment of permeates		
Salt concentration of the final discharge		
Type of power supply (specific or interconnected)		
Proportion of REs in the power supply		
Project type		
Client		
Components of the plant		
Funding		
Cumulative water production at the end of December 2020		

DESALINATION PLANTS				
COUNTRY	Cyprus			
Site				
Geographical coordinates	32.739	34.778	33.631	34.869
Name of the plant	Vasilikos Power Plant		Larnaca	
Year of operation (commissioning)	2014		2001	
Type of technology	RO		RO	
Installed capacity (m3/day)	60000		54000	
Type of resource	Seawater		Seawater	
The company responsible for O&M/ Operator	Ministry of Agriculture, Natural Resources and Environment / Electricity Authority of Cyprus		Government of Cyprus / WDD	
Annual collection and production (m3)				
CAPEX (EUR)				
OPEX (EUR)				
EPC Cost (EUR)	46,000,000 EUR		45,000,000 USD	
Water cost (EUR)	0.86 USD		0.76 USD	
Thermal design				
Type of RO membranes			Spiral Wound Membrane	
Electricity prices for OPEX (EUR/kWh)				

Energy consumption (kWh/m3)		
Utilization rate (%)		
Type of pretreatment		Coagulation-Floculation, Dual Media Filtration, Microfiltration
Population served		
Type of receiving natural environment		
Treatment of permeates		
Salt concentration of the final discharge		
Type of power supply (specific or interconnected)		
Proportion of REs in the power supply		
Project type	EPC	BOOT 10 years
Client		
Components of the plant		
Funding		
Cumulative water production at the end of December 2020		

DESALINATION PLANTS				
COUNTRY	Egypt			
Site				
Geographical coordinates	30.822	28.954	31.265	32.302
Name of the plant	El Alamein		East Port Said	
Year of operation (commissioning)	2019		2019	
Type of technology	RO		RO	
Installed capacity (m3/day)	150,000		150,000	
Type of resource	Seawater		Seawater	
The company responsible for O&M/ Operator	National Organization for Potable Water & Sanitary Drainage		Armament Authority / Metito	
Annual collection and production (m3)				
CAPEX (EUR)				
OPEX (EUR)				
EPC Cost (EUR)	164,000,000 USD			
Water cost (EUR)				
Thermal design				
Type of RO membranes	Spiral Wound Membrane		Spiral Wound Membrane	
Electricity prices for OPEX (EUR/kWh)				
Energy consumption (kWh/m3)				

Utilization rate (%)		
Type of pretreatment	Multimedia filtration (MMF), Microfiltration	Dissolved Air Flotion (DAF), Ultrafiltration
Population served		
Type of receiving natural environment		
Treatment of permeates		Post treatment by calcite filters
Salt concentration of the final discharge		
Type of power supply (specific or interconnected)		
Proportion of REs in the power supply		
Project type	EPC 1	EPC
Client		
Components of the plant		
Funding		
Cumulative water production at the end of December 2020		

DESALINATION PLANTS				
COUNTRY	Spain			
Site				
Geographical coordinates	37.970	-0.710	37.420	-1.590
Name of the plant	Torrevieja		Águilas	
Year of operation (commissioning)	2014		2008	
Type of technology	RO		RO	
Installed capacity (m3/day)	240,000		210,000	
Type of resource	Seawater		Seawater	
The company responsible for O&M/ Operator	AcuaMed		AcuaMed	
Annual collection and production (m3)				
CAPEX (EUR)	341 M€		290 M€	
OPEX (EUR)				
EPC Cost (EUR)			0.5 €/m3	
Water cost (EUR)				
Thermal design				
Type of RO membranes				
Electricity prices for OPEX (EUR/kWh)				
Energy consumption (kWh/m3)				
Utilization rate (%)				

Type of pretreatment		
Population served		
Type of receiving natural environment		
Treatment of permeates		
Salt concentration of the final discharge		
Type of power supply (specific or interconnected)		
Proportion of REs in the power supply		
Project type	EPC	EPC
Client	Government of Spain	Government of Spain
Components of the plant		
Funding	20% UE Feder 40% State 40% BEI	20% UE Feder 40% State 40% BEI
Cumulative water production at the end of December 2020		

DESALINATION PLANTS				
COUNTRY	Israel			
Site				
Geographical coordinates	31°50'58.39"N	34°41'13.16"E	31.637	34.526
Name of the plant	Ashdod		Ashkelon	
Year of operation (commissioning)	2015		2005	
Type of technology	RO		RO	
Installed capacity (m3/day)	384,000		396,000	
Type of resource	Seawater		Seawater	
The company responsible for O&M/ Operator	Mekorot		Adam (JV: IDE 50% + VEOLIA 50%)	
Annual collection and production (m3)	100000			
CAPEX (EUR)			182 M€	
OPEX (EUR)			0.45 €/m3	
EPC Cost (EUR)	300 M€			
Water cost (EUR)			$ 0.53/m3	
Thermal design	No			
Type of RO membranes	Polyamide		Dow Chemical Company	
Electricity prices for OPEX (EUR/kWh)				
Energy consumption (kWh/m3)				
Utilization rate (%)	0.45			

Type of pretreatment	Ultrafiltration	
Population served		
Type of receiving natural environment	Sea	
Treatment of permeates	WWTP	
Salt concentration of the final discharge	58 gr/l	
Type of power supply (specific or interconnected)	Interconnected	
Proportion of REs in the power supply		
Project type	BOT	BOT 25 years
Client	State of Israel	
Components of the plant	Offshore works, Pumping Station, Onshore pipelines, Raw Water tank, Disk Filters, Ultrafiltration, Two stage RO, Remineralization, Product Water Tanks, delivery pipelines, WWTP	
Funding	BEI + Private entities + Government	
Cumulative water production at the end of December 2020		Production is intended to rise to 750 million m^3 by 2020

DESALINATION PLANTS				
COUNTRY	Libya			
Site				
Geographical coordinates	32.117	20.067	32.753	12.730
Name of the plant	Benghazi		Az-Zawiya	
Year of operation (commissioning)	2006		2011	
Type of technology	MED (Multi-effect Distillation)- TVC (Thermal Vapor Compression)		MED (Multi-effect Distillation) - TVC (Thermal Vapor Compression)	
Installed capacity (m3/day)	40,000		80,000	
Type of resource	Seawater (TDS 20000ppm - 50000ppm)		Seawater	
The company responsible for O&M/ Operator	General Electricity Company of Libya - Veolia Sidem (International Seawater Desalination Company)		General Electricity Company of Libya - Veolia Sidem (International Seawater Desalination Company)	
Annual collection and production (m3)				
CAPEX (EUR)				
OPEX (EUR)				
EPC Cost (EUR)	40,000,000 USD			
Water cost (EUR)				
Thermal design				
Type of RO membranes				

Electricity prices for OPEX (EUR/kWh)		
Energy consumption (kWh/m3)		
Utilization rate (%)		
Type of pretreatment		
Population served		
Type of receiving natural environment		
Treatment of permeates		
Salt concentration of the final discharge		
Type of power supply (specific or interconnected)		
Proportion of REs in the power supply		
Project type		
Client		
Components of the plant		
Funding		
Cumulative water production at the end of December 2020		

DESALINATION PLANTS		
COUNTRY	Morocco	
Site		Agadir
Geographical coordinates		
Name of the plant	Al Hoceima desalination plant	Agadir Desalination Plant
Year of operation (commissioning)	2018	2021
Type of technology	RO	RO. 45% recovery, Strainers (200 microns) - Ultrafiltration (INGE)/ RO/ Limestone filters & chlorination
Installed capacity (m3/day)	17,280	275,000
Type of resource	Seawater	Seawater
The company responsible for O&M/ Operator	National Office of Electricity and Drinking Water (ONEE)	Abengoa
Annual collection and production (m3)		
CAPEX (EUR)		
OPEX (EUR)		
EPC Cost (EUR)	24,500,000 USD	120.000.000 USD
Water cost (EUR)		
Thermal design		
Type of RO membranes		Toray Industries, Inc.
Electricity prices for OPEX (EUR/kWh)		

Energy consumption (kWh/m3)		
Utilization rate (%)		
Type of pretreatment		Ultrafiltration
Population served		
Type of receiving natural environment		
Treatment of permeates		
Salt concentration of the final discharge		
Type of power supply (specific or interconnected)		Installation of three high voltage power lines measuring over 55 km from the source station of Tiznit to the solar complex Noor Ouarzazate CSP
Proportion of REs in the power supply		
Project type		BOT 20 years
Client		
Components of the plant		
Funding		
Cumulative water production at the end of December 2020		

DESALINATION PLANTS				
COUNTRY	Mauritania			
Site	Nouakchott		Zouerat	
Geographical coordinates	18.119	-16.041	22.719	-12.452

Name of the plant	Nouakchott	Zouerat WTP
Year of operation (commissioning)	1968	2013
Type of technology	MSF (Multi-stage Flash)	RO
Installed capacity (m3/day)	3,000	2,000
Type of resource	Seawater	Brackish water or inland water
The company responsible for O&M/ Operator	Veolia Sidem (International Seawater Desalination Company)	Wetico
Annual collection and production (m3)		
CAPEX (EUR)		
OPEX (EUR)		
EPC Cost (EUR)	7,300,000 USD	
Water cost (EUR)		
Thermal design		
Type of RO membranes		Spiral Wound Membrane
Electricity prices for OPEX (EUR/kWh)		
Energy consumption (kWh/m3)		
Utilization rate (%)		
Type of pretreatment		
Population served		

Type of receiving natural environment		
Treatment of permeates		
Salt concentration of the final discharge		
Type of power supply (specific or interconnected)		
Proportion of REs in the power supply		
Project type		
Client		
Components of the plant		
Funding		
Cumulative water production at the end of December 2020		

DESALINATION PLANTS				
COUNTRY	Niger		Chad	
Site	Niger		Chad	
Geographical coordinates			15.000	19.000
Name of the plant	Niger		Chad	
Year of operation (commissioning)	2016		2009	
Type of technology	RO		RO	
Installed capacity (m3/day)	190		400	
Type of resource	Brackish water or inland water		Brackish water or inland water	
The company responsible for O&M/ Operator			Suez	
Annual collection and production (m3)				
CAPEX (EUR)				
OPEX (EUR)				
EPC Cost (EUR)				
Water cost (EUR)				
Thermal design				
Type of RO membranes				
Electricity prices for OPEX (EUR/kWh)				

Energy consumption (kWh/m3)		
Utilization rate (%)		
Type of pretreatment		
Population served		
Type of receiving natural environment		
Treatment of permeates		
Salt concentration of the final discharge		
Type of power supply (specific or interconnected)		
Proportion of REs in the power supply		
Project type		EPC
Client		
Components of the plant		
Funding		
Cumulative water production at the end of December 2020		

DESALINATION PLANTS				
COUNTRY	Tunisia			
Site	Djerba		Zarzis	
Geographical coordinates			33.500	11.117
Name of the plant	Djerba		Zarzis	
Year of operation (commissioning)	2018		January 2000	
Type of technology	RO		RO	
Installed capacity (m3/day)	50000 expandable to 75000		15,000	
Type of resource	Seawater		Brackish water or inland water	
The company responsible for O&M/ Operator	National Water Exploitation and Distribution Company (SONEDE)		National Water Exploitation and Distribution Company (SONEDE) - Cadagua	
Annual collection and production (m3)	FCC Aqualia / GS Inima Env / TYPSA		5000000	
CAPEX (EUR)	0.5		0.1	
OPEX (EUR)	0.4		0.15	
EPC Cost (EUR)	69.4 M€		10,990,000 USD + 510,000 USD	
Water cost (EUR)	0.9		0.25	
Thermal design	no		no	
Type of RO membranes	Spiral Wound Membrane Filmtec		Spiral Wound Membrane	

Electricity prices for OPEX (EUR/kWh)	0.1	0.1
Energy consumption (kWh/m3)	2.8	1.3
Utilization rate (%)	0.75	75
Type of pretreatment	Dual Media Filtration, Microfiltration	Classique (Open sand filters)
Population served	160000	100000
Type of receiving natural environment	Sea	Sea
Treatment of permeates	CO2, lime and Bleach	Soda and Bleach
Salt concentration of the final discharge	72 g/l	24 g/l
Type of power supply (specific or interconnected)	Interconnected (STEG network)	Interconnected
Proportion of REs in the power supply	No	No
Project type		
Client		
Components of the plant		
Funding		
Cumulative water production at the end of December 2020		

The following fact sheets are just a few examples of the many projects described in HotspotReuse®.

Spain

6.1 In which country is the site located?	SPAIN	SPAIN
6.2 Name of the site	Cartagena	Roldan
6.3 Geographical coordinates of the site	37°47'48'88' 'N,0°57'33.63' '0	37.79781859660192, - 0.9595971693070714
6.4 Which year was the site commissioned and operated?	2011	2011
6.5 Name of the organization in charge of the operation and maintenance of the site	ESAMUR	ESAMUR + CSIC
6.6 For which treatment level was the plant designed?	tertiary	Included tertiary
6.7 What are the treatment systems?	Conventional active sludge + UV	UV and Ozon
6.8 What is the source of waste waters treated processed by the plant?	Household and Golf course	Local villages and cities
6.9 What is the processing capacity of the plant (m3/day)	3000 m3/day	Do not know
6.10 Is the ideal total volume of wastewater being processed for reuse?	Yes	Yes
6.11 What is the volume of reused processed wastewater?	1500-2000 m3/day	Do not know
6.12 Are processed wastewaters stored before their reuse?	Yes	Yes

6.13 What are the target types of utilization are wastewaters designed for?	agriculture	Farmers and irrigation
6.14 What are the estimated energy needs of the plant?	0,5 Kw h / m3	Do not know
6.15. Based in this consumption, what is the approximate proportion of renewable energies?	0	Do not know

Italy

6.1 In which country is the site located?	ITALY
6.2 Name of the site	Avquaviva delle Fonti
6.3 Geographical coordinates of the site	40.926704, 16.846725
6.4 Which year was the site commissioned and operated?	2006
6.5 Name of the organization in charge of the operation and maintenance of the site	ACQUEDOTTO PUGLIESE
6.6 For which treatment level was the plant designed?	Tertiary treatment
6.7 What are the treatment systems?	Pretreatment – primary – secondary – tertiary
6.8 What is the source of waste waters treated processed by the plant?	Municipal water
6.9 What is the processing capacity of the plant (m3/day)	
6.10 Is the ideal total volume of wastewater being processed for reuse?	No
6.11 What is the volume of reused processed wastewater?	150 m3/day
6.12 Are processed wastewaters stored before their reuse?	Yes
6.13 What are the target types of utilization are wastewaters designed for?	Crop irrigation

6.14 What are the estimated energy needs of the plant?	33 kW
6.15. Based in this consumption, what is the approximate proportion of renewable energies?	It depends on electricity grid no site technologies for renewable energy generation

6.1 In which country is the site located?	ITALY
6.2 Name of the site	Milano Nosedo and Milano San Rocco
6.3 Geographical coordinates of the site	45°25"29.7'N 9°13"19.6'E (Nosedo), 45°23"35'.7'N 9°11"04.1'E (San Rocco)
6.4 Which year was the site commissioned and operated?	2003-2004
6.5 Name of the organization in charge of the operation and maintenance of the site	MM SpA (current)
6.6 For which treatment level was the plant designed?	Biological secondary, tertiary (sand filtration) and advanced disinfection
6.7 What are the treatment systems?	Screening (coarse and fine), grit and oil removal, biological oxidation-nitrification and denitrification, secondary setting, tertiary and filtration, disinfection
6.8 What is the source of waste waters treated processed by the plant?	Urban wastewater
6.9 What is the processing capacity of the plant (m3/day)	5 m3/sec. Nosedo (average dry weather), 4 m3/sec. San Rocco (average dry weather)
6.10 Is the ideal total volume of wastewater being processed for reuse?	No
6.11 What is the volume of reused processed wastewater?	51.704.190 m3 tot year 2020) at Nosedo WWTP, 29090.410 (tot year 2020) at San Rocco WWTP
6.12 Are processed wastewaters stored before their reuse?	No

6.13 What are the target types of utilization are wastewaters designed for?	Agricultural
6.14 What are the estimated energy needs of the plant?	
6.15. Based in this consumption, what is the approximate proportion of renewable energies?	

Malta

6.1 In which country is the site located?	MALTA
6.2 Name of the site	New Water - Malta
6.3 Geographical coordinates of the site	Project includes two sites in Malta and one in Gozo
6.4 Which year was the site commissioned and operated?	2017
6.5 Name of the organization in charge of the operation and maintenance of the site	Water services corporation
6.6 For which treatment level was the plant designed?	Tertiary (highly) polished tertiary effluent
6.7 What are the treatment systems?	Treatment – polishing - disinfection
6.8 What is the source of waste waters treated processed by the plant?	Urban
6.9 What is the processing capacity of the plant (m3/day)	To reach maximum (potential) of 19,000 m3/day
6.10 Is the ideal total volume of wastewater being processed for reuse?	Yes
6.11 What is the volume of reused processed wastewater?	Actual production depends on demand (and is currently limited by distribution capacity)
6.12 Are processed wastewaters stored before their reuse?	Yes
6.13 What are the target types of utilization are wastewaters designed for?	Crop irrigation
6.14 What are the estimated energy needs of the plant?	1.5 kWH/m^3
6.15. Based in this consumption, what is the approximate proportion of renewable energies?	10% (through grid)

Morocco

6.1 In which country is the site located?	MOROCCO	MOROCCO
6.2 Name of the site	Golf Courses in Marrakech	Tiznit
6.3 Geographical coordinates of the site		29.730093, -9.731075
6.4 Which year was the site commissioned and operated?	2010	2011, date when hydro-agricultural developments were achieved
6.5 Name of the organization in charge of the operation and maintenance of the site	La RADEMA, Marrakech water distribution company	ONEE
6.6 For which treatment level was the plant designed?	tertiary	tertiary
6.7 What are the treatment systems?	Tertiary processing with disinfection	Lagooning – filtration – UV disinfection
6.8 What is the source of waste waters treated processed by the plant?	Household wastewater	Wastewater from the city of Tiznit
6.9 What is the processing capacity of the plant (m3/day)		About 5000 m^3/day
6.10 Is the ideal total volume of wastewater being processed for reuse?	Yes	Yes
6.11 What is the volume of reused processed wastewater?		3000
6.12 Are processed wastewaters stored before their reuse?		Yes
6.13 What are the target types of utilization are wastewaters designed for?		Agriculture
6.14 What are the estimated energy needs of the plant?		

6.15. Based in this consumption, what is the approximate proportion of renewable energies?		

6.1 In which country is the site located?	MOROCCO	MOROCCO
6.2 Name of the site	Watering golf courses and parks in Marrakech (and also in Rabat, Tangiers, Agadir …)	STEP Marrakech and reuse in Golf courses
6.3 Geographical coordinates of the site		
6.4 Which year was the site commissioned and operated?		2011
6.5 Name of the organization in charge of the operation and maintenance of the site	Private companies	RADEEMA
6.6 For which treatment level was the plant designed?	Tertiary processing with disinfection and filtration	tertiary
6.7 What are the treatment systems?		Primary tertiary + activated sludge + UV
6.8 What is the source of waste waters treated processed by the plant?	Mainly household	The city of Marrakech
6.9 What is the processing capacity of the plant (m3/day)		6000
6.10 Is the ideal total volume of wastewater being processed for reuse?		No
6.11 What is the volume of reused processed wastewater?	Please ask Mr. Javier (IWMI) to provide you with the draft sheets that I designed for the sites of Marrakech and Tangiers (j.mateo-sagasta@cgiar.com) I am no	

	allowed to provide these data	2000
6.12 Are processed wastewaters stored before their reuse?	Yes	Yes
6.13 What are the target types of utilization are wastewaters designed for?		Watering Golf courses
6.14 What are the estimated energy needs of the plant?		
6.15. Based in this consumption, what is the approximate proportion of renewable energies?		0

Palestine

6.1 In which country is the site located?	PALESTINE	PALESTINE
6.2 Name of the site	Reuse of TWW in Nablus	Jinen, Miilya, Jericho and Nabuls
6.3 Geographical coordinates of the site	Nablus	Jinin WWTP, Misilya WWTP and Nablus WWTP
6.4 Which year was the site commissioned and operated?	2017	After 2020
6.5 Name of the organization in charge of the operation and maintenance of the site	Nablus municipality	Municipalities at each site
6.6 For which treatment level was the plant designed?	Tertiary treatment	Secondary treatment
6.7 What are the treatment systems?	Screening/activated sludge/sand filter/chlorination/UV	Grit removal and then activated sludge, and wet land, most of the treatment plants have no disinfection since most of the water discharged direct to wadis
6.8 What is the source of waste waters treated processed by the plant?	Municipal	Domestic water
6.9 What is the processing capacity of the plant (m3/day)	14000	There are may ranges from 500-25000 m^3/day
6.10 Is the ideal total volume of wastewater being processed for reuse?	No	No
6.11 What is the volume of reused processed wastewater?	200	Around 15000 m^3/day
6.12 Are processed wastewaters stored before their reuse?	No	No

6.13 What are the target types of utilization are wastewaters designed for?	Irrigation of fruit crop & olive	Trees and grass for fodder
6.14 What are the estimated energy needs of the plant?	220000 kW/month	Differ according to WWTP
6.15. Based in this consumption, what is the approximate proportion of renewable energies?	55%	Can be highlighted for studies since four WWTP have renewable energy

Tunisia

6.1 In which country is the site located?	TUNISIA	TUNISIA
6.2 Name of the site	Mahdia / Sousse	Zaouiet Sousse
6.3 Geographical coordinates of the site		
6.4 Which year was the site commissioned and operated?	Projects are implemented yearly but we talk about small projects (20-30 ha)	
6.5 Name of the organization in charge of the operation and maintenance of the site	Water users associations	CRDA Sousse
6.6 For which treatment level was the plant designed?	Secondary treatment and tertiary sometimes	Secondary treatment
6.7 What are the treatment systems?	Pretreatment, secondary treatment, disinfection sometimes when tertiary treatment	Extended aeration, average charge
6.8 What is the source of waste waters treated processed by the plant?	Household water	Mainly household
6.9 What is the processing capacity of the plant (m3/day)	Varies	About 5000 m^3/day
6.10 Is the ideal total volume of wastewater being processed for reuse?	No	No

6.11 What is the volume of reused processed wastewater?	About 50 million m3/year	
6.12 Are processed wastewaters stored before their reuse?	No	Yes
6.13 What are the target types of utilization are wastewaters designed for?	Agriculture	Arboriculture and fodder
6.14 What are the estimated energy needs of the plant?		
6.15. Based in this consumption, what is the approximate proportion of renewable energies?		0

A4_4 Details of the information needed for the comparative analyses of facilities

The level of detailed information desired to describe and compare desalination or REUT plants is as follows:

- For water:
  - Country
  - Geographical coordinates
  - Name of the plant or site
  - Owner
  - Operator/company responsible for O&M
  - Year of Commissioning/Operation
  - Input water: for desalination, type of resource or for REUT, wastewater quality (standard, regulation, ...),
  - Type of technology
  - Uses of treated water (drinking water supply, irrigation, industry, ...)
  - Installed capacity (m^3/day)
  - Annual production (m^3)
- For energy:
  - Type of power supply (specific or interconnected)
  - Proportion of REs in this supply
  - Installed power kVA
  - Energy consumption (kWh/m3)

For countries that wish to share more information, the description may, on a voluntary and non-mandatory basis, go so far as to include the following additional data:

- Details on pretreatment, RO membranes, thermal design and permeate treatment (desalination only)
- Utilization rate (%)
- Population served by drinking water (desalination only)
- CAPEX (equivalent €)
- Funding plan
- OPEX (equivalent €)
- Cost of produced water (cost price, sales tariff)
- Electricity prices for the OPEX (€/kWh)
- Type of the receiving natural environment and salt concentration of the final discharge (desalination only).

We note that a future commissioning date will characterize projects envisaged at the planning stage or even during the feasibility study and mentioned with the name, location and planned capacity.

A4_5 Tool to estimate the standard cost of desalination

One of the products that could be developed by the Observatory and which would be of great added value for the Mediterranean and Sahel desalination community is a tool to calculate the standard cost per m3 of desalinated water (TWC). This cost could integrate the environmental and social cost, not just the economic cost. The Observatory should show leadership on this topic and would achieve cross-sectoral and global impact from it.

The GWI through Desaldata offers a simulator to calculate the TWC (CAPEX and OPEX) but it is not the only tool used by the desalination community. MEDRC has started work in this direction by organizing several workshops attended by renowned experts in 2017 and 2018. This did not go so far as to develop the standard, but nevertheless provided the following very interesting recommendations :

The main objective would be to develop a desalination cost standardization process to reliably compare costs from all over the world and especially from the pilot region. Establishing an international standard for the costs of desalination plants is necessary to allow the comparative analysis of these costs, which is essential for decision-makers (governments, ministries) and also for operators (international and national companies in charge of building and/or operating desalination plants). This information will also lead to better investments in research and better prioritization of investments. Such a standard would also help companies to offer cost-effective solutions and competitive offers, thus contributing to the development of sustainable desalination technologies and reducing their costs.

It is important that the actual costs are reported by experts who have built factories, in order to improve future decision-making. The present cost of water is an important measure rather than judging a project solely on capital expenditures (CAPEX) or operating expenditures (OPEX).

It will be necessary to examine the averages and deviations to identify, with appropriate numerical tools, the important components of the cost. This would bring less uncertainty, a better understanding of how to reduce costs, as well as the identification of research topics and areas for improvement.

The cost must include social and environmental constraints or components. For this reason, costs can differ according to the site, as for example in situations where there is no other source of fresh water and desalination is the only solution. This global analysis will determine the costs and benefits from a triple point of view: social, environmental and financial[16].

Total water costs (TWC) specific to each facility (i.e. based on temperature, age and plant life, discount rate and electricity rates) or concerning a reference facility, broken down by unit operations and including CAPEX investment and OPEX operation, could be used to define research and regulatory priorities, to improve procurement and to help designers achieve the best economic performance. Depending on the complexity of the actual plants, costs depend on pretreatment, reverse osmosis

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[16] This is the case of the Carlsbad project in Australia which evaluated benefits for local GDP, for farmers, for groundwater improvement, etc.

(RO) and post-treatment, but also on external works such as water intake, pumping, auxiliary works and outlet; they also depend on subsidies and the utilization rate of the plants.

Several plants could be used as a reference for small, medium and large-sized sets and for different types of feedwater. This will help to develop a realistic CAPEX for different regions, and the OPEX arising from CAPEX. The case of brackish water desalination could be added later.

A model is needed so that decision-makers feel comfortable making their investment decision. The model should calculate the cost at +/- 20% and include a cost/benefit analysis according to three calculations: economic, social and environmental. This should lead to better decisions, transparency and competitiveness. It will also lead to continuous improvement, cost reduction and policy decisions.

For buyers of desalinated water, the final cost and the process to arrive at the tariff are important.

References for desalination operations are important and necessary to make improvements to an existing project. They can be specific to a region, such as water quality, temperature, etc. Objective benchmarks would facilitate the bidding and negotiation processes.

The information is important to understand the reason for cost differences and to improve the bidding process. The information may include standard or model plants with a set of lessons learned and information on how to qualify bidders. Communication could be improved between members of the desalination community with common interests, for example from government to government on how to qualify bidders and who to contact to gather specific information. For communities that can only build one plant, it's important to quickly determine if a project has a chance to move forward. The tool could provide in a simplified way a reasonable cost for a plant in a given location, which is accurate to +/- 30%.

A4_6 Table of observatories containing information on the REUT

The following table shows the few observatories containing information on REUT:

Name/Accronyme	BDD	Indicateurs	Panorama	Carto dynamique	Rapports	Ressources/biblio	Reglementation	Contacts/Acteurs	Membership	Théatique eau	Thématique REUSE	Actualités	Country	Website
Observatoire National des services d'eau et assainissement (SISPEA)	x	x	x		x	x	x			x		x	FRANCE	https://www.services.eaufrance.fr/
Observatoire de l'eau du Sahel (OSS)	?				x	x			x	x		x	TUNISIA	http://www.oss-online.org/fr
Observatoire mondial de l'eau										x			FRANCE	https://observatoire-me.com/
Hotspot REUSE	x			x							x			Incomplet - En création
Observatoire Climat-Energie - France	x	x											FRANCE	https://www.observatoire-climat-energie.fr/
AQUASTAT - FAO	x	x	x	x	x	x		x		x				https://www.fao.org/aquastat/fr/
Sustainbale Sanitation Alliance	x				x	x		x	x	x	x	x		https://www.susana.org/en/

Even more surprising is the fact that highly developed information systems on wastewater sanitation do not include information on the reuse of treated wastewater; this is the case of that of the European Environment Agency concerning compliance with the European urban waste water directive – and its extension to the EU's neighborhood countries via the SEIS project - or that of the UNEP MAP concerning the protocol for the reduction of land-based pollution.

A4_7 Interview sheets from the field of desalination

a) IME – AFD Interview (Frédéric Maurel)

AFD actually finances studies on desalination in 4 or 5 countries (Egypt and Maghreb), which have been entrusted to the OSS.

AFD is funding another study particularly focusing on the management of brine discharges to control their impact, entrusted to Plan bleu.

AFD is very interested in the Observatory insofar as its desalination policy has three requirements aligned with concerns of CME in its terms of reference and that of IME expressed in its June webinar on desalination. These requirements are difficult to bring together in practice, and exchanges about them between countries or experts could lead stakeholders to take ownership. Confirmation of this interest should be requested officially from AFD but rather towards the end of the feasibility study when contacts with countries have advanced the definition of the possible content of this Observatory.

The requirements in question are as follows for desalination, bearing in mind that the REUT policy is much more flexible:

- Desalination has its place only as a last resort, i.e. provided that the needs prove to be greater than renewable resources but also once all conventional water saving measures have been implemented (in particular reduced loss rates to a minimum, competent operators or adapted pricing). These conditions are rarely met and little accepted by the project owners.
- Desalination projects must be supplied with renewable energy either on site or on energy production programs specific to the territories concerned, with the constraint that the energy need is not continuous. Paradoxically, this requirement is better understood by project leaders.
- Brine discharges and their impact on the environment must be controlled on the basis of serious preliminary studies and monitoring protocols that make it possible to involve a whole multi-stakeholder sector (including tourism players) in investments and improved modes of operation.

b) The following table specifies the other organizations and people contacted as well as their mission, and concludes (in gray) with the possible collaborations with the Observatory of NCWR and associated REs.

Initiative	Mission	Contact
IDA (Global) International Desalination Association	IDA is the leading source of information and professional development for the global desalination industry, and the only global association focused exclusively on desalination and water reuse technologies. With 4000 members from 60 countries, IDA is the largest professional network bringing together the desalination community	Mr. Carlos Cosin Chairman Carlos.Cosin@almarwater.com Mrs. Shannon McCarthy Secretary-General smccarthy@idadesal.org
The experts contacted IDA again. This was already done in the United Arab Emirates when the Mediterranean Desalination Observatory (EMI) was proposed and the idea was very well received by its then president. Now the experts have contacted the new President and the Secretary General to announce the CME/IME initiative and their interest as well as their willingness to collaborate have been ratified.		
AEDYR (Spain) Spanish desalination and reuse association	AEDYR, associated with IDA since 1997, in collaboration with the European Desalination Society and the American Desalination Association to promote the proper use of desalination and water reuse, contributing to the sustainable management of water resources. AEDYR brings together different companies and groups operating in this sector in Spain.	Mr. Domingo Zarzo, Chairman dzarzo@sacyr.com
IME experts have contacted AEDYR again. This was already done when the Mediterranean Desalination Observatory (IME) was proposed, promoted jointly with the reuse Observatory (Murcia), welcoming the initiative with interest. Now the experts have contacted the new president to announce the CME/IME initiative and their interest and willingness to collaborate have been ratified.		

GWI (Global) Global Water Intelligence	The GWI (Global Water Intelligence) through a magazine and a web portal *www.desaldata.com* manages a project tracking system, more than 1,000 live worldwide and updated daily alerts to provide its clients with information on water, wastewater, desalination and reuse projects, from design to financial set-ups. It also provides a simulation tool to calculate OPEX, CAPEX and per m3 costs of desalination projects, as well as a summary of all companies, desalination operators, and reuse in the world.	Mr. Christopher Gasson Board Member cg@globalwaterintel.com Mr. Naftali Rumpaisum Head of New Business nrumpaisum@globalwaterintel.com
The experts have been clients of GWI and have managed its databases, including DESALDATA, whose content and potential we know. We have also contacted the GWI Board of Directors and explored a potential collaboration. GWI wants to be an observatory, but with very different objectives and contents, focusing on its business aspect. It is of course understood that the observatory promoted by CME/IME is compatible, provided that interests are clearly defined and demarcated. DESALDATA data is not essential for CME/IME, although it is useful. A large part of the data of interest, such as water costs for the user, the context of the country promoting water resources or the effects on the environment are not treated intensively in DESALDATA and must be obtained from other sources. A well-defined agreement with GWI is considered highly possible.		

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<tr>
<td>The World Bank</td>
<td>The World Bank is currently carrying out a study entitled "Institutional frameworks and regulations for Desalination and wastewater reuse: review of practices in the Middle East and North Africa (MENA) region and beyond". The main objective of the study is to inform the design and implementation of client initiatives and World Bank operations by developing the existing body of knowledge on the economics, governance and management of desalination and wastewater reuse. The study encompasses the following activities:

(i) Comparative critical analysis of the policy and regulatory framework for desalination and reuse in MENA countries, comparing them with countries in other regions where desalination and wastewater reuse represent an important part of the water mix;

(ii) Case studies of institutional structures in place for sector-wide desalination and reuse integration, and management models used to serve the poor and communities with non-conventional water resources in arid areas where no other water source may be available; and

(iii) Guidelines for the economic and financial evaluation of desalination and reuse initiatives and for the selection of the appropriate delivery model for desalination and reuse of infrastructure projects.</td>
<td>Mr. Andras Kis

Team leader (not confirmed yet but has already submitted a proposal)
andras.kis@rekk.hu</td>
</tr>
<tr>
<td colspan="3">This project could complement the services that may be offered by the observatory. Collaboration with the World Bank would be very useful.</td>
</tr>
<tr>
<td>IWMI

International Water Management Institute</td>
<td>IWMI published a study in 2021 entitled: "Mapping water reuse policy and institutional development in the MENA region: Case studies in Egypt, Jordan, Lebanon, Tunisia and Saudi Arabia"</td>
<td>Mr. Javier Mateo-Sagasta

Senior Researcher & Coordinator-Water Quality,

Project Leader-ReWaterMENA

j.mateo-sagasta@cgiar.org</td>
</tr>
<tr>
<td colspan="3">IWMI could be an interesting actor through their office in Cairo for the observatory.</td>
</tr>
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<tr><td>Plan Bleu, France</td><td>With the support of the French Development Agency, Plan Bleu is launching a consultation process to support the definition of environmental, health, economic and technical eligibility criteria to help in the financing decision of sustainable desalination projects, by collecting technical information, thoughts, data, shared experiences, good practices and highlighting failures and what to avoid, to make desalination a sustainable management option.

In order to support investors' demands for more transparency, consistency and frameworks in impact assessments, Plan Bleu has prepared the ground for comprehensive sustainability standards, guarantees and criteria to evaluate the financing of desalination projects and programs, thus supporting the development of more integrated policy and regulatory landscapes.

Focusing on climate, biodiversity, education, sustainable development, health and governance, Plan Bleu is exploring conditions under which desalination can contribute to the global commitment to achieve the SDGs, through this consultative process.</td><td>Mrs. Céline DUBREUIL

Program Manager at Plan Bleu</td></tr>
<tr><td colspan="3">Plan Bleu could be an important player for the observatory</td></tr>
<tr><td>IEA (Morocco)

Institute of Water and Sanitation</td><td>Water and sanitation research institute, with a strong focus on desalination and reuse in Morocco and internationally. It provides training for staff from countries, especially African ones.</td><td>Mr. Mokhtar Jaait, Head of the R&D Department

mjaait@iea.ma ; jaait.mokhtar@gmail.com</td></tr>
<tr><td colspan="3">The International Institute of Water and Sanitation (IEA) of Morocco was created by ONEE in 2008 with the aim of improving the training plan carried out by the Training Center (CFTE) relying on an experience of more than 30 years. IEA is also in charge of activities related to applied research. The integration of training and research activities constitutes a qualitative evolution of the human resources development model and the general training of the institution.

IEA could contribute to the observatory, in particular with regard to Morocco and the Sahel countries.</td></tr>
</table>

RCREEE (The Regional Center for Renewable Energies and Energy Efficiency)	RCREEE is an intergovernmental organization with diplomatic status that aims to enable and increase the adoption of renewable energy and energy efficiency practices in pan-Arab countries. RCREEE is the official technical institution of the League of Arab States - Department of Energy and the Arab Ministerial Council for Electricity (AMCE). RCREEE partners with governments, international organizations, IFIs and the private sector through several forms of partnerships to initiate and lead clean energy dialogues, strategies and technologies, manage the facilitation of renewable energy investment platforms and capacity development in order to increase Arab states' share of tomorrow's modern energy solutions. Currently with 17 Arab countries among its members, RCREEE strives to carry out renewable energy and energy efficiency initiatives and expertise in all Arab states based on its strategic plan approved by its board of directors. The RCREEE secretariat has several multidisciplinary teams in the subsectors of sustainable energy, climate action, desalination, the water-energy-food nexus, green hydrogen with multicultural teams including Arab and international professionals.	Mr. Jauad El Kharraz Executive Director jauad.elkharraz@rcreee.org
RCREEE is ready to play a role vis-à-vis the observatory, and considers that this is a commendable initiative and should be supported. RCREEE plays an important role in collecting data on renewable energy and energy efficiency, and publishes the Arab Future Energy Index (AFEX) every year: https://taqaway.net, as well as a Tool for monitoring nationally determined contributions (NDCs). RCREEE could collaborate with the observatory to cover the energy data and forecasts part (consumption, cost, etc.) of the desalination and reuse sector.		

IEA (International Energy Agency)	IEA offers energy policy advice to its member countries striving to ensure a clean and reliable environment and affordable energy supply for their citizens. With a staff of about 300 people, mainly energy experts and statisticians from its member countries, IEA carries out an extensive program of energy research, data compilation, as well as publications and dissemination of the latest energy policy analyses and recommendations on good practices, supported by sound data. IEA examines the full spectrum of energy issues, including oil, gas and coal supply and demand, renewable energy technologies, electricity markets, energy efficiency, energy access, demand management and much more. Through its work, IEA advocates for policies that improve the reliability, affordability and sustainability of energy in its member countries and beyond. The IEA's Energy Data Center (EDC) processes a large amount of quantitative information for its own analyses and also to provide global energy information to governments and other external users. It collects data on a number of energy topics, such as oil, gas, coal, renewable energy, electricity, energy efficiency, energy prices and energy technology R&D budgets through questionnaires, submitted by the national authorities of member countries and beyond, as well as through research using official national sources and secondary sources. Based on the data collected, it produces analytical results, such as energy balances and estimates of CO_2 emissions from fuel combustion at the global level. In particular, as of September 2021, the IEA EDC maintains and updates detailed energy time series for 38 OECD members and almost 120 non-member countries from 1971. Further information on the sources, methodologies and results of the IEA energy statistics can be found at: *https://www.iea.org/areas-of-work/data-and-statistics*. IEA does not have confidence in the currently reported data regarding the demand for desalination energy and have identified several risks, such as the possibility of a significant underestimation of demand and the possibility of misclassification (i.e. reported but not labeled as desalination in services). The way these risks are handled today is leading to a data adjustment undertaken by the World Energy Outlook (WEO), the modeling team, which leads to subsequent misalignments between the WEO and EDC. IEA also lacks up-to-date data on desalination projects, technologies and fuels, which means that IEA	Mrs. Céline Rouquette - Head of Section Non-member countries Celine.ROUQUETTE@iea.org

<table>
<tr><td></td><td>analysts and modelers do not have an up-to-date picture of technological transitions and the potential for emission reductions due to desalination.</td><td></td></tr>
<tr><td colspan="3">The International Energy Agency (IEA) has just published a market consultation for help on energy data related to desalination. IEA would therefore be an important partner for the observatory, especially with regard to data regarding desalination energy.</td></tr>
<tr><td>SEMIDE (Euro-Mediterranean Information System on know-how in the Field of Water)</td><td>SEMIDE is an initiative of the Euro-Mediterranean Partnership. It provides a strategic tool for the exchange of information and know-how in the field of water between and within countries of the Euro-Mediterranean Partnership.

Access to the information offered by SEMIDE is open to all persons interested in issues related to water management. A series of actions have been carried out by SEMIDE to help Mediterranean Partner Countries organize their water data to facilitate access and derive the knowledge necessary for good management.</td><td>Mr. Eric Mino

Director of the Technical Unit and Coordinator

e.mino@semide.org</td></tr>
<tr><td colspan="3">SEMIDE is ready to contribute to the observatory if an agreement or a framework could be defined. As part of the Mediterranean Water Knowledge Platform they have no data. It is the countries that manage their data. In addition, there is no follow-up with databases in the countries, at best status reports. SEMIDE (subject to the agreement of the countries) could provide a web application for this observatory, similar to what is being done at European level for urban wastewater (see https://uwwtd.eu/). It could initially feed it with a commercial database, and then ensure updates with the countries. The advantage of the SIIF (Structured Implementation and Information Framework) platform used for the Urban Wastewater directive in Europe is the fact that it is based on national nodes. There could be a combination of PPPs and desalination plants. That said, SEMIDE should still estimate the cost of service.</td></tr>
</table>

FAO/AQUASTAT	The Food and Agriculture Organization of the United Nations (FAO) is a United Nations agency that leads international efforts to overcome hunger. Serving developed and developing countries, FAO acts as a neutral forum where all nations meet on an equal footing to negotiate agreements and debate policies. FAO is also a source of knowledge and information and helps developing countries and others in transition to modernize and improve agricultural, forestry and fisheries practices, ensuring good nutrition and food security for all. The FAO AQUASTAT portal provides users with access to the main database of country statistics, focusing on water resources, water uses and agricultural water management. At the same time, other information on water in the form of complementary databases, such as irrigated crop calendars, the sub-national database on irrigation areas, the detailed database on dams and reservoirs and the database of institutions related to water and agriculture are available.	Mr. Mohamed Al-Hamdi Senior land and water officer and responsible for the delivery of the Water Scarcity Initiative FAO Regional Office for the Near East and North Africa Cairo mohamed.alhamdi@fao.org Mr. Faycel CHEININI Project Coordinator, Tunisia *Faycel.Chenini@fao.org*

The experts presented the observatory's ideas in an FAO webinar attended by representatives of other organizations and associations, receiving widespread support for the idea and the commitment of the regional FAO to collaborate. Particular interest was expressed with regard to the role of desalination in agriculture with seawater or brackish water and also calling for the sharing of experiences. On the other hand, the FAO regional office in Cairo has been in contact with our IME experts, about their work program in collaboration with UN-ESCWA, League of Arab States, UNICEF and other partners, planning several activities related to non-conventional water, specifically: 1. Preparation of a paper on the role, challenges and opportunities of non-conventional water resources for integrated and sustainable water management. The document should be concise and raise provocative questions for policymakers and other stakeholders. The document was presented at a high-level event on water scarcity that was organized during the 13th session of the Arab Ministerial Water Council on November 17, 2021. 2. Preparation of an information document on the use of non-conventional water resources (desalinated seawater and brackish water and treated wastewater) for agriculture. The document aims to help identify different directions for policy makers and prioritize related issues within the cross-links between water and agriculture. These interconnected orientations could include policy issues (e.g. guidance notes, documents, ...), data issues (availability and analysis, field surveys, ...) knowledge products (technologies, guidelines, investment modalities, ...). The aim of the document is to help the Joint High-level Technical Committee (water-agriculture) identify issues to focus on during its non-conventional water program next year. 3. A document of broader scope on technologies, investments and policies for non-conventional water resources in the NENA region. FAO would be an important partner for the observatory, especially for the desalination use and reuse in agriculture component.		
MEDRC (Middle East Desalination Research Center), Oman	MEDRC is an international organization mandated to find solutions to the shortage of fresh water. Established in 1996 as part of the Middle East peace process, it conducts research, training, development cooperation and transboundary water projects. MEDRC is headquartered in Muscat in the Sultanate of Oman, where it operates a state-of-the-art research and training center including desalination plants, laboratories, amphitheaters and administrative offices. In fulfilling its mission, MEDRC aims to become a viable and transferable mechanism for governments seeking to address significant regional or transboundary environmental challenges.	Mr. Kevin Price Senior scientific advisor mkevinprice@gmail.com
MEDRC is an organization that mainly conducts training on the operation and maintenance of desalination plants in Oman, Palestine and Jordan.		

<table>
<tr><td>LAS (League of Arab States)</td><td>The Arab League is a regional organization holding the status of observer with the United Nations.</td><td>Mrs. Jamila Maatar, responsible for energy management

jamila.matar@las.int

Mr. Hammou Laamrani, Senior Expert Nexus water, energy, food security and climate change

Economic Sector hammou.laamrani@las.int</td></tr>
<tr><td colspan="3">The Arab League is very interested in desalination issues. In particular, why are the Arab countries so far unable to have a domestic desalination industry? Why are technologies, innovation and the desalination industry not thriving in the Arab countries, the world's largest market and the largest entrepreneurs of future desalination projects still as "consumers"? Should it be left to the private sector as a business case? In this case, why is local R&D ranked poorly in this very field of innovation?

IME experts exchanged with the water and energy officials of the Arab League, who showed an interest in collaborating with the observatory.</td></tr>
<tr><td>KAS-REMENA (Energy Security and Climate Change Program in the Middle East and North Africa), Morocco</td><td>The objective of the KAS-REMENA program run by the German Konrad Adenauer Foundation is to promote dialogue and partnership cooperation between countries of the Middle East and North Africa Region as well as Europe with regard to resource issues and climate change.</td><td>Mrs. Daniela Dieglemann

Program Director

Daniela.Diegelmann@kas.de</td></tr>
<tr><td colspan="3">KAS-REMENA is interested in desalination issues, in particular desalination powered by renewable energies. They published an interesting report at the beginning of 2021: “Desalination: an alternative to alleviate the water shortage in the MENA region” co-authored by one of IME experts. It is a regional study that aims to present the state of the art of desalination in the MENA region as a valuable alternative for water supply in the face of an increasing water shortage exacerbated by climate change and economic and demographic growth: https://www.kas.de/en/web/remena/single-title/-/content/desalination-an-alternative-to-alleviate-water-scarcity-in-the-mena-region</td></tr>
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<tr><td>UNESCO

Intergovernmental Hydrological Program (IHP)</td><td>IHP is the United Nations intergovernmental program dedicated to water research and management and capacity building. Since 1975, it has evolved to facilitate an interdisciplinary and integrated approach to watershed and aquifer management. The main objective of the current eighth phase IHP is water security (IHP-VIII 2014-2021).</td><td>Dr Fadi Georges Comair

President UNESCO IHP (Arab Countries Group)

f.comair@cyi.ac.cy ; comairfadi@hotmail.com

Mr. Manuel Menéndez

Vice-president

mmprieto@miteco.es

Mr. Abou AMANI, Director

a.amani@unesco.org</td></tr>
<tr><td colspan="3">IHP expressed, through its vice-president, it greatest willingness to collaborate with the observatory and to provide it with all available information. Details of a possible collaboration agreement will be discussed with the Program Director Mr. Amani, a Senegalese national based in Paris. It is interesting for CME to prepare signing the agreement in Dakar. On the other hand, IHP has just created an ECOMED academy with regional observatories planned to monitor pollution discharged by desalination plants and wastewater. We should therefore see complementarity opportunities with our observatory.</td></tr>
<tr><td>OSS (Sahara and Sahel Observatory)</td><td>The Sahara and Sahel Observatory (OSS) is an international organization focusing on Africa, created in 1992 and established in Tunis. It operates in arid, semi-arid and dry subhumid areas of the Sahelo-Saharan region. OSS is a Platform for North-South-South partnerships made available to its Members, and contributes to subregional and regional strategic reflections on innovative solutions for the sustainable and concerted management of groundwater resources on the African continent.</td><td>Mr. Abdel Kader Dodo

abdelkader.dodo@oss.org.tn</td></tr>
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<tr><td colspan="3">OSS has engaged alongside IME to provide feasibility elements. Ultimately, the World Observatory of non-conventional Waters and dedicated Renewable Energies should avoid the duplication of actions carried out by OSS at the risk of supplanting its sovereign mission assigned since its creation in the field of transboundary groundwater (renewable and/or low renewable). The synergy and complementarity of the Actions of the two Observatories should be promoted.</td></tr>
<tr><td>Cyprus Institute</td><td>The Cyprus Institute is a non-profit research and educational institution with a strong scientific and technological orientation, addressing issues of regional interest but of global significance, with an emphasis on cross-disciplinary research and international collaborations.</td><td>Dr. Fadi Comair, Director

f.comair@cyi.ac.cy

Dr Christiana Katti

Scientific Coordinator

Climate Change Initiative

c.katti@cyi.ac.cy</td></tr>
<tr><td colspan="3">The Cyprus Institute is planning to co-organize a Ministerial meeting together with the Government of the Republic of Cyprus in the spring of 2022 as a forum to discuss and negotiate the development of a Regional Cooperation Action Plan for climate change mitigation and adaptation based on the findings and suggestions of the scientific Task Forces created earlier in 2021. The Ministerial meeting will prepare an EMME Leaders’ Summit, planned for the Fall of 2022, which aims at a ten-year Regional Action Plan to mitigate and adapt to the climate crisis. In this regard, The Cyprus Institute can be a strategic partner for the observatory in particular in the eastern Mediterranean region, where they already carried out efforts of data collection (climate, water, energy, etc.), and Dr. Fadi already mentioned their will to contribute to the observatory.</td></tr>
<tr><td>European Bank for Reconstruction and development (BERD/EBRD)</td><td>The European Bank for Reconstruction and Development or EBRD is an international organization responsible for facilitating the transition to a market economy in the countries of Central and Eastern Europe. Created in Paris on May 29, 1990, following an idea by François Mitterrand, it was inaugurated on April 15, 1991. It is headquartered in London.</td><td>Mrs. Heike Harmgart

Director General of the Southern and Eastern Mediterranean Region, Cairo

harmgarh@ebrd.com</td></tr>
<tr><td colspan="3">In 2018, EBRD launched a call for tenders to carry out an assessment of investment opportunities in desalination in the SEMED region (Morocco, Tunisia, Egypt, Lebanon and Jordan). EBRD would be an interesting partner for the observatory.</td></tr>
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<tr><td>CEH – CEDEX

(Spain)

Center for hydrographic studies</td><td>CEH is a public R&D center that offers regulations, standards and technical specifications, the development of research projects, technological development and innovation. CEH has a staff of 120 employees dedicated to various fields of activity, related to water resources, floods, hydrological planning, the safety of hydraulic structures, river hydraulics, water status and water technologies. It is a member of IME</td><td>Mr. Federico Estrada

Director

Federico.estrada@cedex.es</td></tr>
<tr><td colspan="3">After many meetings, including the presentation of the observatory's initiative at its headquarters in Madrid, CEH expressed its readiness to collaborate with CME.</td></tr>
<tr><td>RAED

Arab Network for Environment and Sustainable Development</td><td>The Arab Network for Environment and Development includes more than 250 NGOs from Arab countries in North Africa and West Asia. The Arab League has recognized RAED as a representative of civil society in the Council of Arab Ministers of the Environment (CMAE) as well as in the Arab Water Council.</td><td>Mr. Essam Nada

Executive Director

e.nada@aoye.org</td></tr>
<tr><td colspan="3">We identify RAED as the main actor that federates initiatives of NGOs and civil society in the south and east of the Mediterranean.</td></tr>
<tr><td>CEDARE

Centre for Environment and Development for the Arab Region and Europe</td><td>CEDARE was established in 1992 as an intergovernmental organization with diplomatic status in response to the agreement of the Council of Arab Ministers of the Environment at the Egyptian initiative of UNDP (United Nations Development Program) and the Arab Fund for Economic and Social Development (FADES), as a knowledge and technology center. Its headquarters are in Cairo and it also has offices in Jeddah (Saudi Arabia) and Valletta (Malta).</td><td>Mr. Khaled AbuZeid

Regional water management specialist

kabuzeid@cedare.int</td></tr>
<tr><td colspan="3">CEDARE works to catalyze and facilitate collaboration between countries of the Arab region, Europe and the international community in the field of development and the environment, by (i) disseminating success stories, (ii) fostering alliances with the civil sector, (iii) participation in international environmental treaties and conventions, and (iv) improving human and institutional capacities.

The experts have already been in contact in the framework of the Mediterranean desalination observatory initiative, supported by CEDARE.</td></tr>
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<tr><td>IPCC/ GIEC

Intergovernmental Panel on climate change</td><td>The Intergovernmental Panel on Climate Change (IPCC) was established in 1988 to facilitate comprehensive assessments of the state of scientific, technical and socio-economic knowledge on climate change, its causes, potential impacts and response strategies.</td><td>https://archive.ipcc.ch</td></tr>
<tr><td colspan="3">The information generated by IPCC, in terms of reports and databases from various models make it possible to rely on more elaborate information to complement the observatory's own reports, given the close relationship between non-conventional resources, in particular desalination, with climate change. It is not strictly necessary to sign a specific collaboration agreement. However, it would be interesting to regulate the use of data.</td></tr>
<tr><td>Copernicus

European Union Earth observation Program</td><td>The European Commission coordinates and manages the program, implemented by Member States, the European Space Agency (ESA), the European Organization for the operation of meteorological satellites (Eumetsat), the European Centre for medium-range Weather, EU agencies and the Mercator Ocean company.</td><td>https://www.copernicus.eu</td></tr>
<tr><td colspan="3">Copernicus uses vast amounts of data on a global scale from satellites and measurement systems on land, air and sea to provide information that helps service providers, public administrations and other international organizations in their own needs.

The information it offers is freely accessible and open to its users. In particular, we consider data that are very relevant to observe the marine environment.

A specific collaboration agreement is not strictly necessary, although the firm would be interesting to regulate access to the information.

NOAA is another alternative or supplement.</td></tr>
</table>

A4_8 Interview sheets from the field of REUT in Morocco

1. October 27, 2021 - Interview with Michel Nalbandian - Eaux de Marseille Maroc, Subsidiary of the Eaux de Marseille Group.

Eaux de Marseille Maroc supports the Department of the Interior in the implementation of a study to evaluate the performance of wastewater treatment plants in Morocco and a study on the national mapping of liquid sanitation systems.

It is necessary to show the interest of the Observatory project to partner countries, the benefits to be derived from this project and explain how and by whom data will be used.

Problems of a diplomatic nature at the Mediterranean level can constitute an obstacle to the desired sharing and collaboration between countries.

It is necessary to overcome institutional problems that make access to information very difficult.

2. November 1, 2021 - Interview with Houda Bilgha - acting head of the water quality division directorate of water research and planning at the Moroccan Water Department.

Data are available, but scattered among different stakeholders: operators, ABH, water users…

Centralizing the data at the level of one single database will facilitate the management of projects, but the difficulty is how to structure this operation.

Having an information management dashboard makes it easier to track projects and make decisions quickly in case of an emergency.

Reuse is a main focus in the 20-27 program in Morocco

Wastewater reuse projects are multiplying in Morocco: for example the Rabat 1 and 2 projects, the Casablanca projects, golf courses and green parks in Marrakech, green parks at the Hoceima, green parks in Oujda ... this justifies the need for an Observatory.

A study for the implementation of a national water information system.

3. November 18, 2021 – Meeting with Ms. El Meknassi and SCP (Jacques Beraud and Benjamin Noury) from COSTEA

Such an Observatory project is very interesting because it makes it possible to have useful information for researchers, but also for supervisory bodies allowing them to follow up projects more directly and in real time, if they have all the necessary information for this.

However, it is difficult to motivate the focal points and convince them to feed the database in real time. Having information quickly remains the major problem for this type of projects.

It is necessary to ensure that the focal points are institutionally anchored, which allows them to have reliable data validated by various stakeholders.

It is necessary to identify a terminology that is clear and has the same definition for all countries.

4. November 10, 2021 - Meeting with Mohamed Rifki - Head of water and liquid sanitation division, directorate of local public networks, directorate general of territorial authorities of Morocco.

DEA is in the process of carrying out a study to map out wastewater treatment plants in Morocco and a database is currently being set up.

An observatory seems to be very relevant and interesting. DEA could contribute by making available the data it has as it may share its experience with other countries in this area.

5. November 23, 2021 meeting with the technical directorates of the ONEE-water branch.

The water branch of ONEE contributes to the study on the establishment of a national water information system conducted by the Water Department.

ONEE is ready to collaborate and share the data it holds.

It is important to designate a single focal point at the national level to inform the Observatory's database.

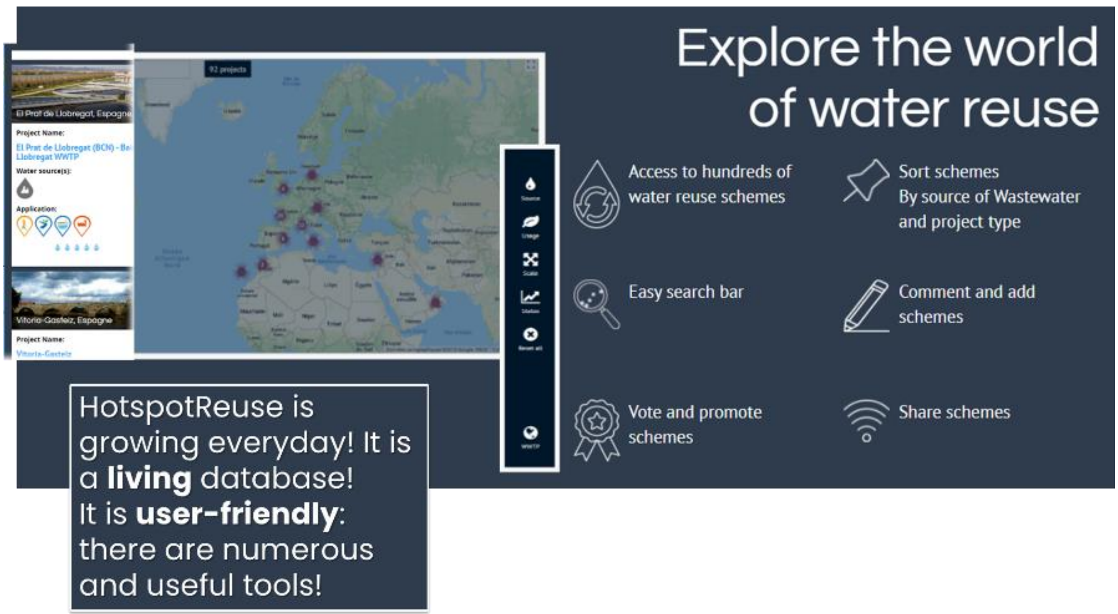
Information expected from the observatory:

- Experience of North African and Arab countries in the field of reuse of purified wastewater;
- A successful project for the reuse of purified water from anywhere in the world;
- Sharing of data on purification processes adopted in different regions of the world;
- Sharing of experience on the recharge of water tables across the Mediterranean;
- Capitalization of various experiences;
- Training and exchange of skills.

A4_9 HotspotReuse®

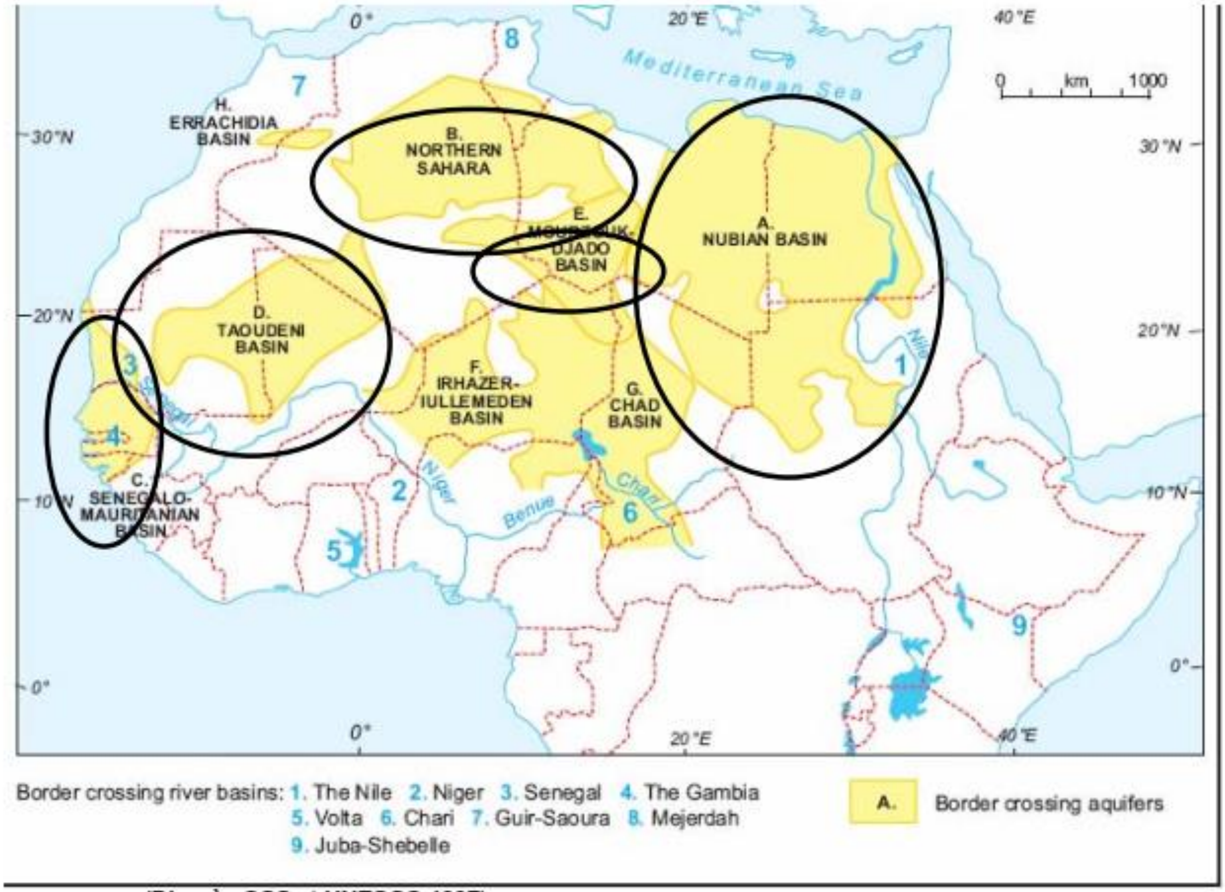
This is a collaborative web-platform of services and intermediation available in both English and French. It allows actors in the water sector, i.e. wastewater producers (local authorities, industrialists), users in need of an alternative source (farmers, road washing companies, individuals, ...), or territory managers, to build sustainable wastewater reuse projects in a win-win logic. The goal of HotspotReuse® is to become the central marketplace for water reuse by offering :

- Access to an open database (OpenData) on treated wastewater reuse projects around the world. This database is then exploited to produce key indicators of interest to the end user;
- Assistance in the development of treated wastewater reuse projects by promoting support solutions ;
- A meeting place between potential users of the treated wastewater resource and water management stakeholders;
- A market place for suppliers of technologies applied throughout the REUT chain (processing, storage, analysis, etc.).



11.5. A5 Maps of aquifers in the study area


IME
Principaux aquifères littoraux dans le bassin méditerranéen
J. Margat 2017
Aquifères littoraux
alluviaux
karstiques
sédimentaires
volcaniques
Principales sources littorales et sous-marines
Limite du bassin méditerranéen
31 Référence dans le tableau "Aquifères représentés"
0 250 500 km
aquaecop



(D'après OSS et UNESCO 1997)

Nota : les bassins d'Errachidia (H), d'Irhazer Iulmeden (F) et du Lac Tchad (G) n'ont pas été pris en compte

11.7. A7 Means to mobilize

This Annex outlines the functioning and resources required for the operation of the Observatory. This preliminary inventory aims at proposing concrete and feasible solutions; however, it would be necessary at the stage of the feasibility study to make a definite assessment of the needs for the future operation. Therefore, these are modalities that the project will put in place during the pilot phase for testing purposes, then for validation or amendments with a view to future expansion.

A7_1 Organization and operation of the Observatory

The Observatory will have to set up a "**committee of expert evaluators - EEC**" to be mainly in charge of filtering issues and reports submitted by third parties, to ensure:

- ✓ The quality of products and services offered by the Observatory;
- ✓ Independence and neutrality, with no commercial or political interest or bias, and giving credibility to the Observatory;
- ✓ A selection of the most interesting questions.

On the other hand, there is a "**List of Experts - LoE**" who will study and offer answers to questions raised by the EEC.

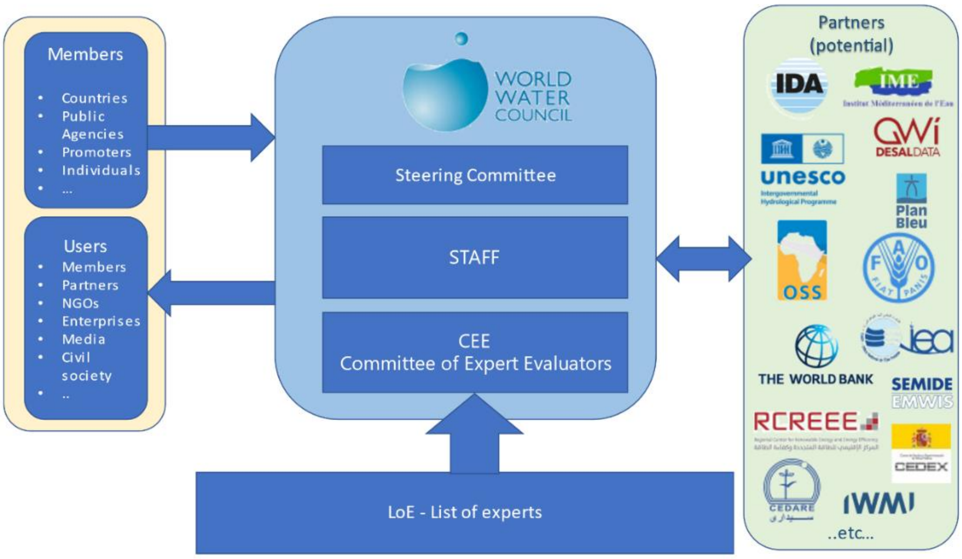
IME could play the role of facilitator of the Observatory's web platform, mobilizing EEC and LoE experts as resources to provide the information mentioned earlier.

The governance of the Observatory will have the form below.

Under the supervision of the CME, there will be a **Steering Committee** made up of member countries (ministries and national operators, etc.). This Committee will be responsible for defining the main strategic orientations, signing partnerships, validating results obtained at each stage and approving the action plan and the annual budget (if necessary) of the Observatory proposed by the Committee of Expert Evaluators (EEC).

The EEC will be in charge of drafting the annual activity program as well as an annual budget proposal (if necessary). The EEC will be responsible for ensuring the quality of the data and information provided, responding to requests emanating from countries, as well as ensuring the neutrality of the Observatory and giving strong opinions on strategic issues of NCWR projects.

The LoE will be made up of renowned experts in areas related to non-conventional waters and renewable energies. They will be requested periodically by the EEC to provide technical reports on concrete issues.



In the first phase, the geographical perimeter should cover countries around the Mediterranean as well as the Sahel. But the participation of countries will be on a voluntary basis and open to any national or local institution dealing with data related to NCWR and REs.

To ensure long-term sustainability, it will have to rely on collaboration with:

- National and local organizations that produce/manage and use desalination data;
- National and regional operators in charge of desalination plants in the pilot area;
- International organizations working on targeted data topics (see § 4.3) for data harmonization actions and sometimes technical or financial assistance actions at the national level.

A7_2 Human and material resources to be mobilized

In order to pool information and international exchanges on experiences related to integrating non-conventional water resources and their energy needs, it is recommended to set up an "*Information and Communication*" program that will aim to enhance knowledge and achievements, as well as the sharing of good experiences and data between countries concerned.

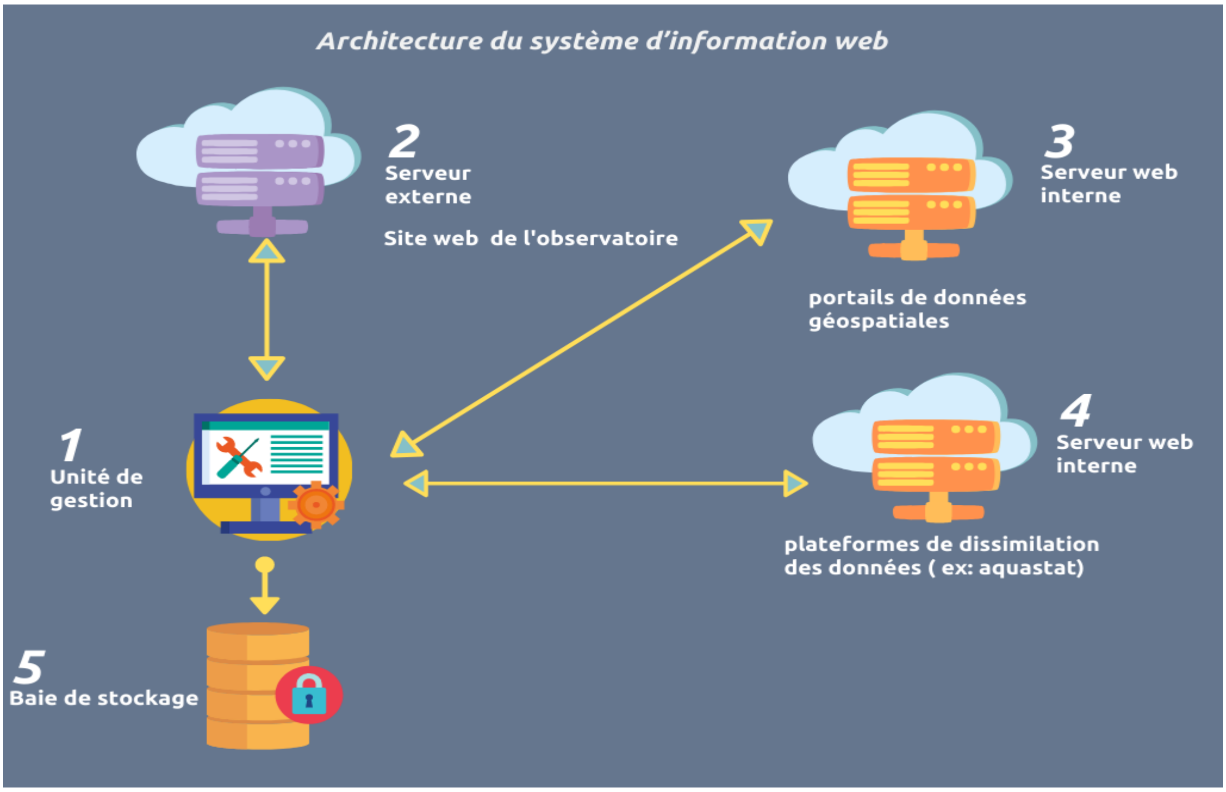
In the framework of this program, books and scientific papers that are produced will be published regularly and put online via a global platform that will be a gateway to several databases, Geoportals and decision support tools. The platform will allow the flow of information and will be a major asset for communication and knowledge sharing between communities of technical and scientific experts.

To guarantee the availability and security of the Observatory's information heritage, it will be essential to set up a robust information structure relying on the following:

1. An external web server at a hosting provider suitable only for the website or exchange platform;
2. An in-house server dedicated to geospatial data portals;
3. An internal server dedicated to data dissimilation platforms (e.g. Aquastat).

The observatory platform and its various subsidiary portals will be considered as the critical IT assets; for this reason, it will be necessary to equip the IT architecture with an internal storage array, which will be periodically fed with images retrieved at the web servers.

The following graph summarizes the necessary IT infrastructure:



In order to ensure the proper technical functioning that is required to guarantee the evolution of the computer system, it will be necessary to provide dedicated technical staff including:

1. An information system analyst for technical assistance and monitoring ;
2. A subject-matter expert (GIS, hydrologist ...) to monitor and feed in data

In a climate of increased vigilance in terms of security, concerns related to internal risks and data breaches, it is recommended to use a modern cloud work environment (ex: Microsoft 365) that can respond to contemporary challenges (email exchanges, document sharing, collaborative work ...) as well as to strengthen the productivity of the observatory.

A7_3 Computer specifications

For the Server

Characteristics	Minimum specifications required
Quantity	1 unit
Manufacturer	To specify
Brand	To specify

Model	To specify
Rack-mountable	Yes (1U)
Rack Assembly Kit	Yes
Redundant and hot-swap power supplies and fans	Yes
Number of supported processors	2
Number of processors offered	1
Number of proposed cores	6 Cores
Number of memory stick slots supported	24 or more
Frequency RAM strips	2400 MHz or more DDR4
Max memory supported	1.5 To
Proposed RAM Memory size	32 GB
Type of discs supported	SATA, NL-SAS , SAS , SSD
Number of supported disks	4 discs or more
Size of the proposed disks	1 TB
Number of discs offered	2
Supported raid type	RAID 0, 1, 10
Minimum number of network interfaces	4 x Ethernet 1 Gbps
Optical drive bays	Option
Minimum number of USB ports	3

VGA Port	Mandatory
Minimum number of PCI Express slots available	3
Supported operating systems	Microsoft Windows Server 2008 R2, 2012, 2012 R2, and 2016; Red Hat Enterprise Linux 6 (x64) and 7; SUSE Linux Enterprise Server 11 (x64) and 12; VMware vSphere (ESXi) 5.5, 6.0, and 6.5
Warranty period	3 years

For the storage bay

DESCRIPTION	Required characteristics
NAS Server	Rack-mountable bays
QUANTITY	1
Processor	E3-1246 v3
RAM	16 Go extensible to 32 Go
Flash Memory	512MB DOM
Msata Port	Two mSata port provided with an mSATA flash of 128Gb each
Location of hard drive	12 locations 3.5“ or 2.5“ SATA 6Gb/s, SATA 3Gb/s HDD, extensible up to 140 disks
Mounted disks	6 disks of 3TO
Supported array	Single Disk, JBOD, RAID 0, 1, 5, 6, 10, 50, 60
Support for Online RAID capacity expansion Online RAID level migration	Yes

Network Interface	4 Ports Ethernet Gigabit RJ45 ; 2 Ports SFP+ 10 G Support of port 40G
Ports	4x USB 3.0 ; 4x USB 2.0 ; Console port
LED indicators	Status, Lan, USB, HDD1,HDD2,HDD3,HDD4, 4xUSB3.0, 1xUSB2.0
Data protection	
Support Hotspare and Hotspare Global	Yes
Local protection via instant copies	Provided
Support for real-time remote replication to another NAS or FTP server	Provided
Thin provisioning with space reclamation	Yes
Tiering and automatic data movement between all disk tiers (Tiering)	Supported + Provided
Consult in real time the performance of the array	Yes
Cache acceleration with SSD	Yes
Administration	
Management tools	Yes, to specify
Remote management of multiple systems	Yes, to specify
Qos Management	Yes
Support for real-time and scheduled data backup under Windows	Yes, to specify
Integration support with Virtual environments	Vmware , Microsoft Hyper-V, Citrix
Support the use of the array as a virtualization platform	Yes, to specify

Monitoring systems - alerts	Power supply, temperature, material, storage space
The integration of an Authentication Domain	Microsoft Active Directory (AD) LDAP Server; LDAP Client Domain Users Login via CIFS/SMB, AFP, FTP
Management of Access rights	User Quota Management Local User Access Control for CIFS, AFP, FTP Support for subfolder permissions for CIFS/SMB, AFP, FTP
Network	Port Trunking/NIC Teaming (Modes: Balance-RR, Active Backup, Balance XOR, Broadcast, IEEE 802.3ad/Link Aggregation, Balance-TLB and Balance-ALB)
Network Protocol	CIFS/SMB, AFP (v3.3), NFS (v3), FTP, FTPS, SFTP, TFTP, HTTP(S), Telnet, SSH, iSCSI, SNMP, SMTP, and SMSC
Supply	Redundant
Warranty	5 years

A7_4 Institutional and financial aspects

The management of such an Observatory responding to the recommendations of § 7.1 and mobilizing means outlined in § 7.3 can be provided by a large number of organizations and according to very diverse governance modalities (beyond the technical governance described in § 7.2), which it seems premature to accurately define at this stage. Indeed, it was not possible to define precisely the areas and actors likely to be stakeholders of the Observatory in the study area, and even less beyond when the geographical field will be extended. There are many criteria to be taken into account depending on the geographical scope of the Observatory; the OSS, for example, would be legitimate to exercise a regional role but not a role in an area that goes too far beyond its institutional scope of operation.

Since the feasibility study's terms of reference deliberately leave open the Observatory's possible contents in order to be eventually co-constructed rather than decided by a few experts, there is no draft negotiation of cooperation agreements or validation of respective priorities in terms of the many topics and subjects considered at this stage.