DESSIN

DEMONSTRATE ECOSYSTEM SERVICES ENABLING INNOVATION IN THE WATER SECTOR

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D42.3 Two business environment (outside-in) reports

Part A - Water Scarcity Focus - Llobregat Case

adelphi, Nov (2014)

The research leading to these results has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement no. 619039

Business environment (outside-in) report

D42.3: Two business environment (outside-in) reports
Part A – Water Scarcity Focus – Llobregat Case

SUMMARY

This report exemplarily analyses the wider market for the DESSIN solution package on water quantity based on the Llobregat case in Barcelona. It has been compiled as part of the initial work of the DESSIN work area 42, the route to market. The report takes an "outside-in" approach by looking at the bigger market picture to determine market risks. The document is structured into five key steps: (1) A product description including the respective solution package and its anticipated impacts on ESS, (2) an initial screening for critical market success factors of the solution, (3) the detailed analysis including the relevant governance framework, an analysis of the market conditions and financial opportunities, (4) barriers and challenges derived from the analysis, and (5) recommendations for SMEs and policy recommendations. Checklists are provided in the Annex that can serve other SMEs to conduct a market screening along the steps applied in this report. In order to appeal to a variety of readers, the report provides general information on the above topics as well as detailed information from the Llobregat case.

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List of Acronyms and Abbreviations

AGUA	Actions for the Management and Use of Water programme in Spain
ASR	Aquifer Storage and Recovery
ASTR	Aquifer Storage Transfer and Recovery
BMA	Barcelona Metropolitan Area
CAGR	Compound annual growth rate
DEMEAU	Demonstration of promising technologies to address emerging pollutants in water and wastewater project
DHI	Danish Insitute of Applied Hydraulics
DWTP	Drinking Water Treatment Plant
EC	European Commission
EEA	European Environment Agency
e.g.	For example
EIP Water	European Innovation Partnership on Water
ENSAT	Enhancement of Soil Aquifer Treatment project
EPEC	European Policy Evaluation Consortium
ESA	Ecosystem Services Approach
ESS	Ecosystem Services
EU	European Union
EUR, €	Euro
GDP	Gross domestic product

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Ibid.	In the same place / the same as previously mentioned
i.e.	That is
IfW	Institut für Weltwirtschaft an der Universität Kiel
IPRs	Intellectual property rights
IUCN	International Union for Conservation of Nature
IUS	Innovation Union Scoreboard
LEI	Landbouw-Economisch Instituut (Agricultural Economics Institute foundation)
m, m3	Meter(s), cubic meter(s)
MAR	Managed Aquifer Recharge
M&E	Monitoring & evaluation
MEGS	Measuring Ecosystem Goods and Services
Mio.	Million(s)
NAMEA	National Accounting Matrix including Environmental Accounts
NUTS	Nomenclature des unités territoriales statistiques - hierarchical classification of spatial reference units of official statistics in the EU member states
NUTS-3	Level 3 regions of the official statistic of the EU NUTS classification
OECD	Organsation of Economic Cooperation and Development
p.	Page
p.a., a	Per annum, annum
PES	Payments for ecosystem services
Pre-potable	Water coming from different steps of the treatment train
PWC	PriceWaterhouseCoopers

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PWS	Public water schemes
R&D	Research and development
RD	Royal Decree
SECA	Simplified Ecosystem Capital Accounts
SEEA	System of Environmental-Economic Accounting
SME	Small and medium-sized enterprises
UNFCCC	United Nations Framework Convention on Climate Change
UNSD	United Nations Statistics Division
USD, $	US-Dollar
VC	Venture Capital
WFD	EU Water Framework Directive
WHO	World Health Organisation
WP	Work package

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Executive summary

This report has been compiled as part of the initial work of the DESSIN work area 42, the route to market. It follows an outside-in approach by looking at the bigger picture and determining market risks. The outside-in approach is complemented by an inside-out report that focuses on a specific SME.

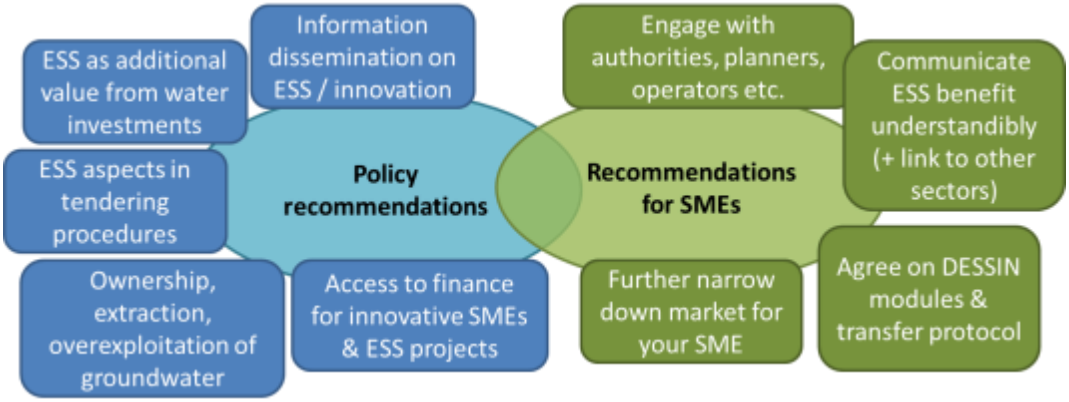
The report provides a market overview for water quality innovations linked to ESS by exemplarily analysing general market for the DESSIN solution package on water quantity based on the Llobregat case in Barcelona. The objective of the DESSIN Llobregat case is to demonstrate the feasibility of Aquifer Storage and Recovery (ASR) with pre-potable water to provide ASR facilities with a most versatile operation to cope with global change in water scarcity regions.

This document is structured into five key steps: (1) A product description (including the respective solution package and its anticipated impacts on ESS), (2) an initial screening for critical market success factors of the solution that can be conducted to check if a full market analysis makes sense, (3) the detailed business environment analysis including the relevant governance framework, an analysis of the market conditions and financial opportunities, (4) barriers and challenges derived from the analysis, and (5) recommendations for SMEs and policy recommendations. Checklists are provided in the Annex that can serve other SMEs to conduct a market screening along the steps applied in this report.

The target group of this report includes a variety of readers ranging from DESSIN technology developers and SMEs to policy makers interested in ESS in the water sector. Therefore, the report provides general information on the above topics as well as detailed information from the Llobregat case.

Generally, the report is not written in a scientific manner but rather hands-on in order to provide practical information to the SMEs and policy makers related to DESSIN and beyond.

Initial recommendations derived from the report include the following:



1 Introduction to the document

1.1 Aim and target group of the document

This outside-in report strives to be a sample assessment report that integrates relevant aspects and criteria for the positioning of ecosystem-services (ESS) relevant technology providers on the current or new markets. Following the outside-in approach, a bigger picture of the market (including customers and competitors) is established that allows the companies to assess what risks they are willing to take (Civichino (2012), p.15). The report also helps to identify the main barriers and challenges towards commercialisation, to identify potential sources of funding and other types of support. By providing examples on several levels (from broad to specific) and by looking at aspects of the market (e.g. policy and financing issues next to market characteristic), the report aims to reach a wider audience beyond the case study SMEs.

1.2 Development process

For this report, the Llobregat case in Barcelona provides the reference case. Information has been gathered mainly through interviews and workshops with the DESSIN project stakeholders, contact with other European projects and desktop research.

1.3 Structure of the document

This outside-in report is structured into five key steps:

(1) A product description including the respective solution package and its anticipated impacts on ESS,
(2) an initial screening for critical market success factors of the solution that can be conducted to check if a detailed market analysis makes sense,
(3) the detailed analysis including the relevant governance framework, an analysis of the market conditions and financial opportunities,
(4) barriers and challenges related to governance, market dynamics and financing, and
(5) recommendations for SMEs and policy recommendations.

Each section starts with a list of guiding questions that characterize the section and that can be used by others when formulating their own market analysis. The sections also all contain an overview graphic that summarises the chapter. The market analysis starts by looking at the broader context (e.g. global / EU) and then looks into the more local market (country) before concluding with the Llobregat case example.

Three annexes complement this report:

(a) Market screening tables that allow other SMEs to conduct a market check based on the examples provided in this report and,
(b) an overview of the European ASR/ASTR sites that are relevant to provide a full picture of the potential market for the LLobregat case,
(c) an overview of the water provisioning and regulating services in the EU.

Below graphic provides an overview of the structure and flow of this document.

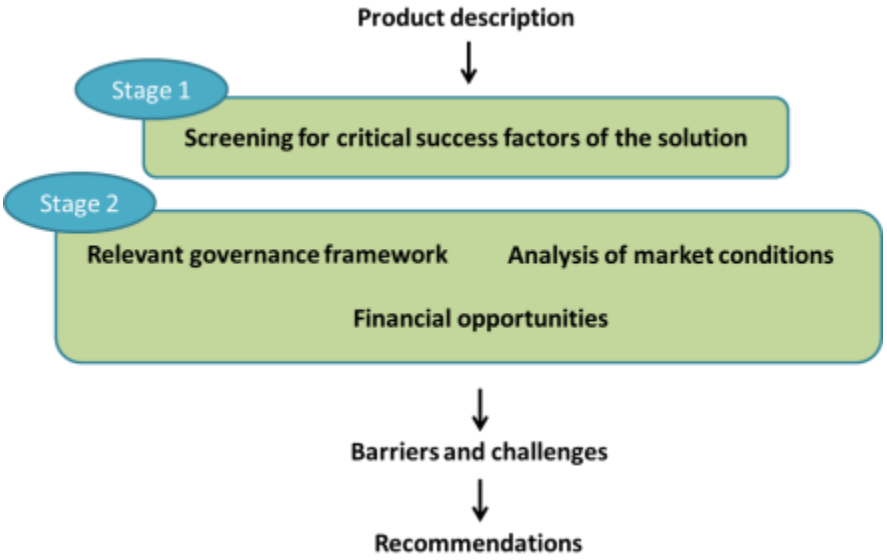


Figure 1: Structure of the Outside-In Report; adelphi (2014)

1.4 Applicability of outputs

The report is mostly compiled in such a way that the methodology and criteria identified are transferable to other cases. In particular, the report has been summarised in the Annex A in the form of screening tables that can be used by other SMEs to conduct a market check on their own.

Potential markets are looked at beyond the Llobregat case. I.e. each subchapter looks at the global / EU market, then at the local Spanish market and then at the Llobregat case. This makes the report suitable for a variety of readers – on the other hand, it is thus not a detailed market report for a specific SME and market but rather an overview.

The upcoming inside-out report will then seek to establish guidance for the view from inside a specific SME onto the market. The combination of both logics is recommended for a thorough assessment as depicted by below graphic for DESSIN.

Throughout the course of the DESSIN project, both, the outside-in report and the inside-out report will be further detailed out according to the individual DESSIN SME needs.

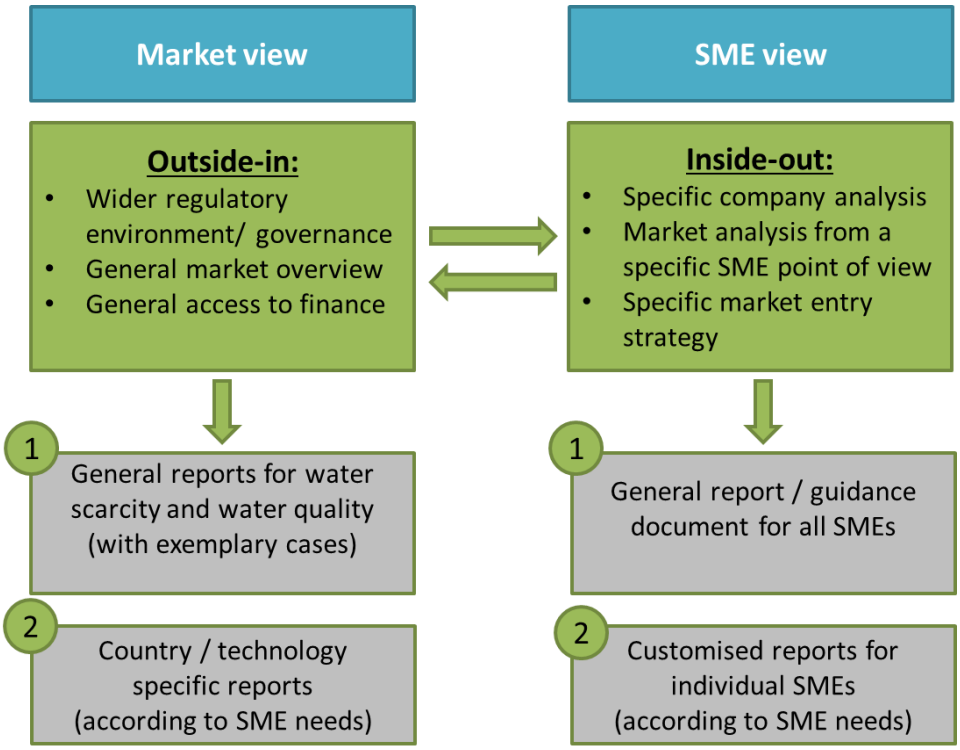


Figure 2: Inside-out vs. outside-in approach; adelphi (2014)

2 Product description

Guiding questions for this section are:

- ***What is the problem that is addressed by the solution? Why is the solution needed?***
- ***How is the solution package structured to address the issue?***
- ***What is the specific context and setting of the initial solution (case)?***
- ***What are the ecosystem services that are expected to be influenced by the solution?***

2.1 Description of the water quantity specific ESS solution package

Managed Aquifer Recharge (MAR) is part of the groundwater manager tools, useful for repressurising aquifers subject to falling water levels, declining yields, saline intrusion or land subsidence. MAR has a significant potential in securing and improving quality and quantity of water supplies in developing and developed countries while protecting or restoring the environment (Dillon (2005)). However, up to now, the conservative and restrictive view of mainly injecting produced drinking water into the aquifer has been dominating, which has been costly and energy and chemical reagents demanding.

The DESSIN solution for water quantity has approached this problem with an integrated solution package comprising of a core solution and support services as depicted in the graphic below.

Figure 3: DESSIN solution package; adelphi (2014)

The core solution contains a technology module, an information module relating to modelling and monitoring, and a management module with the Ecosystem Services Approach (ESA). The support

services aim to make the core solution applicable to an initial market and/or transferable to another market – they can also be linked to other DESSIN activities (e.g. such as the development of the DESSIN showcases). The table below details the solution package for the Llobregat case.

Table 1: DESSIN Solution Package for the Llobregat case; adelphi (2014)

1	DESSIN CORE Solution	Llobregat Case CORE Solution
1A	Integrated Technology/ new or newly combined solutions	• **Concept** of using flexible ASR systems combined with pre-potable water injection in order to maximize groundwater resources (by CETaqua)
1B	Enhanced data and information management	• **Modelling tools – numerical model** is applied on how pre-potable water injection at one site will have influences in terms of water quality and quantity at sites further away (as Llobregat delta has a large number of water users); modelling and monitoring done with this numerical model (by Amphos21)
1C	Management approach	• **DESSIN ESS Evaluation Framework from DESSIN work area 1 (WA1):** Evaluation of the changes in ESS resulting from a full scale injection of pre-potable water (by Amphos21) • **DESSIN ESS software framework from DHI:** for ESS evaluation
2	**DESSIN SUPPORT Services** *Llobregat Case SUPPORT Services to be fine-tuned after market analysis and needs assessment*	
2A	Specific company analysis and information on market situation (inside-out)	
2B	Commercialisation process & capacity building	
2C	Further recommendations for SMEs and policy framework for selected technology and market (outside-in)	
2D	ESS Lobbying with policy makers	
2E	ESS promotion with clients	
2F	M&E system for tracking market framework conditions that are relevant to the DESSIN innovations	

The selected DESSIN demo site is the Llobregat river area, where there is a full-scale Aquifer Storage and Recovery (ASR) facility available for injection.

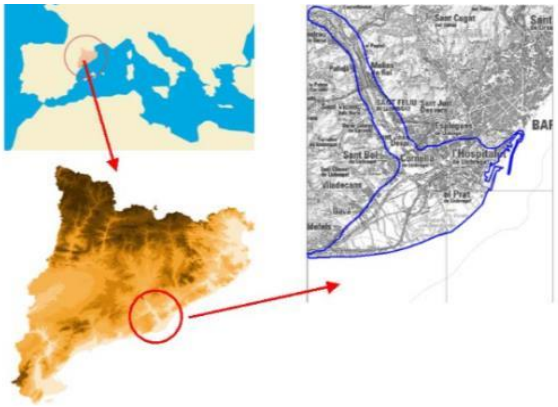
The solution proposed to be tested in the Llobregat demo site is to make flexible ASR systems to deal with different quality injection waters with the aim of improving aquifer water quantity and quality. This will change the traditional way of operations that used produced drinking water for injection. Moreover, the injection of alternative water coming from different steps of the treatment train, will allow operators to inject major quantities of water by reducing both economic and environmental costs of the process.

DESSIN will work specifically with ASR systems, which are the most vulnerable regarding aquifer potential impacts, as injected water is directly stored in the saturated zone, below the water table. DESSIN will promote innovation by adaptating the existing ASR systems to receive pre-potable water qualities, evaluating the potential impacts and adapting them with suitable pre-treatments to maximise injected volume.

Summary box: the DESSIN Llobregat case, Barcelona

Setting

Barcelona Metropolitan Area (BMA) as other Mediterranean regions is facing recurrently and increasingly severe water scarcity periods. The Llobregat River supplies more than 30% of the total water demand to the BMA with 3.23 million inhabitants. Aquifer Storage and Recovery (ASR) facilities are located near the Drinking Water Treatment Plant (DWTP) of Sant Joan Despí. 12 reversible wells (equipped with injection and recovery systems) are able to inject 75,000 m3 of freshwater per day, coming from the surplus of the DWTP potable water. After almost 40 years under operation, the ASR facilities are currently operated below their capacity because of the adjustment of DWTP operations to satisfy supply needs (less surplus of potable water).



OBJECTIVE

To demonstrate increase of fresh water availability in the Mediterranean coastal region by deep injection systems (ASR) with variable water qualities.

SPECIFIC TASKS

- T3.5.1 Selection and design of additional pre-treatments to comply with WFD and specific European operators' requests;
- T35.2 Conditioning of existing network of observation wells and implementation of additional piping and selected pre-treatment;
- T35.3 Evaluation of the impact of the injection with pre-potable water by groundwater and recharge water monitoring;
- T35.4 Advanced hydrogeochemical modelling: application to the case study and calibration with real data;
- T35.5 Valuation of the changes in ESS resulting from a full-scale injection of pre-potable water in the Sant Joan Despí and Cornellà area using the DSS Module developed in WP23;
- T35.6 Development of a methodological approach for economic analysis and payment regulation of the identified ecosystem services in the Barcelona demo site.

DESSIN partners involved

CETaqua, Aigües de Barcelona, Amphos 21, DHI, adelphi

Figure 4: Summary box – the DESSIN Llobregat case; adelphi (2014) / DESSSIN proposal

2.2 Impact of the solution on ESS

One of DESSIN's objectives is to operationalise the Ecosystem Services Approach (ESA) to enable an extended, standardised evaluation of impacts from water-sector innovations.

Within the current state of research at DESSIN, Ecosystem Services (ESS) are regarded as the direct or indirect contributions that ecosystems make to human well-being. The ESA takes a holistic perspective that includes humans, their activities and the services that ecosystems provide to humans as an integral part of the ecosystem (Ecologic (2014)).

The ESA is at a very early stage within DESSIN. So far, several ecosystem services have been initially identified as being relevant to the DESSIN Llobregat case as depicted in below table. An improvement of the ecosystem and thus the ESS is initially assumed in all categories apart from litoral protection, beach formation, and soil formation and maintenance (as assessed by Amphos 21). This will be further detailed out during the course of the DESSIN project and described in the respective DESSIN work areas.

Table 2: Key ecosystem services initially assumed to be improved at Llobregat; Amphos 21 (Nov. 2014)

ES service category	ES service type applicable for Llobregat Case (current status)
Provisioning	• Provisioning of food: vegetables, fruits, fish and meat (bad) • Water resources: aquifer recharge, water supply with local resources, individual small supplies, irrigation, industry (bad)
Regulation	• Litoral protection (poor) • Water quality improvement (salinity intrusion and natural treatments) (bad) • Beach formation (bad) • CO2 emissions mitigation (poor)
Supporting	• Biodiversity (poor) • Ecological connectivity (poor) • Soil formation and maintenance (poor) • Primary production (poor)
Cultural	• Landscape (poor) • Ecotourism (good) • Environmental education (good) • Innovative activities development (good) • Historical and cultural heritage (good)

3 Screening for critical success factors of the solution

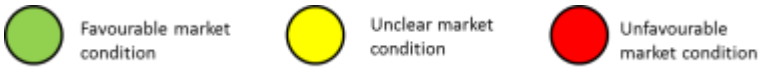
Guiding questions for this section are:

- ***What is the market readiness of the solution?***
- ***What is required in terms of local site specifics?***
- ***What policy mix is needed to support the solution?***
- ***What factors are relevant for the willingness to pay for the solution?***

Before conducting a detailed business environment analysis, it can be beneficial to conduct an initial screening for critical factors of the solution to ensure that the initial hurdles for application are mastered. The screening also inform on the relevant factors to consider for the market analysis. The following categories are suggested:

- Maturity and applicability of the solution
- Proper local setting
- Suitable policy mix
- Willingness to pay

The screening is conducted exemplarily for the Llobregat case in Barcelona[1]. General screening criteria are derived and presented in tables with a traffic light check:



3.1 Maturity and applicability

DESSIN generally focuses on potential solutions that are advanced beyond the research stage but not yet at the marketable stage – the initial application of these solutions is achieved at the DESSIN case sites. Showcases will be developed and promoted as reference sites for the innovative technologies developed through DESSIN. In terms of maturity and applicability of the technology elements of the core solution package for the Llobregat case, the ASR technology is very mature and has been applied elsewhere. However, using pre-potable water for injection into the aquifer is a new method at Llobregat. DESSIN will apply this new method and conduct an expanded evaluation of its impacts using the ESS Evaluation Framework.

[1] With information mainly stemming from an interview with the DESSIN project partner CETaqua and additional input from Amphos21.

Table 3: Screening for maturity and applicability

Criteria	Check
Technology elements of the solution are technically ready for market application / have passed a demonstration site testing	

3.2 Proper local setting

Injecting water into the aquifer for later usage makes sense in areas where a water buffer is needed, i.e. there is excess of water during one season (rainy season) and then demand for this water during a later period (dry season) – as for the Llobregat case, precipitation is characterized by strong inter-annual and intra-annual variations (Petrovic et al. (2009), p.32). Also, the aquifer would need to have enough permeability to construct a well and to inject into it; the aquifer must also be safe from pollution in order to maintain the water quality. Ideal would be a site where a reverse well is already installed. Generally, the method does not only work in large cities/metropolitan areas, as for the Llobregat case, but also in rural areas; however, due to a higher water demand in and around urban areas there is a demand for the solution package. Geohydrologically, there are more prerequisites which need to be met for a suitable ASR site, so that a case to case assessment would need to be conducted in order to estimate the potentials for an ASR-based solution.

Table 4: Screening for proper local setting

Criteria	Check
Area where a water buffer is needed / fluctuation of the water table	
Aquifer has enough permeability	
Ideally, ASR plant / reverse well installed already	
(Urban / peri-urban area, i.e. great number of water users including industry)	

3.3 Policy mix

The development and application of solutions needs a suitable policy framework which provides incentives for their implementation. For the Llobregat case, recharging the aquifer generally works

in line with the WFD, i.e. by maintaining a good quality of the aquifer. However, motivation for doing so had come from Barcelona's water provider, Aigües de Barcelona, before the WFD was in place.

Table 5: Screening for policy mix

Criteria	Check
Following the provisions of the WFD/local regulations, i.e. WFD is implemented in the respective country; for non-EU countries check if similar directive/legislation has been passed	
Including the key elements: • Prescription of water quality targets (e.g. for WFD chemical quality and ecological status) for the aquifer • Users must pay for their water • Participatory approaches • Integrated approach (water, landscape and urban management); • Water is managed on a basin scale	

3.4 Willingness to pay

Without the recharge system, the water supply for Barcelona would not be secured, i.e. the water providers have a strong interest in the method. It has also been estimated that the usage of the recharge system is more cost-efficient than running a water distillation plant. Also, generally, the willingness to pay for the method should be higher in areas where water is expensive. E.g. with respect to the Llobregat case, Barcelona is one of the most expensive places in Spain for water.

Table 6: Screening for willingness to pay (financial drivers)

Criteria	Check
Water providers have an interest (water supply is at risk due to water scarcity)	
Area where water is expensive	
Other techniques for securing water supply, in particular other aquifer recharge techniques, are more expensive than injecting pre-potable water through wells	

4 Governance framework

Guiding questions for this section are:

- ***What is the wider regulatory framework? I.e. what EU directives influence the solution?***
- ***What is the relevant local governance framework of the case? What are the relevant regulatory instruments? Who are the relevant entities?What is the current policy context?***
- ***What potential governance solutions can be extracted from the case?***
- ***What is the pull effect or shaping effect of the European, National or Local conditions for the case?***

The following steps are taken to analyse the relevant governance framework for the DESSIN solution on water quantity:

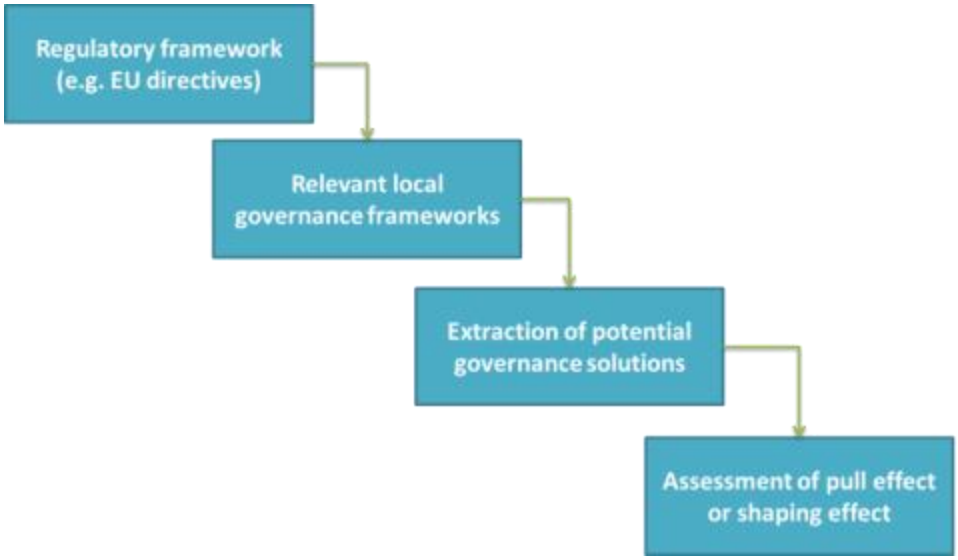


Figure 5: Steps to analyse governance framework; adelphi (2014)

4.1 Description of the regulatory framework

National legal frameworks in Europe are very much shaped by EU directives as they are – with some leeway regarding the exact translation into national rules - binding for all EU member states. The key EU directives that influence the regulatory framework for the Llobregat case are (ENSAT (2012), p. 43f.):

- The **Water Framework Directive WDF (2000/60/EC)** requires an integrative approach to protect all water bodies. It aims to prevent deterioration of the quality of water bodies and therefore enhances the status of aquatic ecosystems. The WFD requires that all groundwaters within defined river basins and districts must have at least a "good" status by 2015. A key component of the WFD is the establishment of River Basin Plans that are reviewed every six years and that set out the measures required to achieve the WFD

objectives. Another key element is an economic analysis (water use, baseline scenario, cost recovery of water services) (IUCN (2009), p. 15).

- The **Groundwater (Daughter) Directive (2006/118/EC),** as linked to the WFD (Art. 17.1), establishes a regime which sets underground water quality standards and introduces measures to prevent or limit inputs of pollutants into groundwater. In accordance with the WFD, it establishes quality criteria taking into account local preconditions. In particular, it includes criteria linked to the "chemical status" of groundwaters (see also EC (2006)).
- The **Directive on Environmental Quality Standards EQSD (2008/105/EC)** sets environmental quality standards for the substances in surface waters and confirms their designation as priority or priority hazardous substances.

Other drivers are stemming from further European political developments such as the "***Blueprint to Safeguard Europe's Water Resources"*** that aims to improve the implementation of current EU water policy, to increase the integration of water policy objectives into other relevant policy areas, to fill the gaps of the current framework (EC (2012)). The Blueprint points towards policy integration (e.g. with the EU Biodiversity Strategy) and the concept of PES to support the implementation of the WFD.

4.2 Description of relevant local governance frameworks

Generally, the Spanish government adopted a strategy for the most of the 20th century that involved building large water infrastructures to increase the availability of water resources – e.g. as a consequence, Spain is ranked 4th globally regarding the number of dams. Since the 1980s, this focus has undergone a shift towards a more sustainable use of water resources (González-Gómez (2012), p.3f.).

The jurisdiction over groundwater in Spain belongs to the autonomous communities as far as the river catchment area is completely within their territories; apart from that the federal state is in charge (IUCN (2009), p.20).

Relevant local regulatory instruments for the Llobregat case include the following (ENSAT (2012), p. 43f.; Government of Catalonia (2014a); Government of Catalonia (2014b); Government of Catalonia (2014c); IUCN (2009), p.20):

- The **National Annual Priorities (NAP) for 2008** aims to implement WFD in national programmes and particularly promotes the reuse of waste water according to an integrated life-cycle approach.
- The **Royal Decree 1620/2007** constitutes the legal framework for the reuse of treated water. It declares the conditions for permitted uses and sets quality requirements of recycled water.
- **Decree of Drought** of the Catalan Government from 2007 ensures as far as possible that water is used to supply the population, as well as to make effective the priority uses declared by law in all the regions of Catalonia. To guarantee this supply, the regulations provide for the adoption of corrective measures which will intensify saving and make even

more efficient use of the water in the reservoirs until the surface and subterranean resources, especially water supplies held in the reservoirs, return to normal levels. These measures foresee a progressive and sequential application of different restrictions to extend the country's water reserves with the aim of delaying as long as possible the worst case emergency scenario which, in the event that it doesn't rain and the reserves continue to deplete, would include the possibility of cuts to domestic supplies.

- Currently, the Catalan Water Agency is writing a **Drought Management Plan** that aims to provide continuity to the management of drought episodes. The plan complies with the mandate of the NHP (Law 10/2001 of July 5), which establishes that all basin organizations should develop a plan to deal with drought. It will include:
    - The definition of drought indices for the different operational units of the river basin that enable differentiated management based on the hydrological situation.
    - The establishment of operating rules that will allow optimal use of unconventional resources (desalination and reuse) and the coordinated use of the groundwater and surface water.
    - Measures to be applied regarding the use of water in each state of drought.
- The **Legislative Decree 3/2003** of 4 November approving the revised text of the Catalan Water Law is regulating the **water rate** through which water users contribute to the costs of water cycle services.
- Basic legislation related to groundwater is provided by the **1985 Water Act**, as modified by the real decreto legislativo 1/2001 ('texto refundido de la ley de aguas') and by the **1986 Regulation of the public water domain**, as partially modified in 1992 and 1993.

The two main water-planning instruments in Spain are the ***National Water Plan*** and the ***Water Basin Plans*** (Sánchez-Martínez (2012), p. 6).

The ***AGUA programme*** (Actuaciones para la Gestión y la Utilización del Agua = Actions for the Management and Use of Water) of the Spanish government summarises the aims of Spanish water policies in recent years and highlights the construction of desalination plants along the Mediterranean coast as a major aim (González-Gómez (2012), p.5).

With respect to agriculture, the future is shaped by the launching of the ***National Strategy for Sustainable Modernization of Irrigation***, timeframe 2015. Also the Technical Building Code, approved by Royal Decree (RD) 314/2006 (BOE, 2006b), incorporates means to save and control water in newly constructed buildings. It is worth noting that there has also been effort put into awareness campaigns for saving water in urban areas (González-Gómez (2012), p.4).

4.3 Extraction of potential governance solutions

For the Llobregat case, the ASR sites had been set up by Aigües de Barcelona in the 70s (i.e. the investment was made through what is now the Agbar company) due to the anticipated increase of water scarcity. Several research activities have been taking place at the site since then, involving various partners and stakeholders. Each of the different public and private partners has brought

technical and economic resources to the project. In addition, the European Commission provided financing to the project's budget. Financing remains, however, a main challenge for the continuous realisation of the initiative.

It is worth noting that the water users' community is also a stakeholder – as by local law, a users' community needs to be set up if an aquifer is overexploited (Fuentes (2011), p.17).[2]

4.4 Assessment of pull effect or shaping effect of European, national or local conditions

Regarding the analysis of the governance framework, it is of interest to discuss what pull or shaping, i.e. driving, effect the European, national or local conditions have on the system of interest.

A strong driver for the DESSIN solution at Llobegrat is the fact that due to an imbalance between water supply and demand the Barcelona Metropolitan Area is at risk of a water deficit that is likely to become significant (Petrovic et al. (2009), p.33). Without the recharge system, the water supply for Barcelona would not be secured. However, as this is the basis for the business of the water supplier, they obviously have a strong interest in securing water supply.

With respect to the provisions of the WFD, the principle of full cost recovery of water services, including those relating to the environment and the use of resources, could further promote the development of PES schemes (IUCN (2009), p. 17). However, as the private-public water provider for Barcelona is driven by making profit, their business objective could be the main driver for PES.

[2] In Spain (Fuentes (2011), p. 17): "Users are required to create **user associations** when they share a common concession or the same outlet. They can also be obliged to do so if the aquifer they exploit is declared overexploited. The associations establish norms for distribution and control, regulate the use and maintenance of shared hydraulic systems, organise the shared payments and resolve problems among members."

5 Market conditions

Guiding questions for this section are:

- ***What characteristics describe the international and national market? I.e. what is the bigger market picture?***
- ***In what geographic regions could the solution be of interest?***
- ***What could be potential customers for the solution?***

In assessing a new market for the ESS (core) solution, a variety of conditions need to be considered as depicted in graphic below. These categories have been chosen to provide a general market overview. "Classical", more focused marketing tools form part of the inside-out analysis.

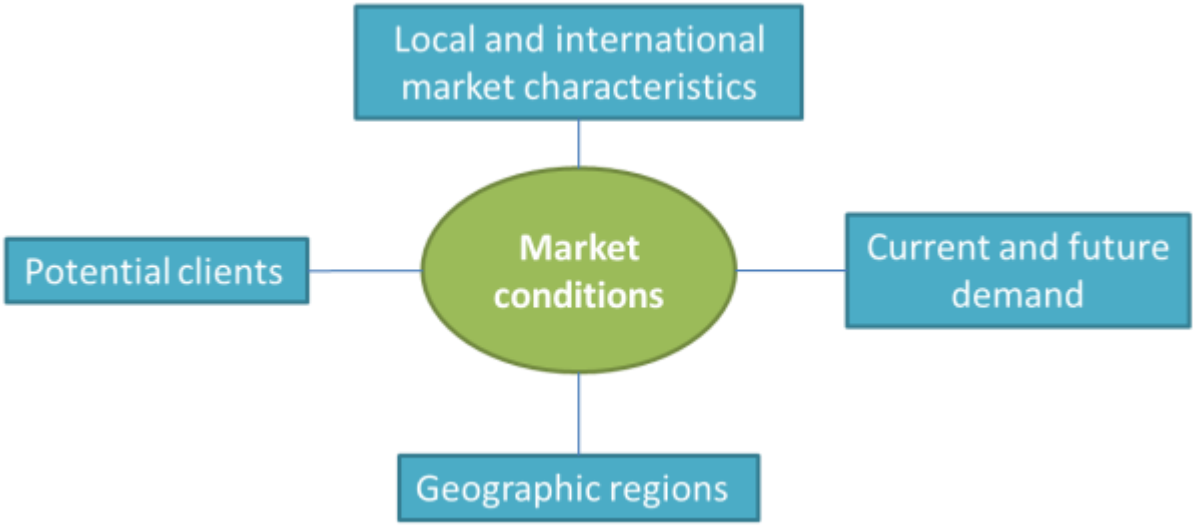


Figure 6: Market conditions analysed; adelphi (2014)

5.1 General description of local and international market characteristics

A description of the market characteristics is primarily conducted in order to control general risks associated with the market[3] and to identify initial business opportunities. To provide an initial overview, the following are looked in terms of local and international market characteristics at a macro level (from wider to narrower aspects):

- The wider ***demographic environment***, in particular, with reference to the solution package, the degree and trend of ***urbanisation*** as the solution has a higher demand in urban areas[4].

[3] Please note that the governance framework has been analysed separately in chapter 4 (as this is a separate DESSIN SME support service).

[4] Social aspects such as consumption trends and environmental awareness levels are aspects that could be observed in more detail for a specific technology and market.

- The wider natural environment in terms of ***status of water bodies and water ESS*** to assess if an improvement of water-related ESS is of relevance.
- General ***investments in infrastructure*** to evaluate whether an improvement of (water) infrastructure and its related services is likely to be performed ("investment friendly").
- Information on the ***technological environment*** and, particularly, on ***competitors*** in the same technology market to assess whether it is possible to enter as a new market player or established player with a new solution.

Demographic environment: Urbanisation

One of the driving forces for water scarcity is urbanisation (EEA (2009), p. 6). ***Worldwide***, more than half of the people live in urban areas, with urbanisation increasing the most in Asia, followed by Africa. In ***Europe***, 72% of the population lives in urban areas (including cities, towns and suburbs), however, European urbanisation takes a more polycentric and less concentrated structure than in Asia for example and urban growth rates in the so-called developed world have been slowing down (EC (2014) , p.1).

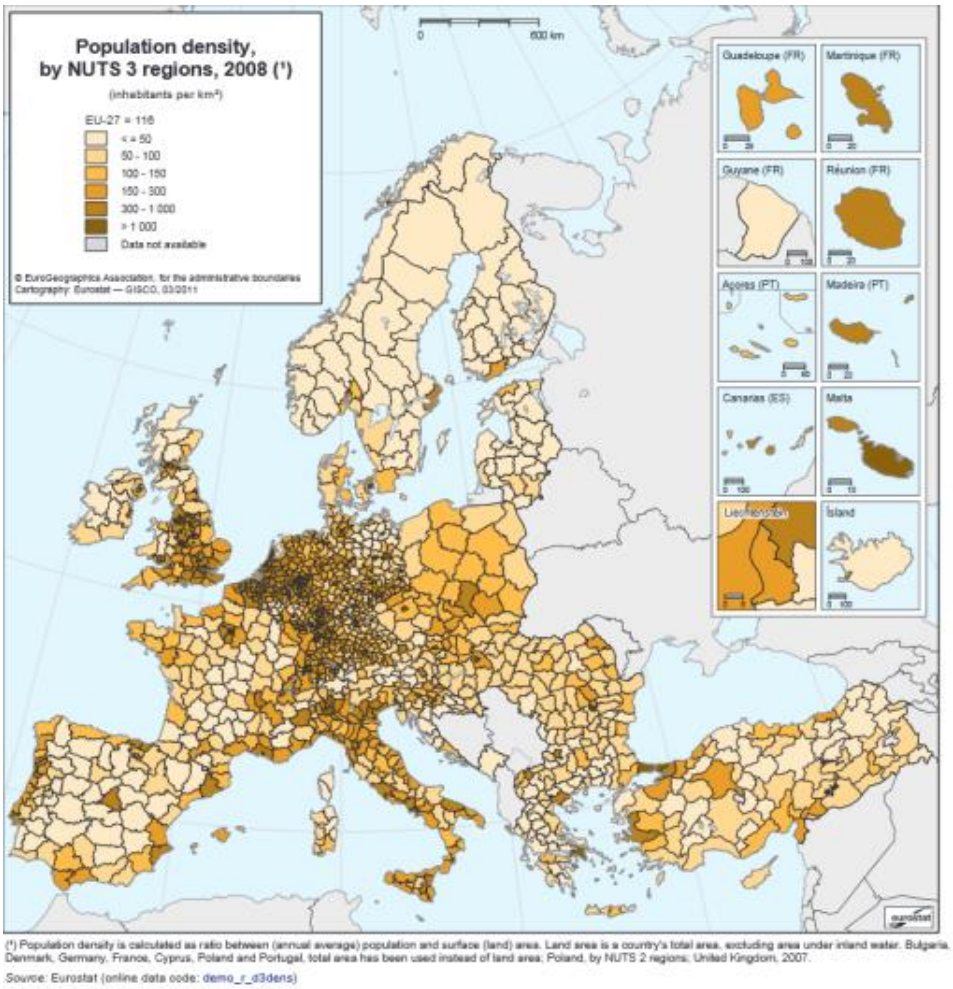


Figure 7: Population density in the wider European region; eurostat (2008)

The ***Barcelona Metropolitan Area*** is the largest demographic and economic concentration in all Catalonia. It is a densely populated and very urbanised area (Waterloss Project (2010-2013)). As for many European cities, Barcelona is currently undergoing a de-urbanisation trend with population shifts towards the periphery. Due to these population and industrial shifts, urban water consumption has been showing a decline in the city itself and in neighboring suburban areas, while it is strongly growing in the periphery (Petrovic et al. (2009), p. 1). Still, the Llobregat river is an overexploited watercourse.

Growth of the cities implies more water users which in turn imply more water demand. This in turn makes the application of a solution that addresses water scarcity more likely. The competitive advantage of the DESSIN solutions would then be that they will be tested for their impact on ESS.

Natural environment: Status water bodies & water ESS

As more than 60% of the world's freshwater supply is found in just 10 countries, the global freshwater resources are unevenly distributed around the globe. By 2030, the number of people impacted by severe water stress is expected to reach 4 billion (ibid. p, 3f.) WHO believe that the total global economic losses related to inadequate water supply and sanitation are US$260 billion/year (WHO (no year)).
In terms of the state of the ecosystem services in ***Europe***, most ESS are assessed as being "degraded" and no longer able to deliver the optimal quality (and quantity) of basic services as shown in below table (EEA (RUBICODE project 2006–2009)). This particularly holds true for lakes and rivers. Annex C provides an overview of the water provisioning and regulating services in the EU.

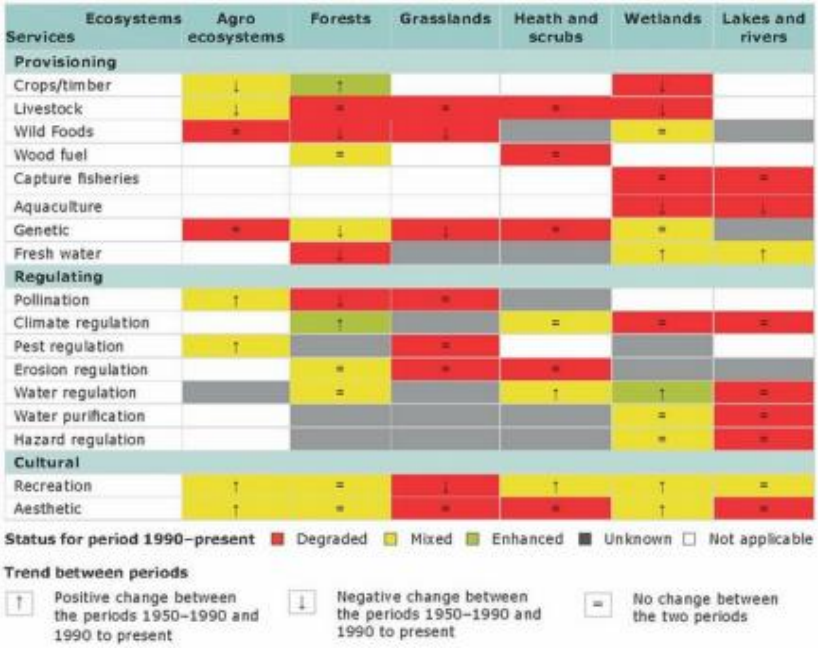


Figure 8: State of the ESS in Europe; EEA (RUBICODE 2009)

Regarding water, below graphic illustrates the groundwater bodies in the EU that are NOT at risk of failing to meet the objectives of Article 4 of the WFD. E.g. Spain, Ireland, Luxembourg and the Netherlands face a high number of groundwater bodies at risk.

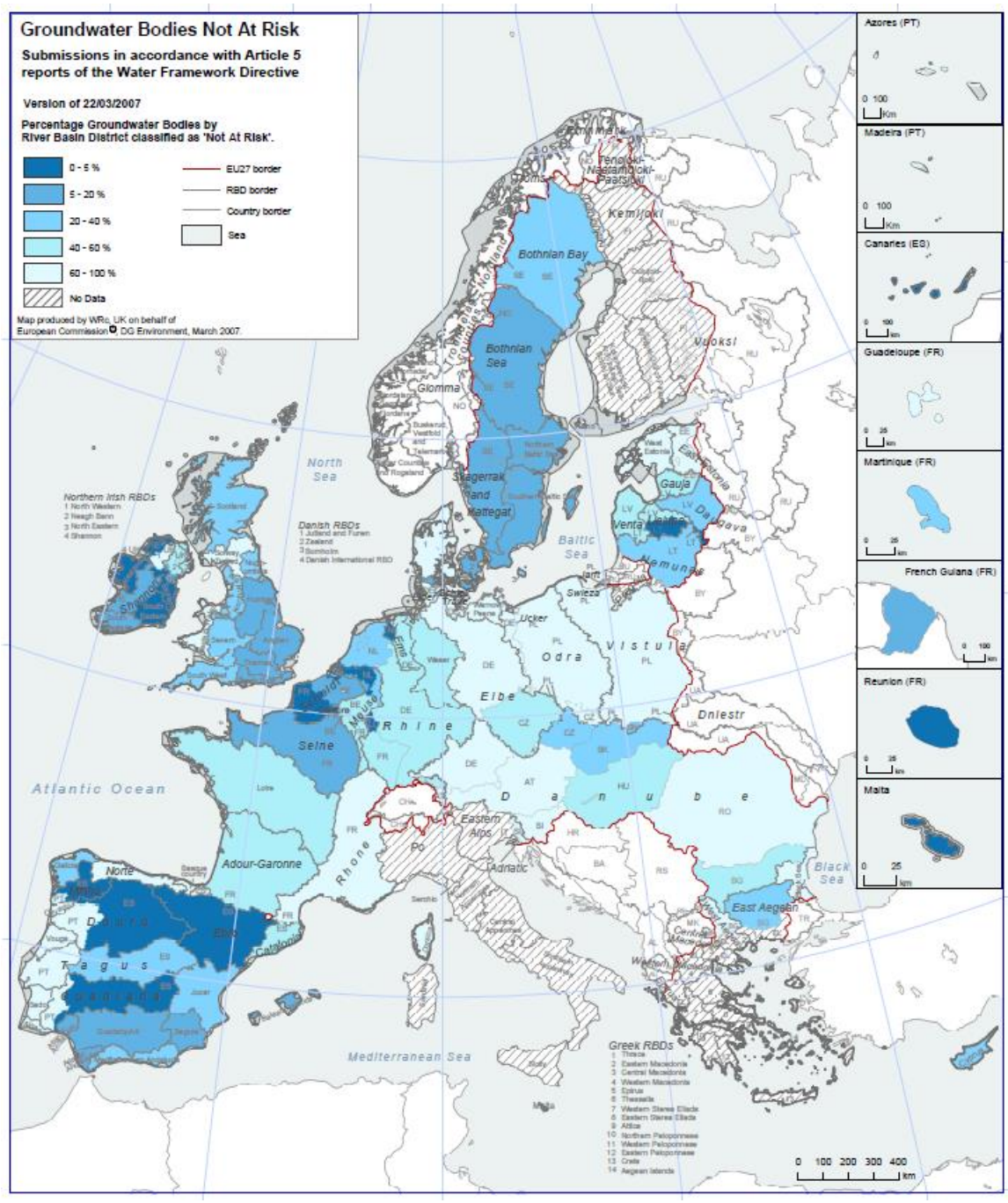


Figure 9: **Groundwater bodies not at risk of meeting WFD objectives; EC (2007)**

With respect to the ***Llobregat case***, the Llobregat river has historically been very polluted as it has been influenced by the expansion of the Barcelona harbor, the airport and by urbanisation, industrialization, agriculture and a dense road network amongst others. The river receives

extensive urban and industrial wastewater discharges and frequent incidents of polluting the aquifer have been reported. Next to various pollutants and contaminants that affect the water quality and the aquatic ecosystem, there is also a salinity problem due to dumping of salt mining effluents and seawater intrusion due to the oftentimes very low water table (Petrovic et al. (2009), p. 35-37). Below graphic for ***Spain*** shows the aquifers at risk of not attaining a quantitatively good status in line with the WFD (Fuentes (2011), p.8).

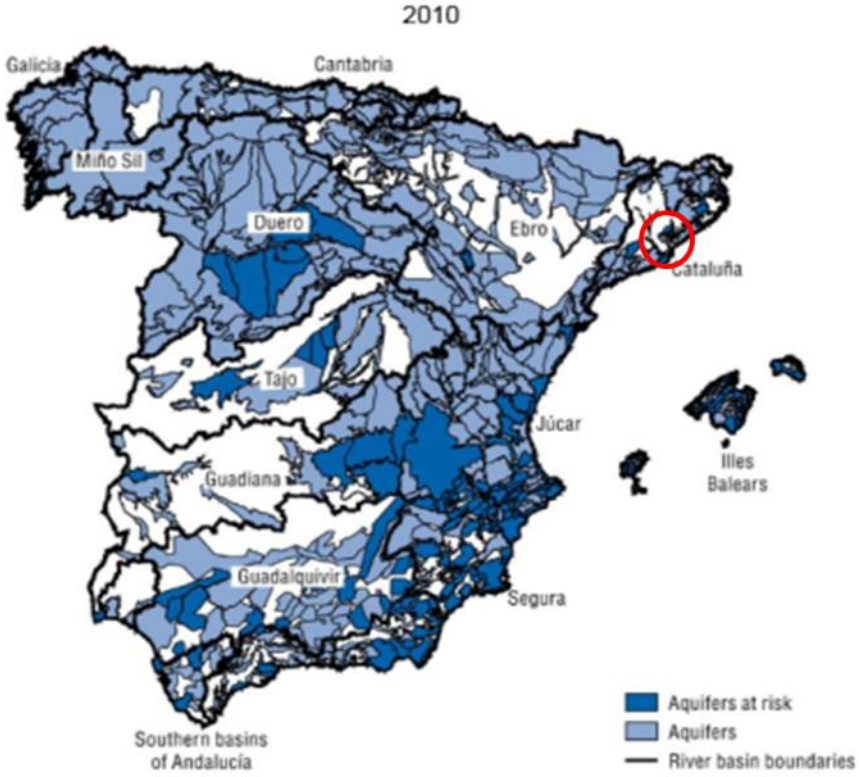


Figure 10: Aquifers at risk of not attaining a quantitatively good WFD status (Llobregat roughly in red); Fuentes (2011), p.8

Infrastructure investments

Globally, infrastructure investments have been particularly high in emerging markets excluding Latin America as depicted in below graphic (Inderst (2013), p.7) for 1992-2011.

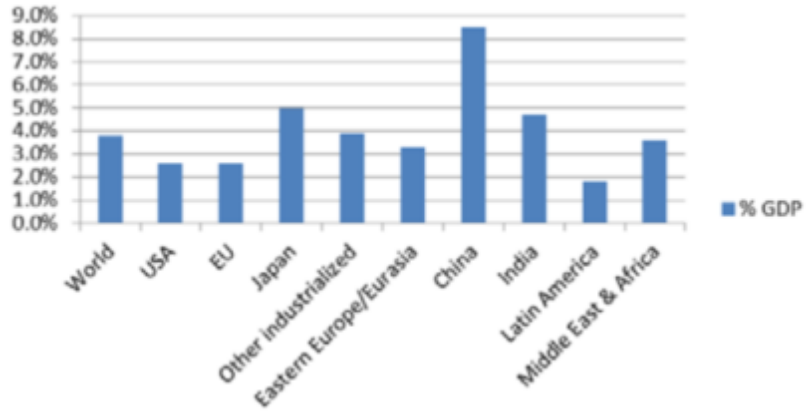


Figure 11: Infrastructure spending 1992-2011: Inderst (2013), from McKinsey 2013

For international comparative studies, the most commonly used indicator for public infrastructure investment is the government's gross fixed capital investment: The average for the ***Euro area*** (17 countries, 2.1%) and the ***European Union*** (2.3%). The highest investment within the OECD countries occurred with over 4 % of GDP in Canada and the EU member states Estonia, Poland and Romania. In general, the newer EU member states had relatively high investment rates, which could be explained by their infrastructural needs, but also by the support of the European Union in financing of infrastructure investments. ***Spain*** has taken the third lowest rank in the 2012 OECD comparison (Ragnitz et al. (2013), p.42f).

Sectorwise, transport (including telecom and storage) has by far been taking the largest share of public investments in the EU, followed by utilities (energy, water, sewage and waste management) (Inderst (2013), p. 7).

EU funding also plays an important role for infrastructure investments (e.g. EFRD) – this is further detailed in section 6.1.

Regarding the ***Llobregat case***, the wells had already been constructed, i.e. the infrastructure investment in the treatment facility and wells were done through the local water provider at an earlier stage.

Technological environment & competitors

In the past years, the top five water and wastewater utilities companies in the ***global*** market, namely Suez, Veolia, SAUR, Agbar and RWE, were from the ***EU***. Through the acquisition of technology companies, they have increased their technological capabilities to a wider scale giving them even more market strength and dominance. As a consequence, they are not only the main users of water and wastewater technologies but also leading suppliers making the market rather consolidated. These industry majors often tend to win framework supply agreements with utilities. Other major suppliers include multinationals such as Siemens or General Electric who have also acquired innovative (water) technology companies. Supplying multinationals with specialized

technology, a number of successful SMEs are also present on the water and wastewater market. For water monitoring, the market is also dominated by a small number of large firms (EPEC (2011), p.14f.).

Several geographical analyses on R&D in the EU can be obtained from Eurostat.

The water services market in ***Spain*** is dominated by the private companies Agbar, Aqualia and A.Valencia (Agbar (2011), p. 24). Public deficit reduction schemes are further fostering privatisation.

With respect to the DESSIN ***LLobregat case***, other storage options could be bigger water tanks or surface water reservoirs which would need prior investments though. Economic viability of the ASR solution will depend on the amount of water which can be regained and the water quality which can be maintained.

Looking at subsurface storage and filtration systems depending on the geohydrological conditions, there are different MAR methods available beyond the aquifer injection through wells, including spreading methods such as infiltration ponds, in-channel modifications including various dams, induced bank infiltration, rainwater harvesting and infiltration (World Bank (2010), p.40). However, not all of these methods will reach deep aquifers that can be reached with injection and not all of these use (partly) treated water.

The DEMEAU project has been developing a catalogue on MAR sites across Europe, finding the following (DEMEAU (2014), p.13 and 16): "With 145 out of the 270 systems (54 %) induced bank filtration is the most dominant MAR type. Surface spreading methods rank second among all main MAR types with 79 systems (29%). Well, shaft and borehole recharge systems form the third largest group of main MAR types with 44 sites in Europe (16%) and in-channel modifications are applied at 2 sites only (0.7%). Rainwater harvesting was not an applied MAR technology at any of the analyzed sites in Europe. Together with induced bank filtration, ponds & basins with 61 sites (23%) are the most important specific MAR types. For the latter, none of the considered MAR sites in Europe belonged to either of its two sub-types (i.e. sub surface dams and sand dams)." […] And "with a total of 44 available data sets, the main MAR type of well, shaft and borehole recharge (i.e. ASR/ASTR and dug well / shaft / pit injection) shows a large variety of primary influent water sources. ASR/ASTR systems are often used for pilot studies and scientific research purposes and they also use the rather exceptional influent sources of storm water and groundwater."

Regarding the management module of the DESSIN solution package, the DESSIN's ESS Evaluation Toolkit aims to be compatible with the Working Group on Mapping and Assessment of Ecosystems and their Services (WG MAES) (Maes (2013)). Some other existing green accounting frameworks include the UNSD "System of Environmental-Economic Accounts" (SEEA part II), the Worldbank's "WAVES", the EEA's framework for "Simplified Ecosystem Capital Accounts" (SECA), the Netherlands' "National Accounting Matrix including Environmental Accounts" (NAMEA) and recently a study on natural capital accounting on behalf of the Ministry of Economic Affairs, Agriculture and Innovation by the Agricultural Economics Research Institute of the Netherlands (LEI), the Canadian "Measuring Ecosystem Goods and Services" (MEGS) and the "Accounting for

Nature project" in Australia (Brouwer et al. (2013), p.23ff.). Bagstad et al. (2013) describe 17 ecosystem services tools for quantification and rate their performance – these also include (several GIS-based) online tools and software; some tools are publicly available (open source).

5.2 Assessment of current and future demand

To appraise market size, the ***current demand*** and of ***future demand*** of the solution are estimated.

Current demand

Goldman Sachs estimate the ***global*** water industry to total over USD 300 billion (Goldman Sachs (2013), p.1). Total turnover of the ***EU*** water and wastewater treatment industry was €95 billion in 2010 (EPEC (2011), p.4).

Current global market size (2013) for payments of ecosystem services (PES) in the water sector is estimated around 7.7 million USD for compliance water quality trading, 4.3-4.8 million USD for voluntary private sector watershed payments, 8 billion USD for PWS and water funds, 170.9 million USD for environmental water rights purchases (Carroll / Jenkins (2008)).

After the real estate crisis in ***Spain*** and the global credit crunch, the past years have been full of challenges for Spain and its economy. The economic downturn appears to have resulted in some companies´ reluctance to commit to purchase new products or services (U.S. (2010)). However, Spain is also the most (semi-)arid country in Europe, which, combined with the need to better manage water resources, still makes the Spanish water supply and sanitation market interesting (Austrade (2010), p. 11f.). Currently, the Spanish environmental sector (including water) moves around 3.2% of the global market, 4.8% of the European market and 0.9% of Spanish GDP - with a market turnover of around 11 billion Euro (InvestInSpain (2014), p. 101).

For the ***Llobregat*** case, it has been reported by CETaqua that it is less expensive to store water with ASR than to provide it with desalination thus making it more demandable - i.e. as the flexible ASR system at Llobregat is using pre-potable water it is estimated to allow to reduce the current cost of potable water to the cost of pre-potable water (effluent of sand filter of the DWTP). The WaterReuse Desalination Committee provides a comparison cost estimate for water from desalination plants (WaterReuse Desalination Committee (2011/12), p.16). Within the DESSIN project, there will be a report upcoming on the "Development of a methodological approach for economic analysis and payment regulation of the identified Ecosystem Services in the Barcelona demo site" (D.35.6); it is therefore not analysed in more detail here.

Future demand

Future demand can be assessed in three stages including a macroeconomic forecast, an industry forecast and a specific product sales forecast (Kotler (2003), p.151):

Stage 1 - macroeconomic forecast:

The IfW Kiel expects ***global*** *output growth to strengthen in 2015 (moderate 3.7% increase) whilst the world economy is still to remain sluggish and world trade is unusually low.* In the ***Euro area***, GDP is expected to increase by 1.3 percent in 2015 depending on improving financial conditions and fiscal policies (Gern et. al. (2014)).

The Economist's Intelligence Unit forecasts low real GDP growth in ***Spain*** with 1.1% in 2014 and 1.4% in 2015 (The Economist (2014)). There are several structural reforms underway in Spain that are showing manifold results including, from a macroeconomic view, that Spain has emerged from a two-year recession in the third quarter of 2013 (InvestInSpain (2014), p.32).

Stage 2 - industry forecast:

Globally, most substantial investments in water infrastructure are required (by 2030) compared across four major infrastructure sectors, water, telecom, transport, energy (Inderst (2013), p.12).

As an increasing number of countries is facing water issues, the demand for the services and products of the water sector is expected to further to rise (Goldman Sachs (2013), p.18). Below graphic depicts the expected investments in water supply infrastructure.

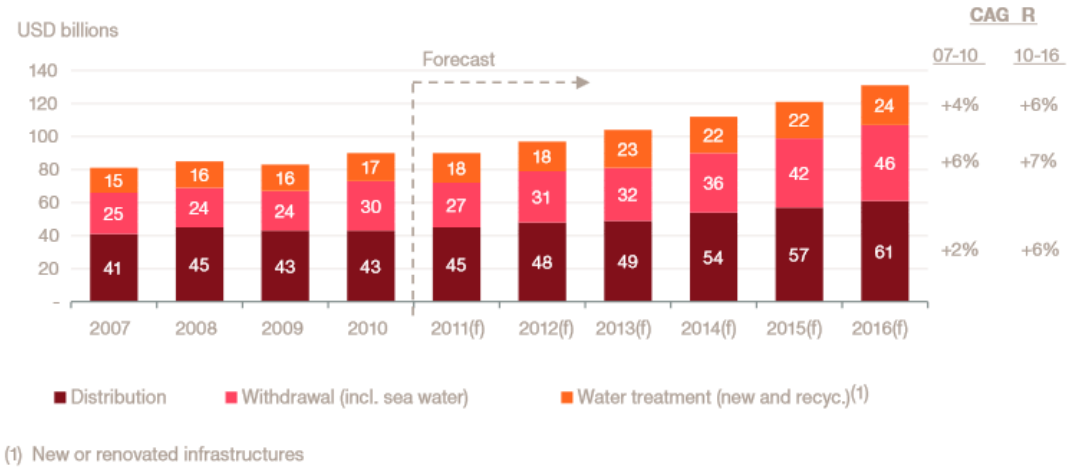


Figure 12: Investments in water supply infrastructure; PWC (2013), p. 46

Regarding ESS aspects, global markets for most PES are growing at around 10 - 20 % p.a. (with the carbon market growing much faster though) and the water sector growing 2-3% p.a.. For the water sector, the potential market size by 2015 (and 2020) is estimated at around 8 million (10 million) USD for compliance water quality trading, 5.5 million (10 million) USD for voluntary private sector watershed payments, 8.7 billion (11.5 billion) USD for PWS and water funds, 178 million (200 million) USD for environmental water rights purchases (Carroll & Jenkins (2008)).

As depicted in the table below, the global markets for water ESS generally show increasing opportunities (potential growth to 2020 and 2050 compared to present day).

Table 7: Emerging markets for biodiversity and ecosystem services (extract); Hill (no year), slide 8

Market opportunities	Market size (USD p.a.)		
	2008	Estimated 2020	Estimated 2050
Payments for water-related ecosystem services (government)	5.2 billion	6 billion	20 billion
Payments for watershed management (voluntary)	5 million Various pilots (Costa Rica, Ecuador)	2 billion	10 billion

In ***Spain***, there are on the one hand side cuts in public spending; on the other hand, water scarcity issues are unlikely to diminish.

Stage 3 – Overview of factors potentially affecting demand for the solution package

As the DESSIN solution package applied through the Llobregat case addresses water quantity problems, all the factors that contribute to combining low water availability with an excess level of water demand can influence the specific demand for the solution. These manifold factors could be separated into the categories human activities, environmental pressures and climate change (EEA (2009), p.7). Human activities include urbanization, tourism, industry and agriculture (i.e. irrigation is a major factor). These activities all create a considerable demand and lead to scarcer water availability creating environmental pressure. The unique ecoystem of the Lllobregat area depends on the availability of a certain quantity and also quality of water. Consequences of water scarcity would be the decrease of local flora which is the basis of the food chain for the fauna. Water quality issues would lead to less biodiversity in surface water bodies which again have impacts on the food chain basis for further predators and higher class animals.

The demand for the solution package is generally likely to increase with climate change, e.g. a water buffer is likely to be needed even more as longer periods of dry seasons are followed by heavy rainfall. For Spain, a higher frequency of longer periods of droughts has already been observed which is expected to increase further over the last decades of the 21st century (OECD

(2013)). For Europe, global warming is generally expected to lead to higher intensity of precipitation and longer dry periods (Hov et al. (2013), IPCC (2012)).

The Water Exploitation Index (WEI) is a widely accepted index for water scarcity (EEA (2009), p.8) which is used to display current and potential future water stress in Europe in below graphics.

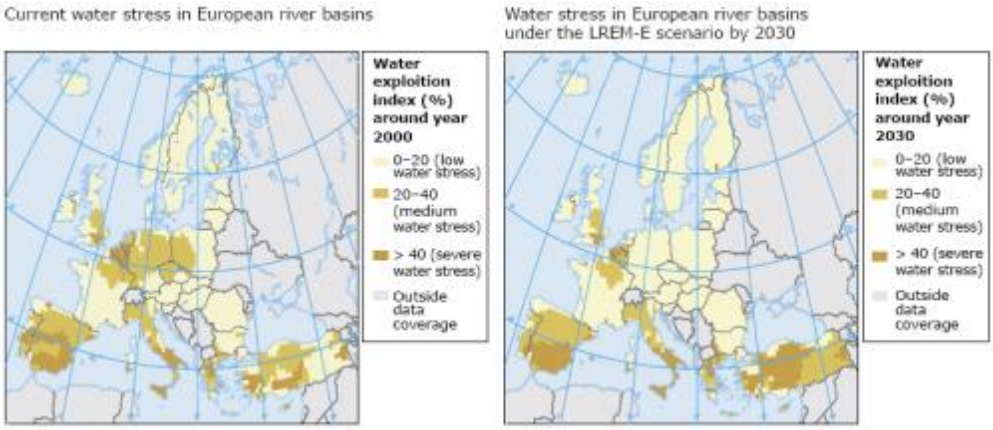


Figure 13: Water scarcity per WEI in Europe; EEA (2014b)

In ***Spain***, around 75% of the entire territory is currently under severe water stress and the situation is not expected to improve in the coming decades (González-Gómez (2012), p.2).

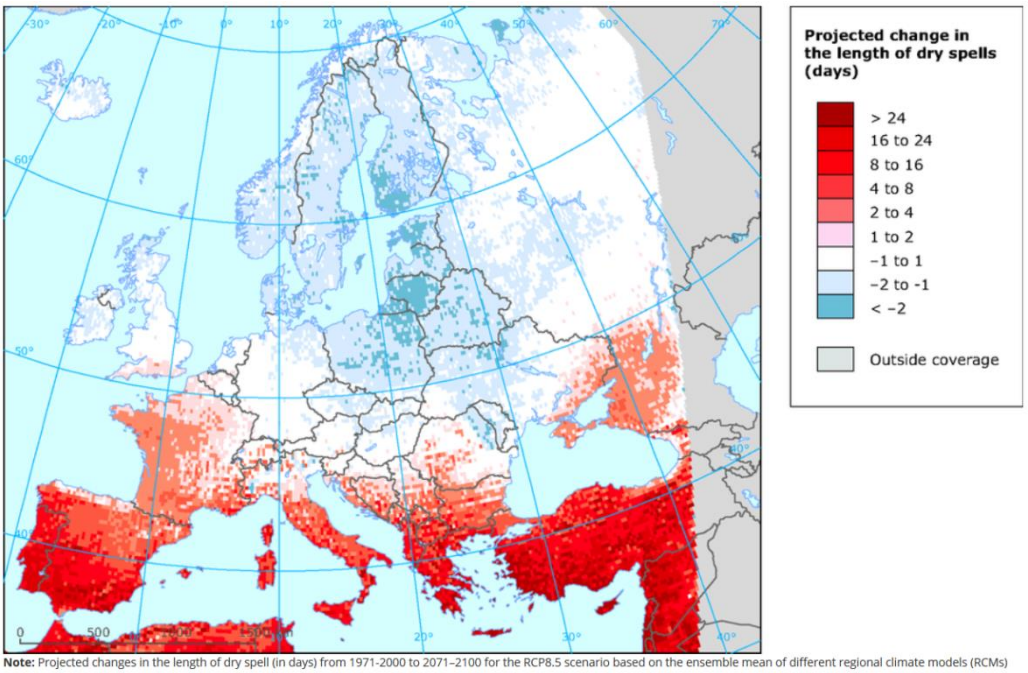
5.3 Geographic regions

The following site criteria have been identified as favourable for this DESSIN solution package:

- Area where a water buffer is needed / fluctuation of the water table;
- Aquifer has enough permeability;
- Ideally, ASR plant / reverse well installed already;
- (Urban / peri-urban area, i.e. great number of water users including industry).

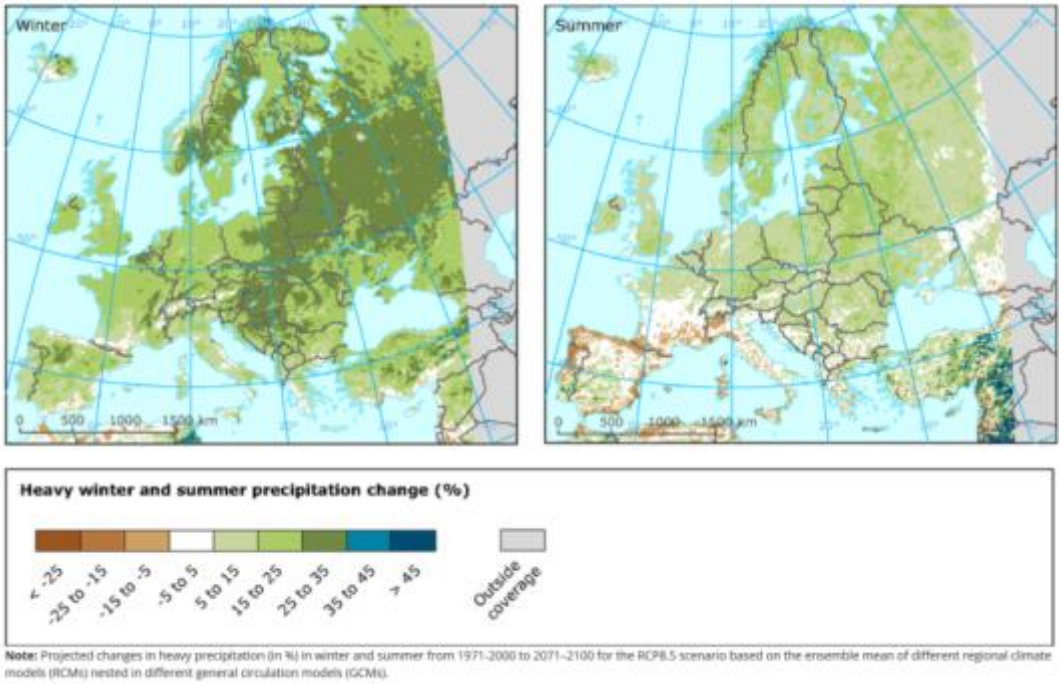
Hydrological variability, i.e. ***fluctuations of the water table*** favour the application of the DESSIN solution for water scarcity. There are seasonal fluctuations following the precipitation and infiltration patterns as well as fluctuations caused by tidal effects which create a back pressure from the seaside into the river causing it to head up and further causing less groundwater drainage or even river bank infiltration. From a hydrological point of view, the Llobregat is a typical Mediterranean river, with its flow being characterized by high variability governed largely by seasonal rainfall (Petrovic et al. (2009), p.35). Floods and droughts are generally a common characteristic of Mediterranean regions like the Barcelona Metropolitan Region and drought conditions have increased in frequency (Petrovic et al. (2009), p.34). This in turn influences the level of water resources available. This is likely to be exercabated by climate change which is expected to lead to higher intensity of precipitation and longer dry periods in Europe (Hov et al. (2013), IPCC (2012)). The first figure below indicates an increase in the projected length of dry spells in the

Mediterranean countries in particular. The second figure highlights the projected changes in heavy precipitation in winter (left) and summer (right) across different countries in Europe.



Note: Projected changes in the length of dry spell (in days) from 1971-2000 to 2071–2100 for the RCP8.5 scenario based on the ensemble mean of different regional climate models (RCMs) nested in different general circulation models (GCMs).

Figure 14: Projected change in the length of dry spells; EEA (2014a)



Note: Projected changes in heavy precipitation (in %) in winter and summer from 1971-2000 to 2071–2100 for the RCP8.5 scenario based on the ensemble mean of different regional climate models (RCMs) nested in different general circulation models (GCMs).

Figure 15: Projected changes in heavy precipitation in winter (left) and summer (right); EEA (2014a)

With respect to evaluating the ***specific site for applying the MAR technique***, amongst other criteria, the ease of injecting (e.g. permeability of the aquifer) and recovering the water, the aquifer storage capacity and the aquifer's resistance to clogging need to be considered (World Bank (2010), p.40).

The availability of ***ASR plants / reverse wells*** at the potential site would reduce the installation costs of the DESSIN solution.

Below graphic shows the spatial distribution of MAR sites across Europe in that respect. About half of the MAR sites can be found in Germany and the Netherlands. However, with respect to ASR/ASTR, mainly the Netherlands, but also Spain, Greece, the UK and Italy provide sites (DEMEAU (2014), p.14) – ASR/ASTR is not the most widely used technique across Europe as they are mainly used for pilot studies and research (DEMEAU (2014), p.16). Regarding the type of end use in Europe, using MAR water for agricultural purposes appears to be much more common in Spain, whereas most industrial uses occur in Germany (DEMEAU (2014), p.19).

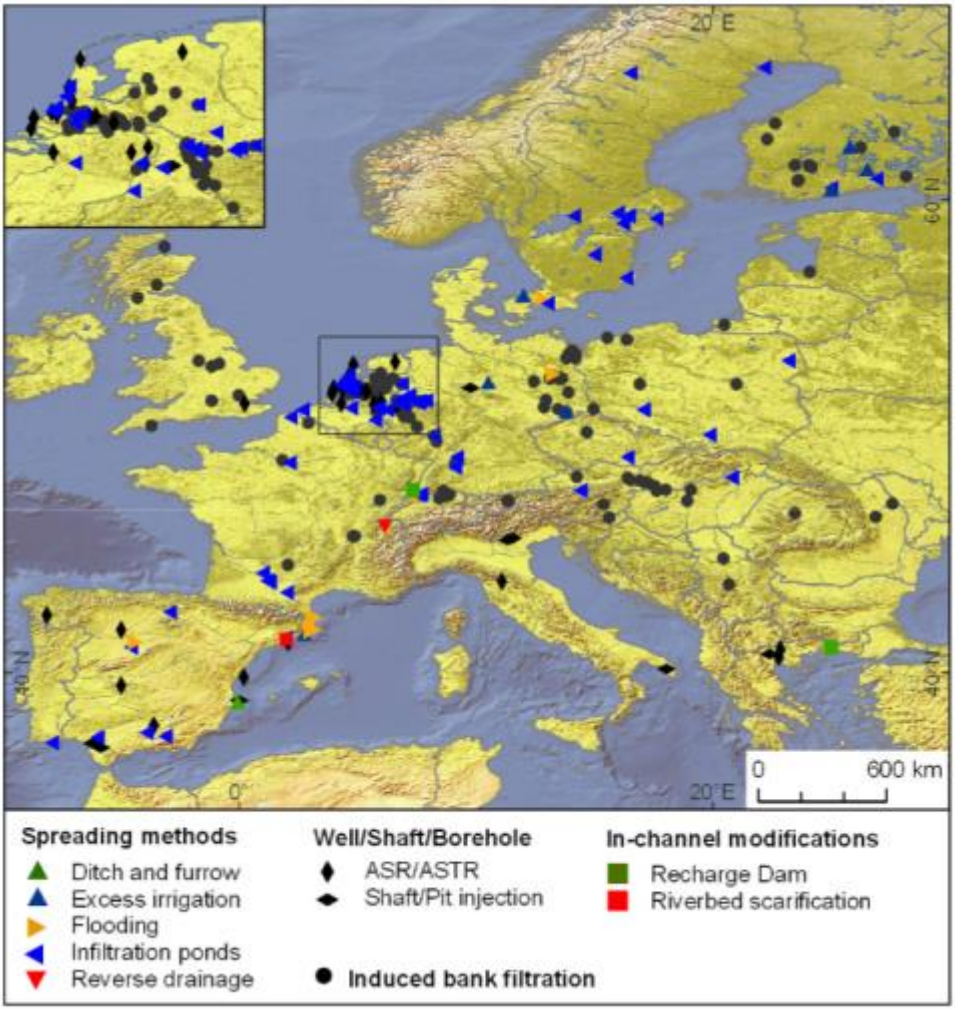


Figure 16: MAR sites in Europe; DEMEAU project (2014), p. 13

An overview of all European ASR/ASTR sites as researched by the DEMEAU project can be found in Annex B.

According to research conducted across Europe, sites with ASR /ASTR methods are tapping into aquifers with larger thicknesses (20m to >100m) (DEMEAU (2014), p.26 and 34). Sites also included aquifer depths greater than 100m below ground surface for ASR/ASTR (DEMEAU (2014), p.33). Aquifer confinemend ranged from confinded to semi-confined; the operational scale of the plants observed ranged from 0.2 to 5.8 Mio.m3/a (DEMEAU (2014), p. 34)

Urbanisation trends have already been discussed in section 5.1 above. Regarding ***demographics***, those countries with stable population growth (e.g. Germany, South Africa) are expected to slow down their investments in water infrastructure, whereas those that experience strong population growth (e.g. China, USA, Brazil) will have to invest (PWC (2012), p. 47). With regard to the EU, the highest overall increases in population in absolute terms (2008-2012) were registered in Madrid, Stockholms län, Barcelona, Berlin, the Arr. de Bruxelles-Capitale / Arr. van Brussel-Hoofdstad and Sevilla – i.e. in these regions the population rose by more than 100,000 people (eurostat (2014)).

With respect to ***PES schemes*** in the water sector (2013), compliance water quality trading is currently carried out in Canada, the USA, Australia, and New Zealand. Voluntary private sector watershed payments are taking place with several beverage companies (e.g. Vittel), industry and manufacturing (e.g. food manufacturing), energy companies (e.g. hydropower), private water utilities, tourism and recreation enterprises and agribusinesses. PWS and water funds and can be found in Bolivia, Brazil, China, Colombia, Costa Rica, Ecuador, France, Japan, Indonesia, Mexico, Nepal, Peru, Philippines, Tanzania, South Africa, USA and Vietnam. Environmental water rights purchases are happening in Australia, Mexico and the USA (Carroll & Jenkins (2008)).

With respect to other ***R&D*** hubs for water technology, Israel and Singapore have been establishing R&D clusters (EPEC (2011), p. 20). Below graphic provides an EU overview of R&D performance by applying the Innovation Union Scoreboard (IUS) – in these terms, Spain is only a moderate innovator (ERAC (2014), p.15):

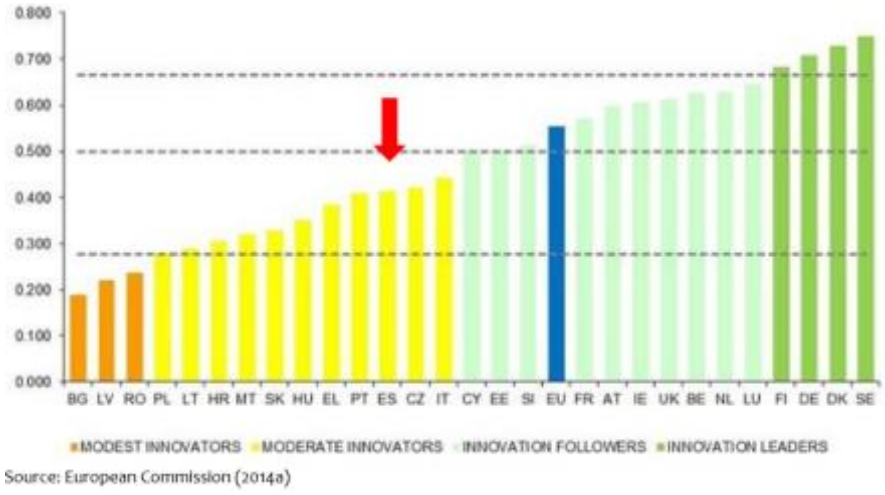


Figure 17: Aggregated innovation performance in the EU; ERAC (2014), p.14

The general market in ***Spain*** is made up of a number of regional markets joined by the two hubs of Madrid and Barcelona, the latter being the setting for the ***Llobregat case***. The 17 autonomous communities in Spain vary in terms of autonomy and cultural identity, however, the majority of market entities operate through the two hubs. Therefore, market entry of a foreign firm in general is recommended either through the appointment of a competent agent or through the establishment of an effective subsidiary in the Madrid or Barcelona areas (U.S. (2010), p.6f.).

5.4 Potential clients

As the DESSIN solutions have an additional ESS value, they particularly apply to public institutions that have an interest in preserving ESS as a public good. Private water companies could also be interested in selling the ESS that are generated.

For the DESSIN Llobregat case application of the solution package for water scarcity, the water provider for Barcelona (Aigües de Barcelona) is the "customer". Overall, the stakeholders at Llobregat include:

Table 8: Stakeholders at Llobregat; DESSIN 2014

Stakeholder name	Description
Sociedas General de Aguas de Barcelona, SA / Aigües de Barcelona	Site owner, public-private water company (with the private company AGBAR owning a large share)
Communidad d'Usuaris d'Aigües del Delta del Llobregat	Public corporation (community of users of the aquifer at the site)
Agència Catalana de l'Aigua	Public organisation / authority – water agency
Àrea Metropolitana de Barcelona	Metropolitan agency – responsible for water supply and sanitation

Elsewhere potential customers in water scarce areas could be:

- any water supplier (private or public);
- a water community of users.

In terms of available ASR/ASTR sites in southern (i.e. water scarce) Europe, the following sites and operators have been identified (DEMEAU project (2014)):

Table 9: ASR/ASTR sites in southern Europe (DEMEAU project (2014))

Country	City	Site	Operator
Spain	Castellón	Belcaire	AQUAMED
Spain	Marbella	El Señorío	AQUALOGY AQUAMBIENTE (SEDELAM)
Spain	Barcelona	Cornella	SGAB (Sociedad General de Aguas de Barcelona)
Spain	River Esgueva	river Esgueva	*not specified*
Spain	Mancha Real	Mancha Real	*not specified*
Spain	Gracia-Morenita	Gracia-Morenita	*not specified*
Greece	Kilkis	Tumpa	NAGREF
Greece	Sindos	Sindos, Giannitsa Plain	*not specified*
Italy	Prato	Prato	Publiacqua
France	Flammerans		*na*

On a more ***global*** scale, the following industries and opportunities for market uptake of MAR (without the ESS aspect) have been identified initially by the "MAR-to-MARket group"[5]:

Table 10: Potential MAR markets per industry (Escalante/Leitão (2014), p. 4)

Industry	MAR opportunities
Agro-industry	• Several examples of implementation as this sector is classically related to the exploitation of groundwater ("early MAR" branch) • Water and energy efficiency improvements by means of MAR • Success linked to the supply guarantee without climate dependence • High quality production in the *"Demo site"* • Scales variety: From individuals to big industries • High blue print (operational and in the distribution chain to be lowered by MAR), Eco-innovation label

[5] MAR-to-MARket was proposed to the IAH MAR Commission as a new Working Group in the last ISMAR (Oct 2013, in Beijing). So far, the main focus has been on Mexico (+USA), South Africa and Spain.

Water supply companies	• Sector with several examples of implementation • Water and energy efficiency improvements by means of MAR • Success linked to the supply guarantee without climate dependence
Wastewater treatment plants	• Independence of environmental circumstances • Technological solution of first order (reengineering) • Highly subject to technological advances • Specific but not exclusive in arid climates • Impacts of difficult evaluation by silting, synergies, emerging compounds... • Low psycho-social perception • Many widely distributed examples • Few well tested examples
Desalination companies	• Activity "of opportunity" (surpluses) • Often insular context • High energy costs • Industry in general related to the public administration • Subject to technological advances (increased energy efficiency) • Currently difficult but not unacceptable alternative
Bottled water companies	• Industry classically related with the exploitation of groundwater. "Early MAR" • High level of dependence on supply security • Associationism gives strength and very high visibility • Vast number of studies undertaken and projects financed by bottled companies • Market analysis on the potential exploitation of the achieved technological solutions
Golf courses	• High level of dependence on groundwater • Good examples (Phoenix, Tucson…) • Important advances in the State-of-the-art (safe yield…) • Solvent industry for technological improvements (reengineering) and R&D results exploitation • Industry mobilizing € millions • Drinkable reuse (directly for community or indirectly through aquifer)

Public administration branches	• Presence of more cells for storage in topological schemes of water management in river basin plans • Promotion of "water markets" (cap & trade management) • Increase the supply security • Promotion of alternative resources • International visibility • Innovative prestige
Spas and balnearies	• Future guarantee • Promoters of projects and studies • High risk before any qualitative variations • Precautionary principle • Emerging cases
Hotels and tourist facilities (market uptakes)	• Increase the supply security • Promotion of alternative resources • International visibility • Innovative prestige

Customer characteristics & requirements

In the following, the customer needs and requirements within the wastewater technology market and regarding single aspects of the solution package are described.

In ***Europe***, the management of the local water supply is also in general the responsibility of the municipal authorities (IUCN (2009), p. 22). However, there are also several private and public-private operators. Below graphic illustrates this for several European countries.

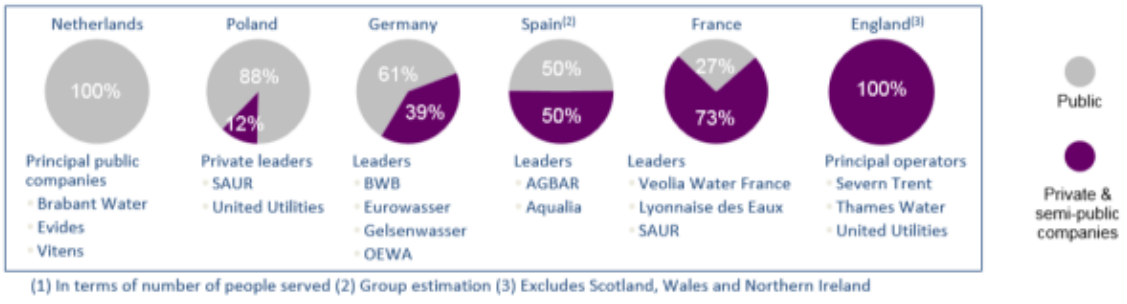


Figure 18: Public-private market shares for water services in Europe; Agbar (2011), p.16

Generally, the ***EU*** water market is rather mature and innovation is taking place incrementally, oftentimes as new legislation is put in place. Also, water utilities are rather risk averse because failing in a proper water/wastewater treatment process can have significant impacts on human

health and on the environment for which they could be made liable. Technology innovations must therefore be "safe" to meet their expectations (EPEC (2011)).

As market drivers for (water and) wastewater technologies in Europe are regularly stricter regulations and, mainly for water treatment, the requirement to reduce energy costs, a focus has been on innovative applications that can produce higher quality water at lower costs (for example energy efficient treatment processes such as low pump rate membrane technologies) (ibid.).

The key interest of watershed investors by type of buyer could provide an indication of the benefits that the different customers are looking for as depicted in below graphic[6].

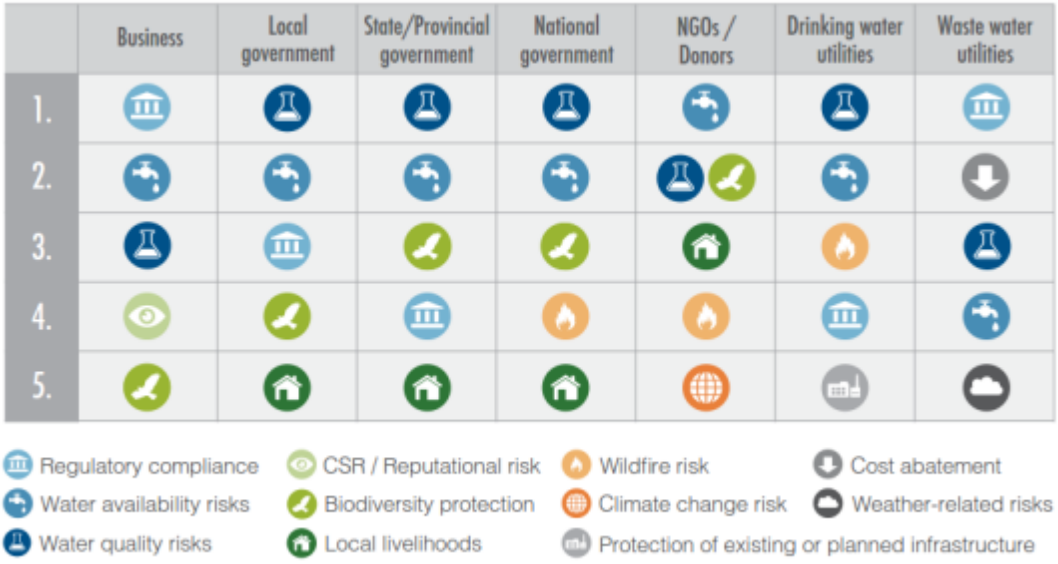


Figure 19: Top investment motivations by buyer sector in 2013; (Bennett/Caroll (2014), p. x

With respect to the objectives regarding the final use of European MAR projects, the DEMEAU project states the following according to types of users:

[6] It is worth noting that these were nature investments in watersheds not infrastructure investments.

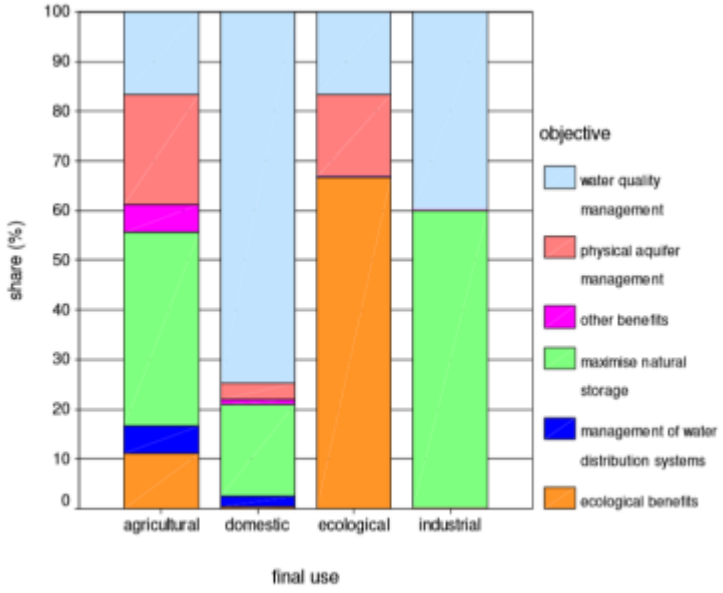


Figure 20: Main objective in % share per final use of European MAR systems; DEMEAU (2014), p.19

Generally, agriculture uses the largest share of water in ***Spain*** - however, this sector consumes water that is heavily subsidized and is thus not necessarily complying with the principle of cost recovery promoted by the WFD (González-Gómez (2012), p.3). Regarding water provision, the Spanish water sector is characterized by long-term contracts (20-25 years) that are given through competitive tenders. Due to public deficit reduction schemes, privatization is further aggravated (Agbar (2011), p. 24). Below graphic further details the governance structure regarding pricing, collection and reinvestment in Spain.

Country	Authority responsible for price setting	Authority responsible for collection of revenues	Authority responsible for reinvestment of revenues
Spain	Regional pricing committee and regional administration	Supply services: urban water supply operators (public or private) Sanitation services: municipalities (through public or private service providers) and regional water agencies	Supply services: urban water supply operators (public or private) and regional water agencies Sanitation services: municipalities and regional water agencies

Figure 21: Basic characteristics of the governance structures of the water supply and sanitation services in Spain; EEA (2013), p.39

For the DESSIN ***Llobregat case***, the "customer" is the Barcelona water provider, a public-private company in which Aigües de Barcelona has an 85% share and Àrea Metropolitana de Barcelona (AMB) has 15% (Agbar (2014)). As a water provider, their main interest should be the continued water provision despite water scarcity to generate profit. Selling the ESS through a Payments for Ecosystem Services (PES) scheme could also be of interest.

6 Financial opportunities

Guiding questions for this section are:

- ***What public/private funding options are generally available for the solution?***
- ***What are the characteristics regarding Payments for Ecosystem Services (PES)?***
- ***What kind of private sector financing could be sought?***

6.1 Funding

Public funding

As the DESSIN solutions are expected to have an additional impact on ESS and their provision, they particularly apply to public institutions that have an interest in preserving ESS as a public good, in addition to the water quality benefits generated. Therefore, public funding for the initial applications could be the most likely source. As described in the section on potential clients above, funding sources include communities / municipalities, river basin organisations, waste water corporations, public works departments, and generally all decision makers in public infrastructure planning bodies who are in charge of sewerage and surface water management. Procurement is in these cases likely to take place through ***public tenders*** announced from the respective public organisation or if beyond a certain threshold value EU wide.

Public funding could also be tapped into again through other ***EU programmes***. For example, the EIP provides the following overview of public funding opportunities for the water sector (EIP Water (no year)):

Table 11: Public funding opportunities for water sector innovations

Programme	Type	Group of beneficiaries
Horizon 2020	Public	Research and innovation; also: Horizon 2020 SME instrument
LIFE+	Public	All levels up to commercialization phase
Eurostars	Public	Not very clear; best fitting is pre-commercialization and commercialization phase.
ACQUEAU (Eureka Cluster)	Public/private	The project must have a strong market and exploitation orientation.
Structural and Regional development Funds. RIS3 Regions	Public	n/a
European Regional Development Fund (ERDF)	Public	Support for small and medium-sized enterprises (SMEs) included

The EC also provides a list of direct EC grant programmes online[7]. Indirect funding per EU country can also be accessed online, i.e. through the relevant funding authorities[8]. Generally, the EU wants to relate European subsidies to national and regional funding programmes.

As climate change poses a significant risk to water supply, national and international ***funding sources for climate change adaptation*** projects might also be sought (e.g. with respect to adapting water supply). Emerging climate funds include, e.g., the World Bank Climate Investment Funds and the UNFCCC Green Climate Fund.

For the sake of setting up an ESS trading scheme, the state might also support by ***subsidising or guaranteeing credit*** used on the project. Loan guarantees could, for example, catalyze private financing by absorbing risk that may otherwise be inhibiting ESS finance (Hartwell et al (2010), p. 25).

There is also non-financial public support for innovative SMEs in Europe such as provided by INNOWATER (e.g. free "Internationalisation Coaching").

In ***Spain***, the following funding opportunities are mentioned (InvestInSpain (2014), p. 45):

R&D&i:

- The **Centre for Industrial Technological Development (CDTI)** has got a wide range of grants and loans at competitive low interest rate for technological projects.
- The **the State Secretariat for Innovation** in the Ministry of Economy and Competitiveness (MINECO) also offers support with grants and loans for technological projects developed by companies and public organisms
- INVEST IN SPAIN/ICEX has developed a programmed for supporting foreign companies up to € 200,000 for investments with a high degree of R&D in competitive tender
- The **National Innovation Company (ENISA)** finances SMEs up to €1.5 million with participative loans at a very competitive interest rate and where no-guarantee is required.
- The Public organization **RED.ES** promotes the IT activities of technological companies and start-ups financing investments in infrastructures, equipments and so on.

Investments:

- The **Official Credit Institute (ICO)** supports the creation/investment carried out by companies and entrepreneurs with loans/ leasing at a low rate
- The **Ministry of Industry, Energy and Tourism (MINETUR)** and The **Ministry of Economy and Competitiveness (MINECO)** support investments in equipment and infrastructures with grants and loans for large and SMEs companies
- The **Institute for Energy Diversification and Saving (IDAE)** participates directly in the projects with loans at a low interest rate

Human Resources:

- The **Ministry of Industry, Energy and Tourism (MINETUR)** and **The Ministry of Economy and Competitiveness (MINECO)** support investments in human resources, training and hiring, personnel with grants and loans

45

Figure 22: Spanish institutions promoting incentives; InvestInSpain (2014), p.45

[7] EC grant programmes: http://ec.europa.eu/contracts_grants/grants_en.htm
[8] Funding authorities in EU countries: http://ec.europa.eu/regional_policy/manage/authority/authority_en.cfm

The ***DESSIN project*** has received funding from the European Union Seventh Framework Programme (FP7/2007-2013).

However, in Europe, public investment has been decreasing since the 1970s from about 5% to about 2.5% of GDP in the 2000s (Välilä et al. 2005).

Private funding

In addition to the potential public clients listed above, private companies that take a similar role (e.g. private wastewater companies) could buy the DESSIN solution package. However, their interest might differ in that they would also be looking at selling the ESS that are generated. Already the specific case of the Llobregat points in a direction where the involvement of a private international holding (AGBAR) could open opportunities for replication of the DESSIN solution in various regions outside the EU where the company has market presence and where market conditions are similar (building on the analysis of Chapter 5).

Also private companies (e.g. large beverage companies) might act as payers in a voluntary ESS trading scheme.

In addition, the EIP provides a list as general private funding opportunities for the water sector (EIP Water (no year b)).

Table 12: Private sector funding opportunities for water innovations

Programme	Type	Group of beneficiaries
ACQUEAU (Eureka Cluster)	Public/private	The project must have a strong market and exploitation orientation.
Veolia Innovation Accelerator	Private	Start-ups, researchers, suppliers on disruptive solutions
Kickstarter	Private	Start-ups
Enterprise Europe Network	Public/private	Help small companies find international business partners, source new technologies and receive EU funding or finance; advise on issues such as intellectual property, going international, or EU law and standards; there are contact points per country and city (e.g. here for Germany)
WssTP	Public/private	WssTP is the European Technology Platform for Water consisting of 98 members and a network of more than 700 individuals from Industry, research, technology providers, policy makers and water users; there is an ecosystems working group

ERRIN – Europeans Regions and Research and Innovation Network	Public/private	ERRIN is a Brussels-based platform of research and innovation organisations and stakeholders in different regions; there is a working group on water

6.2 Payments for Ecosystem Services

Following the DESSIN ESS Evaluation Framework (i.e. economic quantification – where achieved), PES could be aimed for with the DESSIN solution package. IUCN describes the PES approach as follows (IUCN (2009), p. 11): "*The PES approach is a market-based approach to conservation financing based on the twin principles that those who benefit from environmental services (such as users of clean water) should pay for them, and that those who contribute to generating these services should be compensated for providing them. The approach seeks to create mechanisms to arrange for transactions between service users and service providers that are in both parties' interests, thus internalizing what would otherwise be an externality.*"

Generally, PES could be divided into three categories (Carroll & Jenkins (2008)):

1. *Compliance markets* that are driven by regulation and enforcement, similar to other pollutant trading markets; e.g. cap-and-trade models;

2. *voluntary markets* which are driven by ethical and/or business-case motives (or in oftentimes the threat of future regulation); e.g. such as generated by a few beverage companies;

3. *government-mediated markets* that are publicly-administered programs using public funds (e.g. taxes) to directly pay private landowners for the stewardship of ecosystem services on their property; this is the most common PES.

I.e. on these markets, ESS could be traded.

The ESS are generally provided by the owner / manager of the particular ecosystem. To prove the existence and delivery of the ESS, the owner needs to (IUCN (2009); p.8):

- Define the service,
- Assess by what particular ecosystem the service can be provided,
- Measure if the service is delivered (for that a baseline against which the additional ESS units that are generated needs to be set up).

For the compliance markets, quantifying the environmental impacts is the greatest challenge.

As for most markets, the price for a particular ESS is ultimately determined by what the buyer is willing to pay and what the seller is willing to accept and deliver. In regulated markets (i.e. compliance and government-mediated), the willingness to pay is often mandated, whereas it is negotiated in voluntary markets (OECD (2008), p.39).

However, finding funds to pay for the specific actions needed to generate and maintain credits is critical to the eventual success of any markets for ESS credits. Below graphic shows the cash flows over time for a rural ecosystem services example which illustrates the initial need for financing.

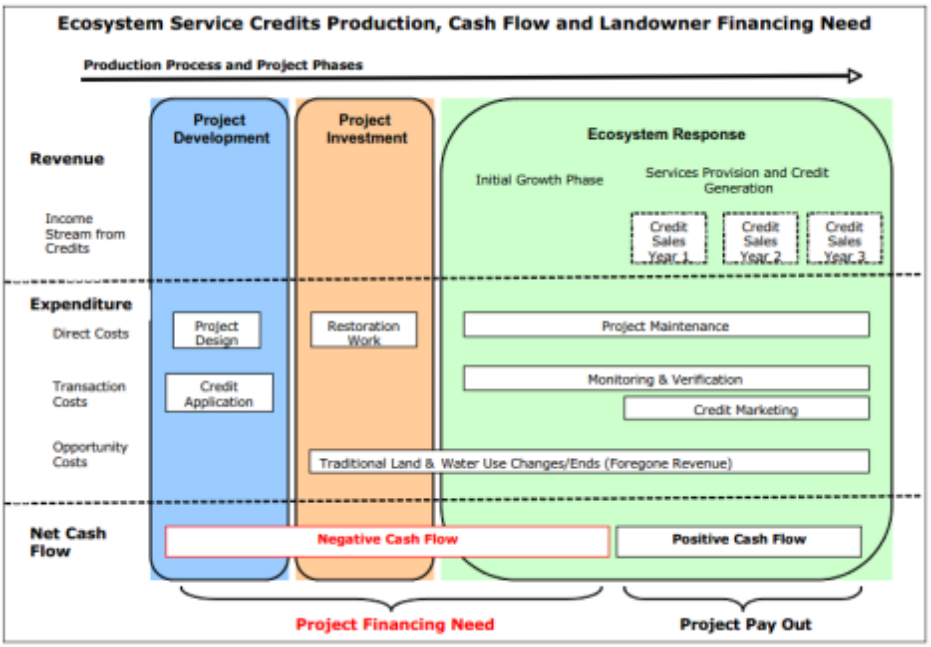


Figure 23: **Ecosystem Service Credit Production, Cash Flow, and Landowner Financing Need – Rural ESS Example; Hartwell et al. (2010), p. iv**

It is worth analyzing the existing compensation mechanisms for the use of (ground-)water, since the collected money provides a potential source of funds through which a PES scheme can then be financed (IUCN (2009), p. 13). In ***Catalonia***, water users contribute to the costs of water cycle services through the water levy (Cànon de l'aigua) (Government of Catalonia (2014c)). The water levy in Spain is mostly calculated as a function of the used water and follows an increasing block-tariff design (EEA (2013), section 5.1.4). Below graphic provides an overview of the tariff structure and average rates in Spain (ibid., p.51).

	Tariff structure		Average rates (EUR/m³)	
	Households	Industry	Households	Industry
Spain	• Varies according to location. The application of progressive tariffs (increasing block tariffs (IBT)) is common in many urban areas of Spain (¹) • For instance, in the city of Barcelona, water supply services are managed using a hybrid model which encompasses a flat rate (service fee) coupled with increasing block rates	• Similar pricing structure to that of the household sector • Example: City of Barcelona (Aigües de Barcelona)	• Spain: 0.85 EUR/m³ • Catalonia: 1.14 EUR/m³ • Barcelona (province): 1.181 EUR/m³	• Spain: 1.12 EUR/m³ • Catalonia: 1.66 EUR/m³ • Barcelona (province): 1.342 EUR/m³

Figure 24: **Tariff structure and average rates in Spain (EEA (2013), p.51)**

However, as noted above, the main water user in Spain is the agricultural sector for which water is subsidized.

6.3 Financing

Private sector financing might be sought for several reasons, including the following amongst others:

- As initial funding to set up a PES scheme until ESS credits are generated;
- Due to public sector budget constraints and anticipated infrastructure financing gaps, private sector involvement for financing of public infrastructure might be sought;
- To generally access the much larger pool of financing from private capital markets.

In very general terms, there are two main types of financing: debt or equity financing. Debt financing tends to be the type of financing received from a traditional bank loan and equity financing tends to be financing from venture capital into the business from outside investors. There are also several debt-equity combinations possible.

Straight debt: corporate lending

The most conventional source to receive innovation finance from is banks: they are oftentimes unlikely to invest equity in a new, small company but are able to provide loans. However, despite turning more often to banks for financing than large firms, SMEs are rejected more often. Structural reasons for that include that SMEs are more opaque and their corporate capabilities more difficult to assess, because their financial statements are less informative and their credit histories are usually shorter. Due to higher transaction costs (e.g. external assessment), SMEs then tend to face higher costs for bank finance (Cœuré (2013)). To encourage Banks to make loans to "undesirable" SME customers, public authorities have put in place some guarantee schemes (see above).

The EU portal "access to EU finance" provides a detailed list of financing institutions per country, mainly for loans/guarantees (EU (2014)).

Infrastructure project financing (debt & equity)

For large wastewater infrastructure projects, project finance could be applied. However, this is a rather complex model that requires external advice. Projects are generally tendered EU wide in lengthy and resource intensive procedures.

Private capital spent on infrastructure finance in the EU amounts to around 0.33% of EU GDP (based on 2009 GDP) – with 0.19% being part of public private partnerships (PPP) and the rest being non-PPP project finance. The capital structure of the project financing has been looking as follows: 80% loans, 6% bonds, 14% equity financing (Inderst (2013), p.6).

A general overview on project infrastructure financing instruments is provided in below graphic – there are also mixed instruments, hybrids, and variations of these instruments (Inderst (2013), p.17).

		direct	indirect
equity	public	listed infrastructure & utility stocks	listed infrastructure equity funds; index funds; EFTs
	private	direct equity investment in infrastructure company / project	unlisted infrastructure funds
debt	bonds	corporate bonds of infrastructure companies; project bonds; PPP/PFI bonds; US municipal	infrastructure bond funds
	loans	direct loans to companies / projects / asset backed financing	infrastructure loan / debt funds

Figure 25: Infrastructure financing instruments and investment vehicles: Inderst (2013), p.17

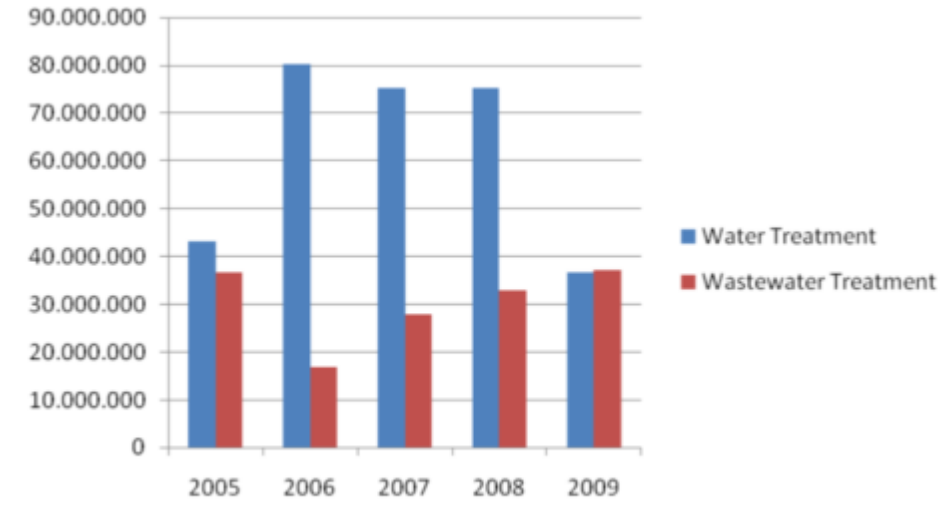
With respect to institutional investors from which infrastructure project finance has been coming from globally so far, the banking sector still plays a major role. However, folllowing the world economic crisis and the Euro crisis, most European banks now reduce risk by decreasing long-term lending (projects over 7-10 years), by reducing foreign exposure, and by offloading assets from their balance sheets (Inderst (2013), p.31).

Private Equity: Venture Capital vs. Angel Investors

For private equity, oftentimes the market stage of the product / solution determines the type of equity available. Most private equity companies also have a very strong sectoral focus (Für Gründer (no year)).

One of the most relevant financing sources for innovative companies is ***Venture Capital*** (VC). VC funds buy shares or convertible bonds in the respective company. As VC funds allow the respective company to expand and thereby increase the value of their investment, they are interested in innovative SMEs with very rapid growth rates (CORDIS (no year)).

With respect to venture capital regarding wastewater treatment technologies, past venture capital deals included activated sludge technology, advanced oxidation, membrane based wastewater treatment and advanced aeration. Out of fifteen investments (2009), just three were EU companies. The figure below shows VC investments made into the water and wastewater sector between 2006 and 2009 (for water and wastewater treatment) (EPEC (2011), p.22).



Source: GHK analysis adapted from Cleantech Group LLC. 2010.

Figure 26: VC investments for water and wastewater treatment; EPEC (2011)

Other institutional private equity, e.g. including ***pension funds***, are generally more risk averse and rather interested in mature technologies not innovations.

In strong contrast to venture capitalists, ***angel investors*** give more favorable terms than other lenders. This is due to the reason that they are investing in the person and are focused on helping the business succeed, rather than reaping a huge profit from their investment. (Investopia (no year)).

The EC funded INNEON project provides access to three types of investors: business angels, venture capital and corporate investors. Self-help tools, coaching and networking support are also provided (see http://www.inneon.eu/).

Private (-Public) Innovation Funds

Large private companies or funds set up by a group of companies, governments and public/private banks are also looking for innovative SMEs to invest into. This can happen through the set-up of funds into which fund managers can then in turn invest into.

The European Investment Fund (EIF) is an example of a public-private innovation fund that provides risk finance to innovative SMEs in Europe[9]. EIF has been active in Spain since 1997. Initiatives there include amongst several others NEOTEC, European Angels Fund (EAF) Spain and JEREMIE (EIF (2013), p.1).

[9] See www.eif.org

7 Barriers and challenges

Guiding questions for this section are:

- ***What barriers and challenges have been identified regarding the governance framework for the solution?***
- ***What are hindering market characteristics for the solution?***
- ***What financial obstacles could be encountered?***

Barriers and challenges are derived from insights generated during the development of chapter 3, 4 and 5 and discussed in view of the current product maturity and readiness. The following types of barriers and challenges are thus looked at:

Figure 27: Categories for barriers and challenges; adelphi (2014)

7.1 Governance frameworks

Generally, the EU water sector is characterized by a ***complicated regulatory environment***. The complexity covers various political topics and hierarchy levels in the EU and has resulted in different regulations / standards per region and sector. Also, the EU water sector is highly fragmented and conflicting in policy, ownership and responsibilities (see also EIP Water (2014), p. 6f.).

Products are certified at (EU) national level with each country having specific requirements. The ***certification cost*** can therefore be a hindering factor for market entry possibly leading to the adoption of sub-optimal technologies locally (EIP Water (2014), p. 6).

The different characteristics and regulations are also reflected in the ***different average tariffs*** for water in the different EU countries (Agbar (2011), p.15).

The governance within ***river basins districts*** as opposed to administrative borders is also an issue in Spain ***for inter-regional rivers*** (Sánchez-Martínez (2012), p.35; also González-Gómez (2012)). The creation of river basin authorities in Spain took place already in 1926 and river boundaries were classified by the Water Act of 1985 as either inter-regional (to be managed by the State) or intra-

regional (to be managed by the autonomous community). However, there has been a power struggle between the two government tiers which is having negative consequences for the river basin management and is leading to the river basins being partitioned and the rivers being fragmented (Sánchez-Martínez (2012), p.40). The management of cross-boundary rivers (e.g. across Spain and Portugal) in basins according to the WFD is also an issue.

Regarding the set-up of PES, the ***ownership of water resources*** is an issue. However, across the EU countries, groundwater ownership is not regulated in a unified way. According to an IUCN analysis regarding country legislation within the EU, three types of groundwater ownership can be differentiated (IUCN (2009), p.22): (1) Public groundwater ownership, (2) public and private groundwater ownership and (3) groundwater as a "res nullius" (ownerless property). Spain is a special case in that respect as originally all groundwater was under private ownership but with the Water Act from 1985, all groundwater resources are now public domain– however, developments made before 1986 may continue as private domain leaving an unknown number of groundwater resources private (IUCN (2009), p.23; Sánchez-Martínez (2012), p.14). This makes the proper public management of groundwater in Spain problematic.

There are also issues regarding the ***overexploitation of aquifers***. E.g. in Spain, many aquifers that are extensively used are not declared as being overexploited which is partly due to the strong representation of established users. Few of the user associations that are set up in Spain are oriented towards the sustainable use of the aquifers as a common resource as most are rather interested in the common use of infrastructure (Fuentes (2011), p. 24).

While European and national water policies can encourage greater utilisation and investment in ***MAR techniques, existing regulations*** tend to impede uptake of recharge projects with non-potable quality of water (e.g. Spanish regulation for reclaimed water RD1620/2007).

There is currently relatively ***poor knowledge on the role of ecosystems*** in the provision of water related services (EIP Water (no year)). ESS as an additional benefit of innovative technologies for improving water quality needs is not yet widely acknowledged in public guidelines and regulations.

The DEMEAU project has also identified several barriers on the ***contextual level***, related to the embedding of water technology innovations into policies and regulations such as (DEMEAU (2014b), p.44f.):

- For relevant policies: "a lack of demand for optimal efficiency, a demand for improved quality and/or specific guidelines for the respective methods and technologies"; and
- for the intra-organizational aspect of financial resources: "e.g. governmental institutes have tight budgets, the developing stakeholders often do not have the means to invest, and water utilities tend to be driven mainly by regulatory thresholds".

7.2 Market dynamics

The water sector is generally characterized by ***high risk aversion*** for innovative technologies and is therefore rather reluctant to launch innovations in practice including demo sites. The application of innovations is further hindered by conservative procurement approaches that neglect longer-term operational or lifecycle costs and favour proven technologies (EIP Water (2014), p. 5-7).

As the market is rather ***consolidated***, another barrier for bringing innovative technologies to market in the EU is the ***dominance of large established firms*** who exercise considerable control and influence across the supply chain (EPEC (2011)).

The EU water market is also rather ***mature*** and innovation is taking place only incrementally, oftentimes as new legislation is put in place.

Regarding the stipulation of demand, public infrastructure investment in Europe has been decreasing, as well as in Spain and the region of Catalonia. The demographic trend of de-urbanisation in the EU also somewhat provides a new shape to the demand side.

Generally, the successful operation of MAR techniques requires ***appropriate training for operators***, access to successful demonstrations of the technologies being deployed and sound and integrated management of water resources (akvopedia (no year)).

The DEMEAU project has investigated several MAR implementation drivers and barriers including those perceived by stakeholders of the Llobregat case (DEMEAU (2014b), p. 15-17). E.g. one of the perceptions is that MAR solutions are found not to be directly ***transferable to other contexts***.

7.3 Financial hurdles

The EIP has identified the ***lack of funds for SMEs*** as one of the major barriers and bottlenecks for innovation in the EU water sector (EIP Water (2014), p.5): “Many SMEs are innovative and develop excellent products and services. In their innovation process when a prototype is developed they are often confronted with a lack of financial resources for further development, customization, demonstration and commercialization. Due to little or no access to funds, R&D programs or other financial resources, further development stops. “

In terms of public funding of infrastructure investments, ***public budgets in the EU are expected to remain tight*** for some time following the global financial crisis and global economic slowdown and the Euro crisis (Inderst (2013), p. 39).

With a lack of investor confidence in that environment, ***raising private infrastructure finance is also not easy***. The new accounting and tax framework in the EU is perceived as another barrier to investment. Generally, most European banks reduce risk by decreasing long-term lending (projects over 7-10 years), by reducing foreign exposure, and by offloading assets from their balance sheets (ibid).

In terms of raising the financing needed to set up ESS trading, the above also apply.

Regarding the Llobregat case, one of the longer-term practical issues is the question of ***who should pay for the recharged water***.

8 Recommendations

Guiding questions for this section are:

- ***What recommendations could be derived from the market analyses that are of relevance for policy makers?***
- ***What recommendations can be concluded for the SMEs?***

Recommendations on how to improve the innovativeness of European SMEs in the sector, in particular with the co-benefits identified with the DESSIN ESS Evaluation Framework, are derived for policy makers and for SMEs (with few overlaps occurring). Policy makers are also included as a wider audience of interest and to properly shape the upcoming DESSIN support services that target policy makers.

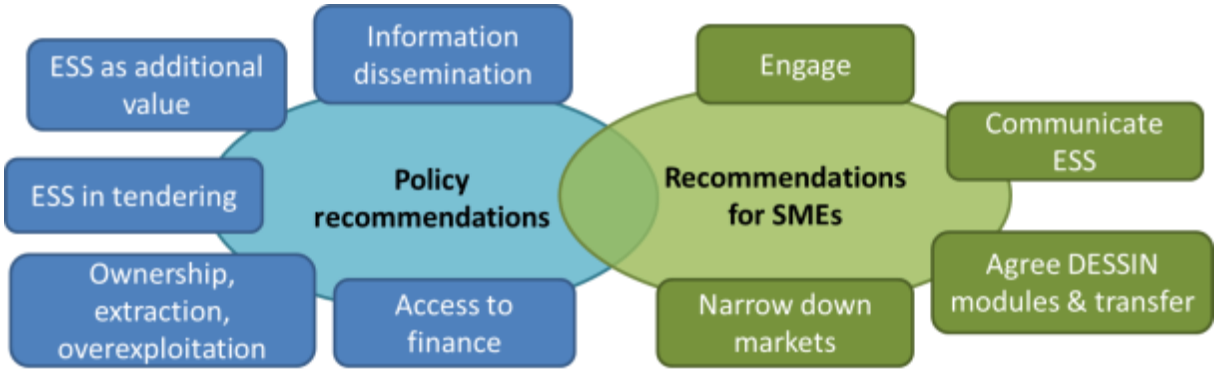


Figure 28: Recommendations derived; adelphi (2014)

8.1 Policy recommendations

Generally, wider ***information on the linkage between innovative water technologies and the improvement of ESS*** are a first step.

As another step, ***including ESS aspects in tendering procedures*** (e.g. at EU level or locally) could set an example. EIP Water suggests evaluating the potential of public procurement for driving innovation in that sense (EIP Water (2014), p. 7-9).

In Spain, further effort needs to be put into the establishment of clear ***ownership of groundwater*** resources, the monitoring of ***extraction*** of groundwater and the ***overexploitation*** of aquifers. Also, the ***governance of inter-regional river basins*** and the current ***legislation on MAR techniques*** using pre-potable water need to be reviewed carefully.

With respect to ***improved funding / financing for innovative SMEs in the water sector***, there are various levels of suggestions for enhancement, ranging from targeted public funding support for

specific innovative SMEs to setting up specific funds (e.g. water technology fund, export fund) and a European performance guarantee scheme for innovative technologies (EWP (2014)).

Regarding increased ***availability of financing for ESS projects*** the following primary strategies could, for example, be looked at (Hartwell et al. (2010), p.19f.):

- Build financial and market infrastructure to help to manage transaction costs and enable basic deals (e.g. create standard contracts, appraisal and accounting protocols; develop simple crediting protocols that can reduce transaction costs);
- Reduce project risk to increase capturable value by managing the volatility of potential returns (e.g. set up clear and simple crediting and trading rules; establish secondary markets for ESS credits; check other mechanisms such as insurance);
- Increase project value through policy or other mechanisms to attract financing (e.g. tax policy, public support in building demand, financing through revolving funds, minimum price guarantee by government, route projects through "save" (government) institutions to the market);
- Structure projects differently can help match the economic opportunities of ESS projects with investor and financier priorities to increase access to funding (e.g. aggregate projects to larger bundles);
- Provide financing directly through public policy (next to private funding) is an approach that reduces the need to reposition projects as private investment opportunities (e.g. government subsidies for credits; guaranteed minimum price with state being the ultimate buyer).

8.2 Recommendations for SME's

Generally, next to engaging with the ***relevant state authority***, it is important to ***engage with planners*** as they are important decision makers for implementing technologies; ***operators*** also need to be engaged regarding operational aspects of the technologies. Enrolling in ***organisations that set and promote codes of practice*** can be of benefit in terms of promoting certain techniques (not particular solutions). In Spain, explaining the MAR technique with pre-potable water to the relevant legislative body could increase awareness of the benefits and issues around that technique. Regarding MAR, liaising with the EIP action group called „MAR Solutions - Managed Aquifer Recharge Strategies and Actions (AG128)" that includes aspects on bringing MAR to the market could be sought. Also, other EU FP7 programmes such as MAR-SOL and DEMEAU have route to market elements that could be linked to.

For proper communication, it is essential to find methods and tools to ***communicate*** the DESSIN solution package, its technologies and the ESS benefits ***in understandable terms*** to potential clients. Regarding the Llobregat case, as Agbar is interested in selling ESS, they need to be able to (IUCN (2009); p.8):

- Define the service,
- Assess by what particular ecosystem the service can be provided,

- Measure if the service is delivered (for that a baseline against which the additional ESS units that are generated needs to be set up).

Regarding the ***DESSIN solution package*** for the Llobregat case, Amphos21 can take the package to the market as a lead entity. In terms of modularising the package, the ***specific modules and entities*** repsonsible for these modules should be agreed upon by the project stakeholders. The DESSIN solution is currently still very site-specific – the development of ***transfer protocols and mechanism*** to other sites (e.g. also regarding the numerical models) could therefore be of benefit.

It is also essential to further discuss the protection of ***Intellectual Property Rights*** (IPRs) of the technology companies within the DESSIN solution package and beyond.

For a more detailed assessment of markets, these should be ***further narrowed down*** (ideally with a single lead SME). The following process could be applied for that (Innowater (2013), p.7):

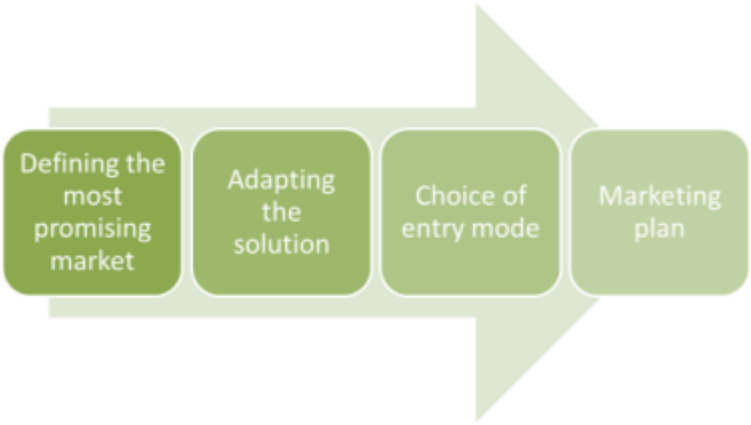


Figure 29: Four steps for internationalisation; based on Innowater (2013), p.7

1. *Defining the most promising market:* From the potential geographic markets provided in this report, one market should be selected. This could be done by checklists, including items such as, e.g. (next to the screening criteria in chapter 3):
    - Is the geographic proximity appropriate for your company?
    - Is the country's political stability and local legal framework sufficient?
    - Are there IPR/licensing issues in the country that need to be considered for your module within the solution package?
    - Is the quality of local infrastructure and staff supportive?
    - Are there language or cultural barriers?
    - Is the market size sufficient? Is the number of potential customers sufficient and are you able to identify them in detail?
    - Can you participate in tenders there? Is there potential for collaboration with others?
    - If your competitors are not there, what are the reasons for that?
    - How does your product and pricing compare to local competitors?
    - What are payment methods and habits of the potential customers?
    - And ultimately: Does the potential customer (i.e. target market) have a need that he/she is willing and (financially) capable to address?

2. *Adapting the DESSIN solution package:* It needs to be determined whether the solution satisfies an unmet need in the market selected. For that, the DESSIN solution needs to be

positioned relative to the products of the competition in that market. Once the positioning is clear, it can then be assessed whether and to what extent an adaptation of the solution package is required and if only selected modules should enter the market.

3. *Choice of entry mode:* Once the specific solution is decided upon, the specific form of market entry can be chosen. This can range from exporting the technologies, to working with local agents or collaborating with a local partner company, to setting up a subsidiary.

4. *Marketing plan:* Finally, once the market, product and entry mode are clear, the detailed marketing plan can be developed.

In order to create more fovourable conditions for the DESSIN solution package and motivate more stakeholders, the advantages of ESS improvements for other sectors can be elaborated and comunicated. E.g. it could potentially be looked into **linking the arguments** from the water sector to the energy sector (e.g. water needs for generation and cooling) or even the agriculture (e.g. irrigation needs).

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ANNEX A: Market screening tables

For an initial market screening, and before a detailed market analysis is carried out, the following criteria could be checked for the DESSIN solution package on water quantity (examples have been taken from the Llobregat case in Barcelona and the detailed market assessment):

Guideline for product description
Guiding questions: • What is the problem that is addressed by the solution? Why is the solution needed? • How is the solution package structured to address the issue? • What is the specific context and setting of the initial solution application (where does it work)? • What are the ecosystem services that are expected to be influenced by the solution?

STEP 1:

Criteria for initial screening for critical success factors	Check
Guiding questions: • What is the market readiness of the solution (maturity and applicability)? • What is required in terms of local site specifics? • What policy mix is needed to support the solution? • What factors are relevant for the willingness to pay for the solution?	
Maturity & applicability of the solution, e.g. Technology elements of the solution are technically ready for market application / have passed a demonstration site testing	
Proper local setting, e.g. for ASR • Area where a water buffer is needed / fluctuation of the water table • Aquifer has enough permeability • Ideally, ASR plant / reverse well installed already • (Urban / peri-urban area, i.e. great number of water users including industry)	
Policy mix, e.g. Following the provisions of the WFD/local regulations, i.e. WFD is implemented in the respective country; for non-EU countries check if similar directive/legislation has been passed	

Willingness to pay, e.g. • Water providers have an interest (water supply is at risk due to water scarcity) • Area where water is expensive • Other techniques for securing water supply are more expensive	

If STEP 1 has provided positive results, the following could also be looked at – **STEP 2**:

Criteria for assessing the governance framework	Check
Guiding questions: • What is the wider regulatory framework? I.e. what EU directives influence the solution? • What is the relevant local governance framework of the application example? • What potential governance solutions can be extracted from the application example? • What is the pull effect or shaping effect of the European, National or Local conditions for the case?	
Description of the regulatory framework, e.g. • Provisions from the WFD (and daughter directive on groundwater) and current implementation challenges • Other relevant EU directives and policies	
Description of relevant local governance frameworks, e.g. • Framework is transposed to national legislation • Monitoring network is established • Pricing policy exists • Screening of relevant local and / or national governance actors *The online database ECOLEX can be checked for environmental laws globally: http://www.ecolex.org/start.php (however, caution needs to be applied regarding the actuality of the laws)*	
Extraction of potential governance solutions, e.g. • Relevant local stakeholders and potential financial contributors are committed • Potentially existence of site/regional plan for the future	
Assessment of pull effect or shaping effect of European, national or local conditions, e.g. • Continued water provision despite local water scarcity as a driver • Full cost recovery (incl. environmental aspects) in line with WFD as driver for PES	

Criteria for analysing market conditions	Check
Guiding questions: • What characteristics describe the international and national market? I.e. what is the bigger market picture? • In what geographic regions could the solution be of interest? • What could be potential customers for the solution?	
General description of market conditions • Assessment demographic environment (e.g. urbanisation) • Screening of status of water bodies and water ESS in the particular area • Evaluation of financing environment (investment friendliness) • Identification and benchmarking of competitors •	
Assessment of current and future demand, e.g. • Analysis of customers' current needs and demands • Analysis of different demand forecasts (macroeconomic / industrial / sales)	
Geographic regions, e.g. • Locations with strong hydrological variability, i.e. fluctuations of the water table • Check where this is aggravated by climate change • Specific site requirements for applying the MAR technique, e.g. ease of injecting (e.g. permeability of the aquifer) and recovering the water, aquifer storage capacity and aquifer's resistance to clogging; • Existing ASR site (e.g. in Netherlands, Spain, Greece, the UK and Italy)	
Potential clients, e.g. • Once a country has been selected, customers similar to Aigües de Barcelona (e.g. large public/private water provider or operator) could be searched for • Needs and characteristics of users/clients	

Financial opportunities	Check
Guiding questions: • What public/private funding options are generally available for the solution? • What are the characteristics regarding Payments for Ecosystem Services (PES)? • What kind of private sector financing could be sought?	
Opportunities for funding, e.g. • Mostly public funding (e.g. public tenders, grant programmes, subsidies); also	

non-financial public support / advice • Private funding (e.g. tenders from private operators) • Payments for Ecosystem Services (PES)	
Opportunities for financing, e.g. • Loans, project financing, equity, venture capital or angel investors	

Identify potential barriers and challenges	Check
Guiding questions: • What barriers and challenges have been identified regarding the governance framework for the solution? • What are hindering market characteristics for the solution? • What financial obstacles could be encountered?	
Governance frameworks, e.g. • Regulatory environment including regulation of MAR with pre-potable water • Public knowledge on the role of ESS • Governance of inter-regional rivers • Ownership of (ground-)water resources	
Market dynamics, e.g. • Risk aversion of the water and wastewater sector • Market is consolidated and mature; innovation is taking place only incrementally, oftentimes as new legislation is put in place • Transferability of the MAR solution to other contexts	
Financial hurdles, e.g. • Lack of funds for SMEs as major hurdle for innovation • Public budgets in the EU are expected to remain tight • Who is going to pay for the injected water	

Identify recommendations / next steps	Check
Guiding questions: • What recommendations could be derived from the market analyses that are of relevance for policy makers? • What recommendations can be concluded for the SMEs?	

Policy recommendations, e.g. • Require additional value generated from investments in the water sector, e.g. through ESS improvement from innovations; include ESS aspects in tendering procedures • Establish clear ownership of groundwater bodies and monitor extraction (and overexploitation) • Carefully review legislation on MAR techniques • Improved funding/financing for innovative SMEs in the water sector; improved funding/financing environment for ESS projects	
Recommendations for SME, e.g. • Promote additional benefit of DESSIN technologies with ESS aspect to authorities and their environmental agencies • Engage with planners, operators, organisations that set and promote codes of practice • Be able to communicate the additional ESS benefit to clients in understandable terms • Agree upon entities responsible for different modules within the DESSIN solution package • Discuss IPRs of the DESSIN solution package and its modules • Develop transfer protocols and mechanism to transfer the solution to other sites • Further narrow down markets: (1) Define most promising market, (2) adapt DESSIN solution package, (3) choose entry mode, (4) develop marketing plan	

ANNEX B: ASR/ASTR sites in Europe

Below table provides an overview of the ASR/ASTR sites in Europe as detailed in the MAR catalogue of the DEMEAU project (also see DEMEAU project (2014), Annex a).

Country	City	Site	Operator	Influent source	Final use	Objective
Netherlands	Groningen	Haren	Waterbedrijf Groningen (GWG)	brackish water	ecological	physical aquifer management
Netherlands	Ouddorp	Ouddorp	Evides	brackish water	ecological	physical aquifer management
Spain	Castellón	Belcaire	AQUAMED	river water	agricultural	maximise natural storage
Spain	Marbella	El Señorío	AQUALOGY AQUAMBIENTE (SEDELAM)	groundwater	agricultural	physical aquifer management
Netherlands	Castricum	Watervlak	PWN	lake water	domestic	water quality management
Spain	Barcelona	Cornella	SGAB (Sociedad General de Aguas de Barcelona)	river water	agricultural	maximise natural storage
Netherlands	Zoelen	Zoelen	Vitens	groundwater	domestic	other benefits
Netherlands	Den Haag	Schevening en DIP	Dunea	river water	domestic	
Netherlands	Den Haag	Schevening en CIP	Dunea	river water	domestic	water quality management
Netherlands	Amsterdam	Castricum AIP	Waternet	lake water	domestic	water quality management
Netherlands	Heemstede	Leiduin WIP	Waternet	river water	domestic	
Netherlands	Den Burg	Bergje Texel	PWN	distilled water		
Netherlands	Haarlem	Dam 9 Geul 1	PWN	river water		
Netherlands	Den Haag	Schevenin-gen Flip-Flop	Dunea	river water	domestic	water quality management

Country	City	Site	Operator	Influent source	Final use	Objective
Spain	River Esgueva	river Esgueva	not specified	river water		
Netherlands	Den Haag	Waalsdorp	Dunea	river water		
Netherlands	Hoofddorp	Toevoers-loot	Waternet	river water		water quality management
Netherlands	Leunen	Breehei	WML (Waterleiding Maatschappij Limburg)	groundwater	domestic	water quality management
Netherlands	Nieuwegein	Nieuwegein	Vitens	river water	domestic	water quality management
Netherlands	Someren	Someren DIZON	Brabantwater	river water	domestic	water quality management
Netherlands	Heemstede	Leiduin IP1-2	Waternet	river water	domestic	water quality management
Netherlands	Herten	Herten	WML (Waterleiding Maatschappij Limburg)	groundwater	domestic	maximise natural storage
Greece	Kilkis	Tumpa	NAGREF	river water	agricultural	maximise natural storage
Italy	Prato	Prato	Publiacqua	river water	environmental	maximise natural storage
Netherlands	Ossendrecht	Ossen-drecht	Evides	groundwater	domestic	water quality management
Greece	Sindos	Sindos, Giannitsa Plain	not specified	reclaimed domestic water	domestic	water quality management
Spain	Barcelona	Barrera hidraulica del llobregat	ACA (Agencia Calatala de l'Aigua). Regional Water Administration	reclaimed domestic water	ecological	physical aquifer management
Netherlands	Nootdorp	Nootdorp	private	storm water		maximise natural storage
Spain	Mancha Real	Mancha Real	not specified			maximise natural storage
Spain	Gracia-Morenita	Gracia-Morenita	not specified	groundwater		

Country	City	Site	Operator	Influent source	Final use	Objective
United Kingdom of Great Britain and Northern Ireland	London	Horton Kirby, south east London	Thames Water	na	domestic	maximise natural storage
France	Flammerans		na	river water		
United Kingdom of Great Britain and Northern Ireland	London	North London Artificial Recharge Scheme (NLARS)	Thames Water	drinking water	domestic	physical aquifer management
United Kingdom of Great Britain and Northern Ireland	Dorset	lytchet Minster	Wessex Water			

Annex C: Water ecosystem services in the EU

Below graphics provide an overview of the water provisioning and regulating services in the EU (Maes et al. (2011), p. 23, 25, 28):

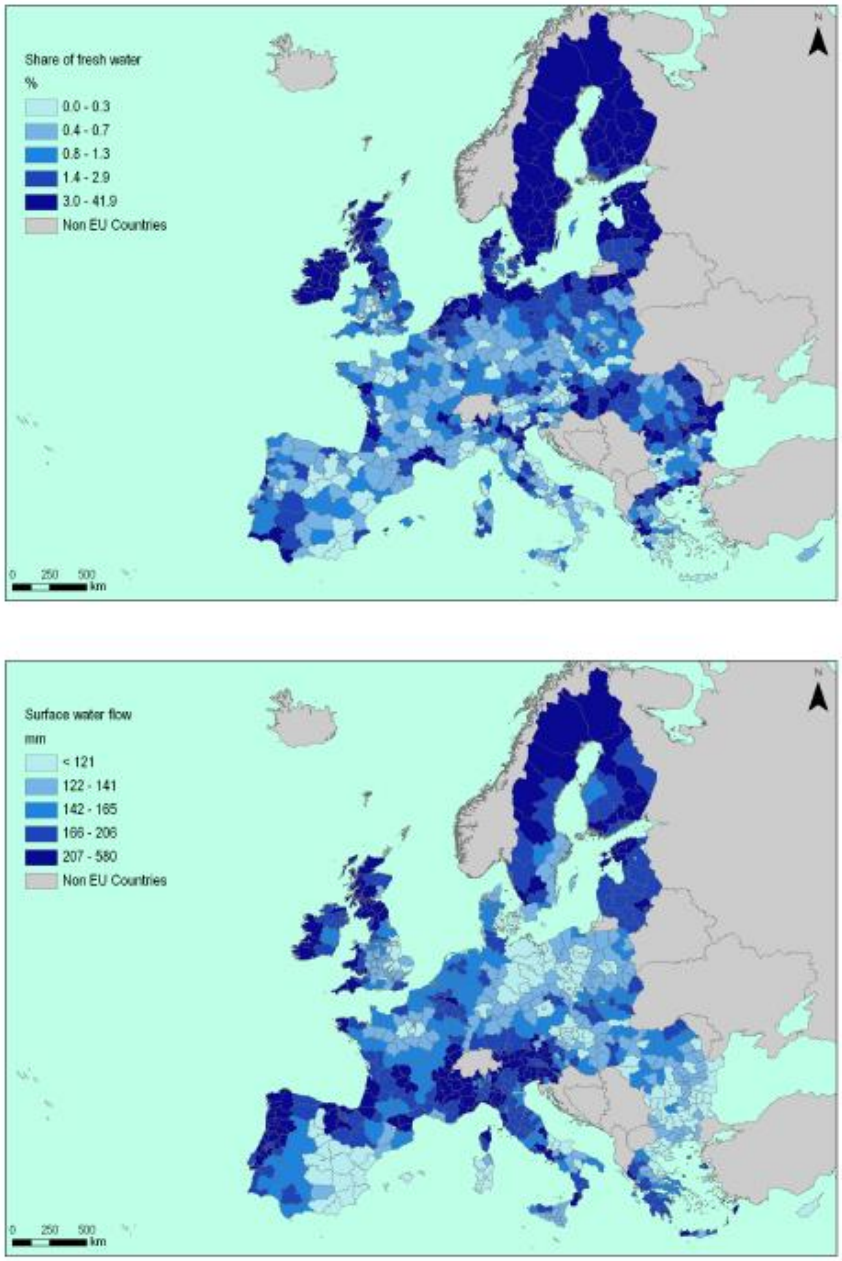

Fig. 5. Water provisioning services.
Top: The share of fresh water providing land cover classes in the land cover per NUTSX statistical area. Source: Corine Land Cover 2000 raster data - version 13. Bottom: The annual average water provision based on surface water flow.
Source: Wriedt and Bouraoui et al. (2009)

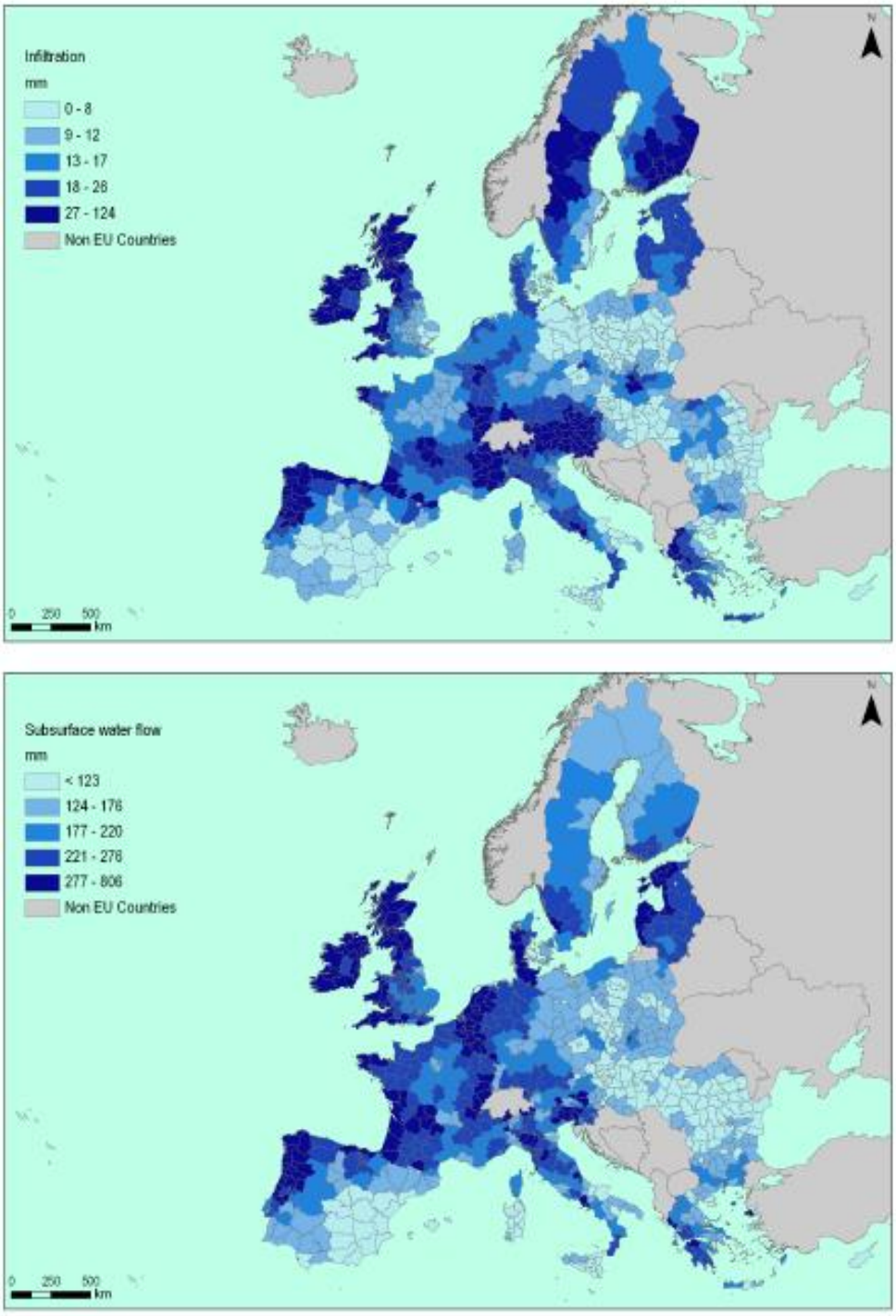

Fig. 6. Water regulation services.
Annually summed soil infiltration averaged over the statistical NUTSx areas (top) and averaged sub surface water flow (bottom). Source: Wriedt and Bouraoui et al. (2009)

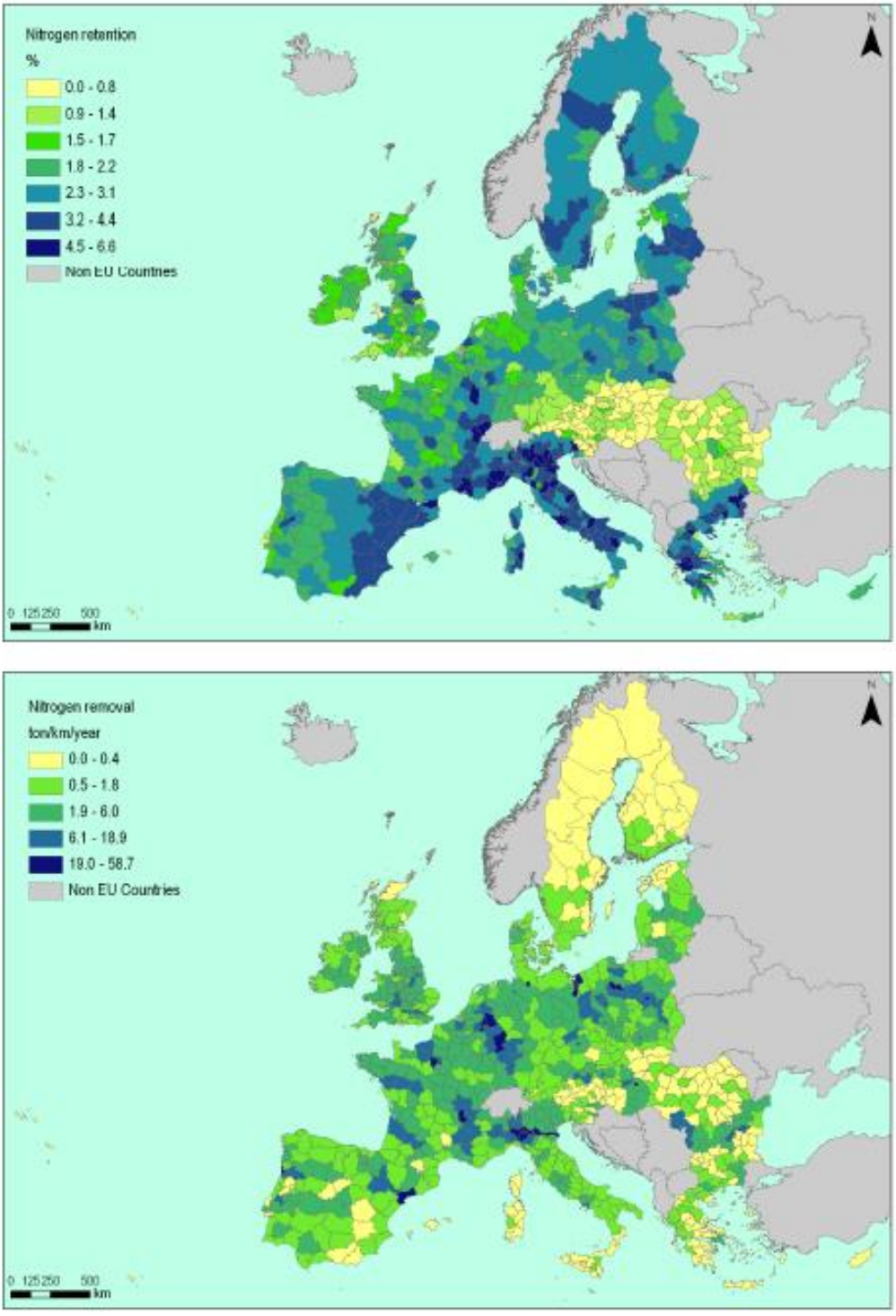

Fig. 7. Average nitrogen retention and removal by rivers and streams in the EU27.

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