DESSIN

DEMONSTRATE ECOSYSTEM SERVICES ENABLING INNOVATION IN THE WATER SECTOR

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

Part B - Water Quality Focus - Emscher Case

adelphi, November (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 B – Water Quality Focus – Emscher Case

SUMMARY

This report exemplarily analyses the wider market for the DESSIN solution package on water quality based on the Emscher case in Germany. 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 Emscher case.

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adelphi	Sibylle Kabisch (adelphi) Ronjon Chakrabarti (adelphi) Diana Nenz (adelphi)
QUALITY ASSURANCE	
Gerard van den Berg Gerardo Anzaldua	KWR Ecologic
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List of acronyms and abbreviations

AbwAG	Abwasserabgabengesetz
BDA	Bund Deutscher Arbeitgeber
BMUB	Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit
CAGR	Compound annual growth rate
CSO	Combined sewer overflow
DHI	Danish Insitute of Applied Hydraulics
DWA	Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e. V
EC	European Commission
EEA	European Environment Agency
e.g.	for example
EIP Water	European Innovation Partnership on Water
EPEC	European Policy Evaluation Consortium
ESS	Ecosystem services
EU	European Union
EUR, €	Euro
EY	Ernst & Young
GDP	Gross domestic product
GTAI	Germany Trade and Invest
i.e.	That is
IFAK	Institut für Automation und Kommunikation Magdeburg e.V.
IfW	Institut für Weltwirtschaft an der Universität Kiel
Ifo	Leibniz-Institut für Wirtschaftsforschung an der Universität München e.V.
IPRs	Intellectual property rights
ITWH	Institut für technisch-wissenschaftliche Hydrologie GmbH
IWW	IWW Zentrum Wasser
KfW	Kreditanstalt für Wiederaufbau

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LEI	Landbouw-Economisch Instituut (Agricultural Economics Institute foundation)
LWG	Landeswassergetz NRW
M&E	Monitoring & evaluation
MEGS	Measuring Ecosystem Goods and Services
NAMEA	National Accounting Matrix including Environmental Accounts
NRW	Nordrhein-Westpfahlen
OECD	Organsation of Economic Cooperation and Development
p.a.	Per annum
PES	Payments for ecosystem services
PWS	Public water schemes
R&D	Research and development
RTC	Real time control system
SECA	Simplified Ecosystem Capital Accounts
SEEA	System of Environmental-Economic Accounting
SME	Small and medium-sized enterprises
UFT	Umwelt- und Fluidtechnik Dr. H. Brombach GmbH
UNFCCC	United Nations Framework Convention on Climate Change
UNSD	United Nations Statistics Division
USD, $	US-Dollar
VC	Venture Capital
VDMA	Verein Deutscher Maschinen- und Anlagenbauer
W&WWT	Water and wastewater treatment
WISE	Water Information System for Europe
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.

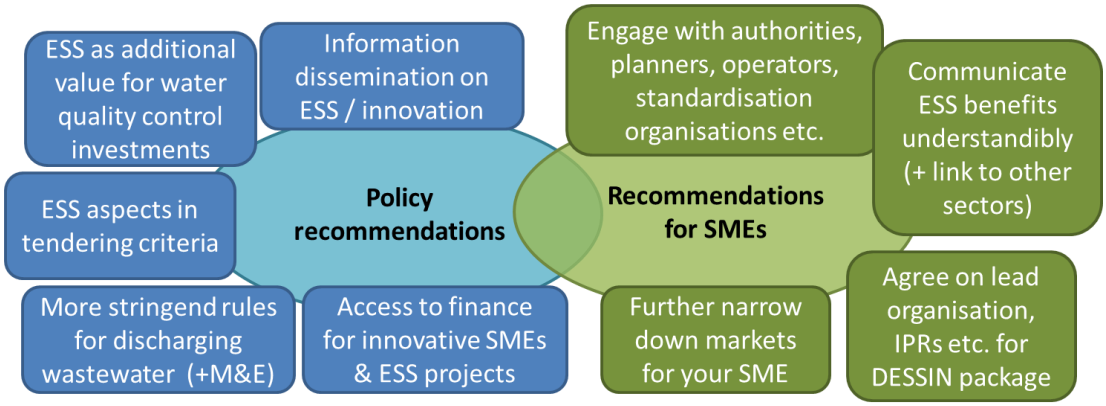
It provides a market overview for water quality innovations linked to ESS by exemplarily analysing the general market for the DESSIN solution package on water quality based on the Emscher case in Germany. The objective of the DESSIN Emscher case is to generate improved water quality in strongly urbanised areas by implementing novel and cost efficient treatment solutions for existing combined sewer overflow facilities that will enhance ESS and their provision and serve as an example in the reconversion process of the whole Emscher system.

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 Emscher case. It is not intended to be a specific market analysis for the Emscher case stakeholders only.

Generally, the report is written in a hands-on manner in order to provide practical information to the SMEs and policy makers related to DESSIN and beyond. The view of the Emscher case SMEs has been included as much as possible.

Initial recommendations derived from the report include the following:



1. Introduction

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 Emscher case in Germany provides the reference case. Information for this report has been gathered mainly through desktop research, interviews and workshops with the DESSIN project stakeholders, in particular, with the relevant SMEs.

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 Emscher case example (SME view).

Two 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) A table providing an overview of European cities with a population greater than 500,000 (highlighting German cities with CSOs).

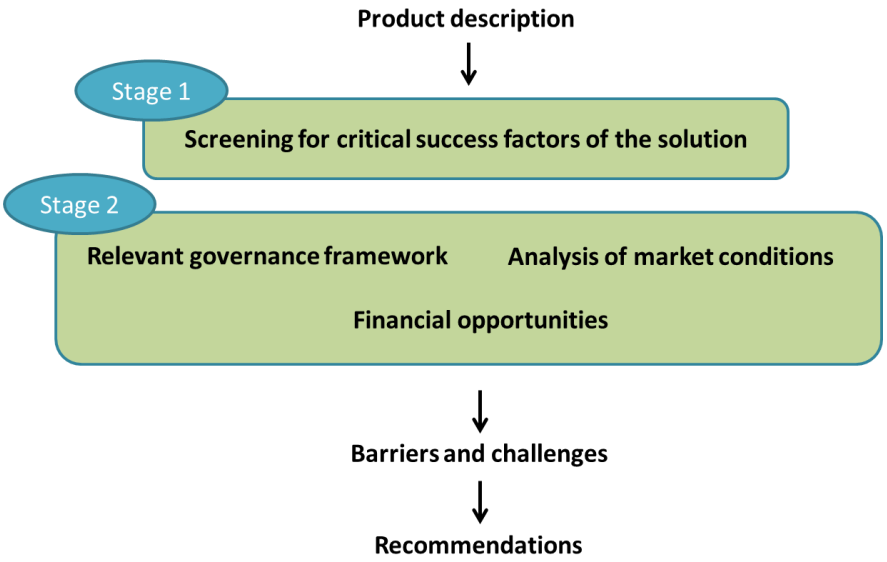


Figure 1: Structure of the Outside-In Report; adelphi (2014)

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 Emscher case. I.e. each subchapter looks at the global / EU market, then at the local German market and then at the Emscher 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.

The upcoming inside-out report will then seek to establish 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 SME needs.

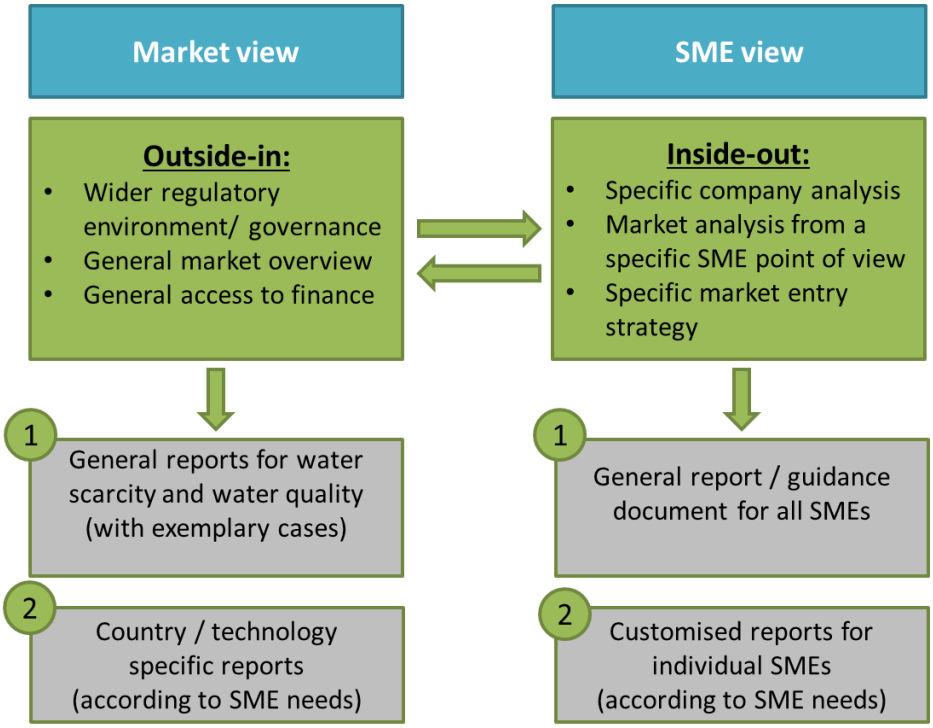


Figure 2: Inside-out vs. outside-in approach; adelphi (2014)

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 quality specific ESS solution package

In most organically grown cities, the sewerage network in the historical center of the city is common for waste water and storm water. During heavy rain events the sewerage network cannot handle the entire volume flow and thus overflow points discharge the untreated waste water mixed with rainwater runoff into rivers if no temporary holding tanks are provided. Untreated effluents from these Combined Sewer Overflows (CSO) pollute the river and cause eutrophication as well as biological and chemical contamination of the surface water thereby damaging the river ecosystem and its related services, such as the water quality, air quality regulation, aesthetic value and recreational services.

Measures to reduce the overflow volumes or improve the water quality in discharges from CSOs are two complementary approaches the water utilities can implement, and paramount for solving the water quality challenges in receiving waters and improving the ecosystem and its services. The solution combines technologies acting at local and system level.

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

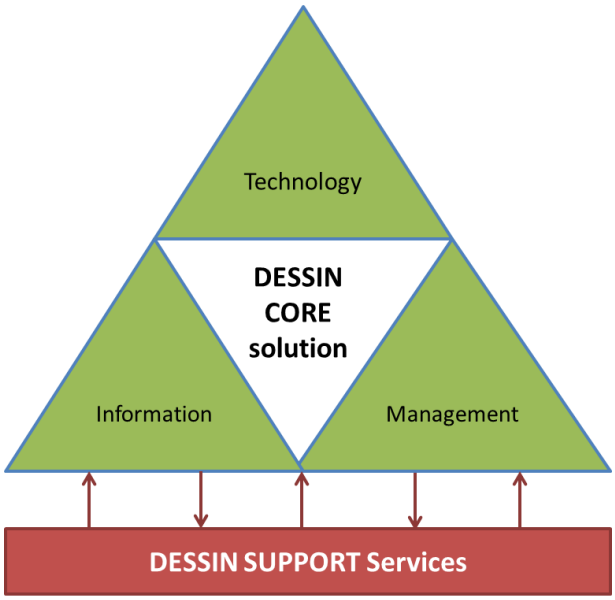


Figure 3: DESSIN solution package; adelphi (2014)

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 Emscher case.

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

1	DESSIN CORE Solution	Emscher Case CORE Solution
1A	Integrated Technology/ new or newly combined solutions	• **Cross-Current Lamella Settlers from UFT:** to enhance the treatment efficiency in CSO holding tanks and improve the water quality of discharges
1B	Enhanced data and information management	• **Real Time Control System (RTC) ADESBA from SEGNO:** reduces overflow volumes by optimizing the usage of existing storage volumes in the network • **Modelling tools** (e.g. hydrological models)
1C	Management approach	• **DESSIN ESS Evaluation Framework from DESSIN Work Area 1 (WA1):** to quantify the impacts of technology implementation on ESS at the Emscher river system • **DESSIN ESS software framework from DHI:** for ESS valuation
2	**DESSIN SUPPORT Services** *Emscher 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	

Technically this approach reduces sewer system overflow volumes with a **RTC system (ADESBA)** by optimizing the usage of existing storage volumes in the network and **Cross-Current Lamella Settlers** to improve the quality of discharges.

Real time control of large-scale systems reduces overflowing of CSOs by controlling the hydraulic load in different parts of the system. This requires a hydraulic model of the system and optimised performance of the available control hardware in the system, e.g. actuator as valves, gates and volumes. The ADESBA-control box overcomes the lack of algorithms and programming systems of current systems which are based on existing manuals and mathematical models. The ADESBA-control box is thus an innovative fully automated real time control system to minimize combined sewer overflow. Another advantage of ADESBA is that it has a standardized setup which makes it cheaper and easier to implement compared to a site specific tailored version. In tailored solutions, the planning itself is very expensive. ADESBA comes with a free planning tool which the client can use and support for its application is given free of cost. The standardization has to be compromised only with 80% efficiency as compared to a tailored solution.

The solution for local treatment of CSO overflows is a new system with modular cross-flow lamella settling units for application in CSO holding tanks which acts as a high rate filtration system. Cross-current lamella settlers allow the flow to pass the inclined lamella plates horizontally while the sludge may slide down in a perpendicular direction, to avoid any re-mixing of sludge into the inflow. Together with the suspended solids it removes pathogens.

Generally, a modular approach can be taken regarding the DESSIN solution package depending on the specific customer requirements. E.g. there might be cases where only the RTC is in demand which would then be the technology element in that case. There might also be examples for which only the ESS evaluation aspect is of interest but without the software etc..

Figure 4: Summary box – the DESSIN Emscher case; adelphi (2014)/DESSIN proposal (2013)

Summary box: the DESSIN Emscher Case, Germany

Setting

Large parts of the Emscher River and its tributaries (350 km of watercourse) had been operated for decades as an open sewer system at the very heart of a highly industrialized and urbanized area of 865 km2 with about 2.4 million inhabitants. In a 4.5-billion EUR investment program, the Emscher is currently being re-converted to a more natural stage by construction of 400 km of underground sewers that will take up most of the sewage. This 30 years river conversion project requires numerous additional solutions provided by industry and SMEs.

DESSIN objective

To demonstrate the feasibility and effect on the ecosystem services of different innovative solutions developed to mitigate the negative effects on the water quality in the Emscher river system caused byCSOs.

Specific DESSIN tasks

- Task 31.1 Decentralized water treatment (lamella settler)
- Task 31.2 Real Time Control of sewer network
- Task 31.3 Evaluation of solutions (linked to WA1 and WA2)

DESSIN partners involved

Emscher Genossenschaft, UFT, IWW, DHI, SEGNO, University Duisburg Essen, Ecologic Institute, adelphi

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. First assumptions (based on the general thought that a better ES state leads to enhanced ESS) are that the DESSIN solution package for water quality has a positive impact on ESS as it contributes to water purification and biodiversity preservation and improvement. Indirect effects of the ESS could include the improvement of cultural services.

For the Emscher case it is assumed that the RTC system improves the water quality by reducing the number of times water is overflowing and the amount of overflow. The lamella settlers are assumed to improve the water quality by reducing the load of particles during rain events. The DESSIN solution thereby contributes to the aims of the EU WFD for achieving overall good water quality standard in surface waters.

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 Emscher

Technology	Effect	ESS improved (initial assumption)
RTC	Reducing the number of times water is overflowing and the amount of overflow ➔ improved water quality	• Capacity of the ecosystem to provide the water purification service • Biodiversity preservation and improvement • Improvement of cultural services
Lamella settlers	Reducing the load of particles during rain events ➔ improved water quality	• Capacity of the ecosystem to provide the water purification service • Biodiversity preservation and improvement • Improvement of cultural services

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 following categories are suggested: Maturity and applicability of the solution, proper local setting, suitable policy mix and willingness to pay.

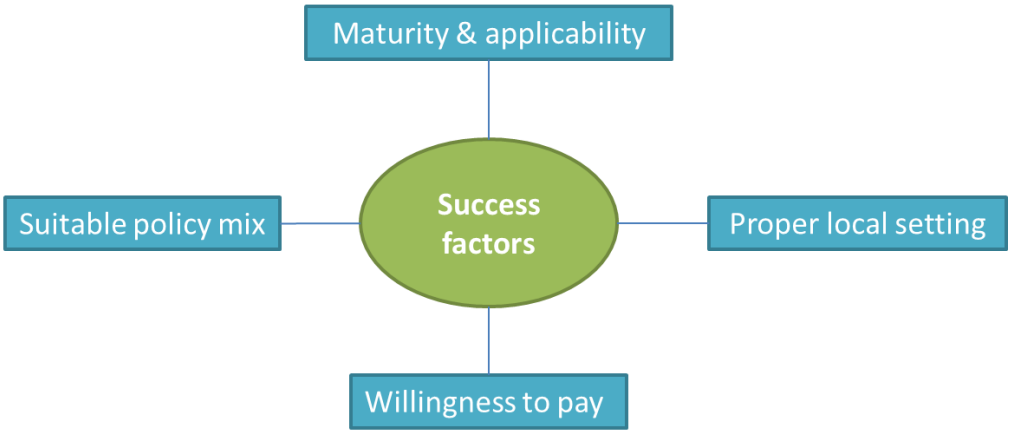
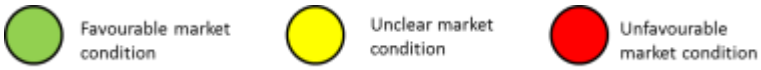


Figure 5: Success factor categories; adelphi (2014)

The screening is conducted exemplarily for the Emscher case in Germany. General screening criteria are derived and presented in tables with a "traffic light check":



3.1 Maturity and applicability

For innovative technologies to enter a market, they need to have undergone an initial test application to prove market readiness. In terms of maturity and applicability of the technology elements of the core solution package for the Emscher case, both technologies are tested at Emscher as part of the DESSIN project. Showcases are developed and promoted as reference sites for the innovative technologies developed through DESSIN. The general concepts of lamella separators and RTCs are approved technologies in other contexts – the DESSIN project is applying

these proven systems to a new case setting and added new methods and modules to these concepts. E.g. with the lamella settler, one can either reduce the pollution load to the water beyond what is state of the art or build smaller pools with the same performance at new sites. DESSIN will apply these technologies in a new setting and conduct an expanded evaluation of their impacts using the ESS Evaluation Framework.

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

As a first prerequisite, both technologies that are applied at the Emscher case generally work in bigger cities with common sewer (mixed water channel systems as sewer network) and stormwater networks where challenges are faced with overflows into the local surface water bodies in heavy rainfall events. Another prerequisite for SEGNO and its ADESBA application is data availability from the sewage network.

Table 4: Screening for proper local setting

Criteria	Check
City has a CSO which discharges into a surface water	
Pollution in surface water body has an impact on its usage	
Options for refitting separate sewer systems are technically not given or comparably more expensive (compare 3.4)	
Sewage data availability	

3.3 Policy mix

The development and application of solutions needs a suitable policy framework which provides incentives for their implementation. For Europe, the policy framework for the management of water resources (including water quality) is provided through the WFD.

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) • 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

In addition, the legal/policy environment has to provide incentives for reducing the pollution load to the river. This could either be done by enforcing effluent discharge standards and by punishing non-compliance or by paying for treatment performance and e.g. collecting fees from beneficiaries of the ESS provided by the river. In case the beneficiaries are the general public (bathing water, drinking water quality, recreation) initiative can be taken by governmental bodies for financing the treatment.

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

Criteria	Check
Stakeholders are interested in reducing the pollution to the surface water body	
Financial mechanisms are in place to reduce the pollution of the surface water body (e.g. in Germany “Abwasserabgabegesetz”)	
Options for refitting separate sewer systems are more expensive than real time control systems and cross current lamella settlers	

4. Relevant 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 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 quality:

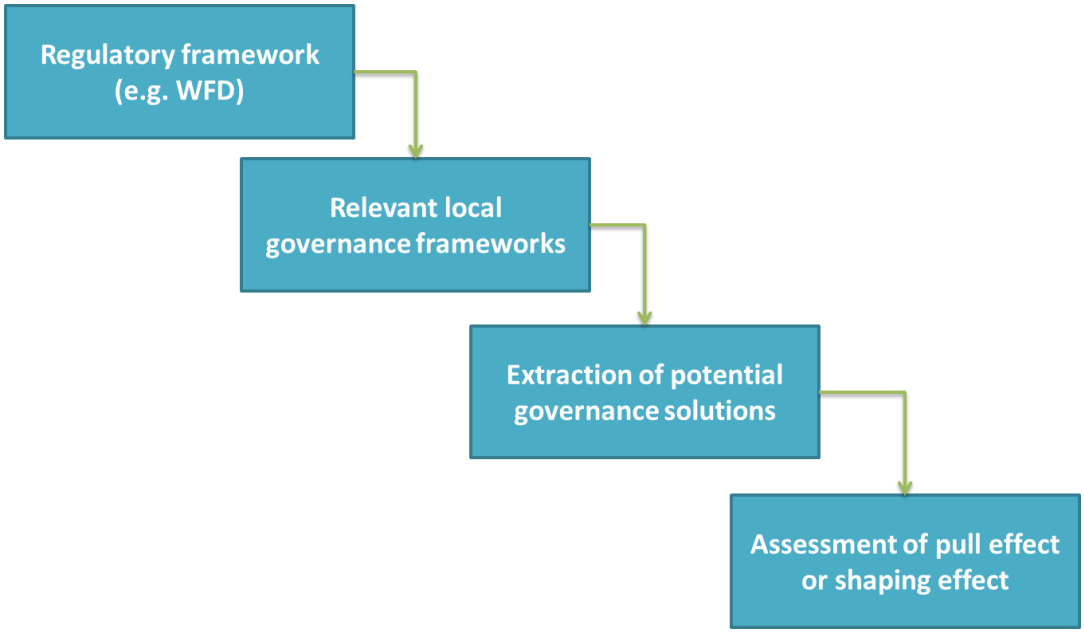


Figure 6: Steps to analyse governance framework; adelphi (2014)

4.1 Description of the regulatory framework

The ***Water Framework Directive (WFD)*** provides the main regulatory framework for the improvement of the Emscher's water quality. Adopted in December 2000, the Directive focuses on integrated water protection, an approach designed to achieve the following goals (Emschergenossenschaft/Lippeverband (2014)):

- Water protection should no longer stop at administrative or national borders. Rather, a holistic approach is called for, treating the river basin as a whole, as defined by its natural boundaries.

- Water protection should no longer be treated as a purely ecological or technical problem. In future the related economic and social issues will also be taken into account.
- Groundwater, surface waters and aquatic ecosystems should achieve a “good status” by 2015.
- Deterioration in the state of groundwater, surface waters and aquatic habitats should be prevented.
- Water resources should be managed sustainably and thus secured for future generations.
- The public should be involved in the measures undertaken.

Achieving a “good status” water quality by 2015 constitutes the Directive’s main goal. Evaluation of water quality is done by making use of a range of criteria, including the chemical status, ecological features and appearance of waterways.

The key milestones of the WFD are as follows (EC WFD (2014)):

Table 7: Key milestones of the WFD

Year	Issue	Reference
2000	Directive entered into force	Art. 25
2003	Transposition in national legislation	Art. 23
2004	Characterisation of river basin: pressures, impacts and economic analysis	Art. 5
2006	Establishment of monitoring network	Art. 8
2008	Present draft river basin management plan	Art. 13
2009	Finalise river basin management plan including progamme of measures	Art. 13 & 11
2010	Introduce pricing policies	Art. 9
2012	Make operational programmes of measures	Art. 11
2015	Meet environmental objectives	Art. 4
2021	Second management cycle ends	Art. 4 & 13
2027	Third management cycle ends, final deadline for meeting objectives	Art. 4 & 13

The WFD requires EU member states to coordinate programmes of measures and management plans according to its stipulations, calling for management plans for all river systems flowing into

the sea. Most EU countries have now adopted River Basin Management Plans. Even Norway is implementing the WFD as part of the European Economic Area Agreement with a specific timetable agreed.

The Emschergenossenschaft was already operating as an integrated, catchment area-based river basin management long before the WFD was issued which facilitated the implementation process of the latter. In September 2002, the Emschergenossenschaft submitted a first version of its Emscher river basin plan, which was updated in April 2009 (Emschergenossenschaft/Lippeverband (2014)). The plans were complemented by descriptions of overall water management conditions and of the ecological and chemical conditions of the waterways. Moreover, an effective river basin organization was established for WFD implementation including the WFD Emscher basin agency, a core working group committee with representatives from involved municipal administration units and the Emschergenossenschaft as well as an Area Forum to ensure public participation.

Despite these favourable prerequisites for implementing the Directive, the achievement of a "good status" of the Emscher by 2015 is unlikely. Authorities thus expect to extend the WFD deadline. Main constraints are of organisational (the Emscher reconstruction is planned to be finished by 2020), technical and economic nature (Herbke et. al. (2006)).

Another EU directive relevant to the the DESSIN solution on water quality is the ***Urban Waste Water Treatment Directive***. It "concerns the collection, treatment and discharge of urban waste water and the treatment and discharge of waste water from certain industrial sectors. The objective of the Directive is to protect the environment from the adverse effects of the above mentioned waste water discharges" (EEA (no year)).

Also the ***EU Habitats Directive*** (1992) and the ***EU Birds Directive*** (1979) are key EU nature legislation that are relevant to the biodiversity aspects of the project.

Other EU Directivesof interest for water quality solutions include the ***EU Bathing Water Directive*** and the ***EU Priority Hazardous Substances Directive***.

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

The EU Water Framework Directive has been transposed into ***the Water Resources Act (Wasserhaushaltsgesetz)*** on the national level and the ***State Water Act of the State NRW (Landeswassergesetz)***, the two German regulatory frameworks determining the improvement of the Emscher's water quality. The State Water Acts, regulations of the states, address the

protection, use, supply and disposal of water thereby complimenting and specifying the water regulations of the national government.

In addition, the ***Abwasserabgabengesetz (AbwAG)*** of the German Federal Government is important for providing incentives (including the obligation to pay) for reducing the overall level of wastewater discharge (quantity) and the pollutant load carried by it (quality); the respective fee is collected by the states.

For discharging into waters in Germany (i.e. whenever wastewater or rain water is discharged into water bodies) a water permit is needed, which is only granted by the lower water authority if the planning conforms to the ***codes of practice ("Regeln der Technik")***. The latter are defined in worksheets of the Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e. V. (DWA). Specific DWA guidelines which are important for setting incentives for the application of the cross current lamella settlers are the guidelines for the construction of CSOs (DWA-A 128), the construction of rainwater holding tanks (DWA-A 166 (DWA (2013))), for sewerage control (DWA-M 180) or integrated discharge control (DWA-AG ES2.4). Generally, the requirements for rainwater treatment have been more stringent over time, because, for example, more recently the orientation towards immissions has been weighted more heavily.

The central instrument for the conversion of the Emscher is the ***"Emscher Future Master plan"*** from 2006 which has been developed in continuous dialogue between all relevant stakeholders.

In addition to regulatory frameworks, the ***willingness and commitment*** of different local stakeholders to improve the water quality has been relevant. Each cooperating entity has a particular interest in the conversion of the Emscher within the framework of a voluntary agreement (Salian / Anton (no year)). The municipalities aim to enhance the living quality of their inhabitants as well as the water quality to ensure a decent water supply in the area. The modernisation of the waste water infrastructure along the Emscher is helping to stimulate investment and advance innovation in the region. Companies are particularly eager to increase the Emscher Valley's attractiveness as a location to win new and qualified employees. The mining companies, besides profiting economically from the revitalization of the Emscher, have become aware of their responsibility to repair the ecological damages of their mining activities (Emschergenossenschaft (2008)).

4.3 Extraction of potential governance solutions

The "Emscher Future Master plan" from 2006 has been developed in continuous dialogue between all relevant stakeholders. As a result of hundreds of discussions with participating communities, residents and landowners, the idea of an open transformation strategy was integrated into the Master plan as it developed. Thanks to the planning platform's adjustability and its flexibility of action and reaction, the Master plan serves as a vehicle for exchanges and cross-sectoral planning, as well as between politicians, administrations and the people of the region. The plan emphasises the interconnection between water, landscape and urban management in the region.

A combination of different funding mechanisms ensures the feasibility of the Emscher conversion until 2020. Approximately 90% of the costs of the conversion of the Emscher are covered by the Emscher Genossenschaft. The funds collected by the Emscher Genossenschaft include membership fees and wastewater charges of the state NRW. In 2014, municipalities and communities paid EUR 186,0 Mio. (67,7%), the mining industry EUR 42,7 Mio. (15,5%) and the industrial enterprises EUR 45,9 Mio. (16,7%). The mining companies thereby constitute the biggest single contributors. Additionally, the conversion of the Emscher is financed through low-interest and long-term loans provided by the state NRW as well as the European Investment Bank. Several concrete projects in the framework of the Emscher conversion are directly funded by the state NRW through different large-scale funding programs.

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

The introduction of the WFD in the year 2000 provided the legislative support for the rehabilitation of the Emscher River. It thus became mandatory for the federal state government to improve the river's ecological and hydromorphological status by the year 2015. The WFD also provided new funding opportunities from the European Commission for the restoration of the Emscher River and proved to be a crucial factor in the adoption of sustainable practices in the region.

In addition, the strong engagement of local stakeholders, the Master Plan as the central cooperation instrument as well as the combination of diverse funding mechanisms have positively influenced the effectiveness of governance in the case of the Emscher.

With respect to the DESSIN solution package, a strong driver for the technology elements are technical guidelines – i.e. technical solutions have to be mentioned in the DWA recommendations (mentioned in 4.2) or at least have to be certified as equivalent or state of the art.

In Germany the respective state water act provides the legal outline, but the detailed responsibility lies with the federal states and their water authorities (supreme, upper and lower water authority). The attitude and activities of the respective state water authority can be a driver to incentivize the application of the DESSIN solution package including its additional ESS benefits. The state of NRW has generally been perceived by the SME UFT to be more proactive regarding wastewater issues.

5. Analysis of 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.

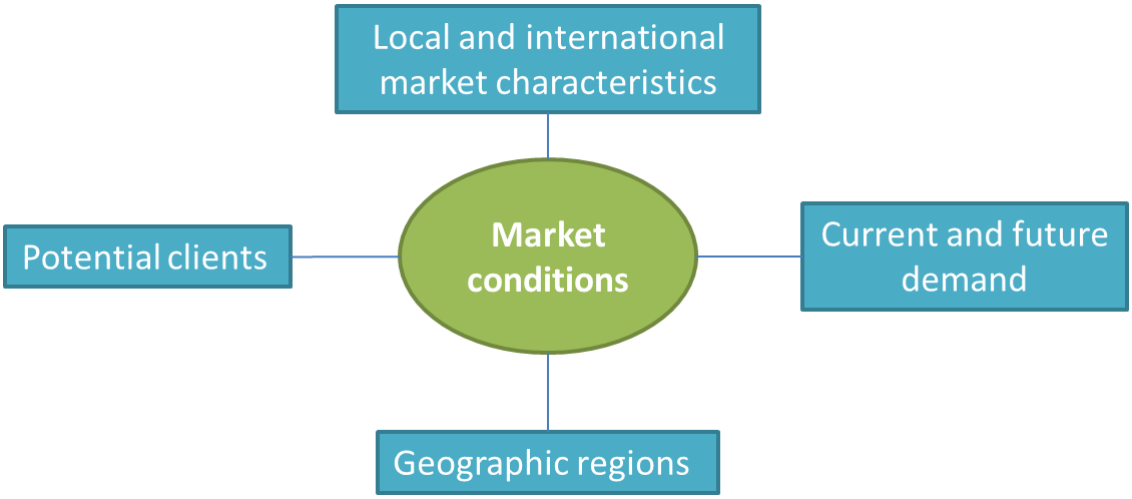


Figure 7: Market conditions analysed; adelphi (2014)

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[1] 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***[2], in particular, with reference to the solution package, the degree and trend of ***urbanisation*** as the solution mainly works in urban areas.

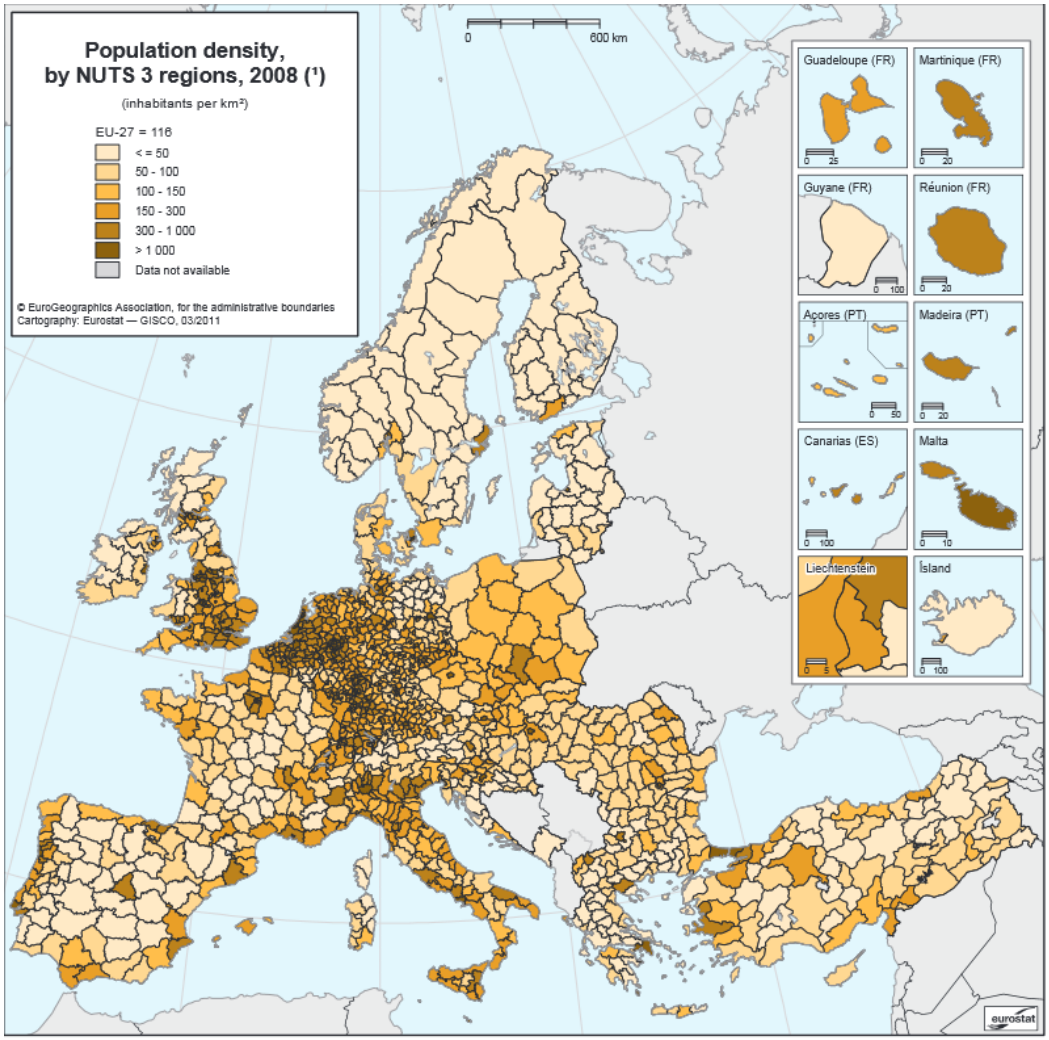
[1] Please note that the governance framework has been analysed separately in chapter 4 (as this is a separate DESSIN SME support service).

[2] 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

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).



(¹) Population density is calculated as ratio between (annual average) population and surface (land) area. Land area is a country's total area, excluding area under inland water. Bulgaria, Denmark, Germany, France, Cyprus, Poland and Portugal, total area has been used instead of land area; Poland, by NUTS 2 regions; United Kingdom, 2007.

Source: Eurostat (online data code: demo_r_d3dens)

Figure 8: Population density in the wider European region; eurostat (2008)

According to eurostat, 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)).

Growth of the cities implies more surface sealing which in turn implies more surface runoff and stormwater collection. More population implies more wastewater production. This in turn makes the application of a solution that addresses water quality more likely. The competitive advantage of the DESSIN solutions would then be that they will be tested for their impact on ESS.

However, even in a more deurbanising environment with suburban growth on the edges, the solution also works. I.e. for the ***Emscher*** *case*, the three key demographic trends of the Ruhr valley "less", "older" and "more colourful" are distributed very unevenly in the region: Decreases in population are occurring in the main cities such as Gelsenkirchen, Mühlheim, Duisburg, whereas Dortmund is an exception with rather constant numbers. Forecasting until 2025, a clear "edge-core" gradient is expected, i.e. a deurbanisation combined with growth in suburbia (Metropole Ruhr (2010)).

Natural environment: Status water bodies & water ESS

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.

Ecosystems / Services	Agro ecosystems	Forests	Grasslands	Heath and scrubs	Wetlands	Lakes and rivers
Provisioning						
Crops/timber	↓	↑			↓	
Livestock	↓	=	=	=	↓	
Wild Foods	=	↓	↓		=	
Wood fuel		=		=		
Capture fisheries					=	=
Aquaculture					↓	↓
Genetic	=	↓	↓	=	=	
Fresh water		↓			↑	↑
Regulating						
Pollination	↑	↓	=			
Climate regulation		↑		=	=	=
Pest regulation	↑		=			
Erosion regulation		=	=	=		
Water regulation		=		↑	↑	=
Water purification					=	=
Hazard regulation					=	=
Cultural						
Recreation	↑	=	↓	↑	↑	=
Aesthetic	↑	=	=	=	↑	=

Status for period 1990–present Degraded Mixed Enhanced Unknown Not applicable

Trend between periods

↑ Positive change between the periods 1950–1990 and 1990 to present

↓ Negative change between the periods 1950–1990 and 1990 to present

= No change between the two periods

Figure 9: State of the ESS in Europe; EEA (RUBICODE 2009)

Despite the successful and ongoing revitalisation of the Emscher River, as mentioned above, the achievement of a "good status" of the Emscher as prescribed by the WFD by 2015 is unlikely.

Consequently, an improvement of water-related ESS is of relevance and an application of the DESSIN solution more likely (e.g.. beyond the WFD and in the context of the Blueprint to safeguard Europe's Water Resources).

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.

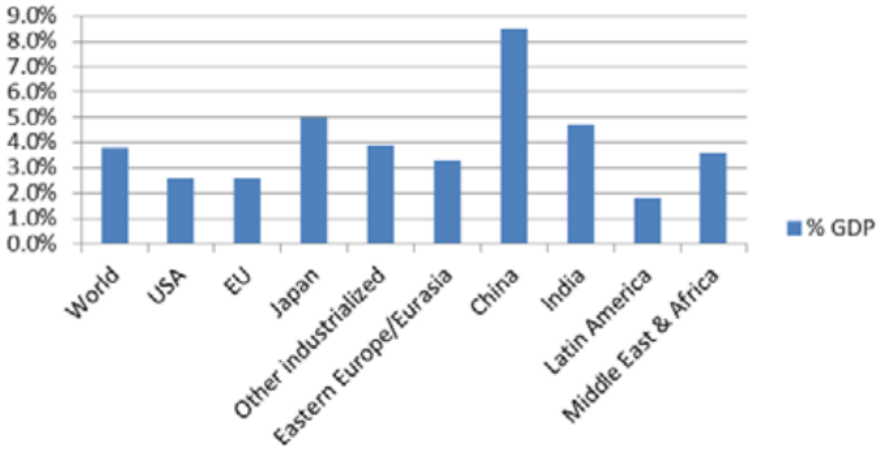


Figure 10: Infrastructure spending 1992-2011: Inderst (2013), from McKinsey 2013

For international comparative studies, the most commonly used indicator for public infrastructure investment is the government's gross fixed capital investment ("Bruttoanlageinvestitionen"): With an investment ratio of 1.5 % in 2012, ***Germany*** has been well below 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 (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.

With an investment volume of 4.5 billion Euros spread over several decades, the conversion of the ***Emscher*** is one of Europe's biggest infrastructure projects (Emschergenossenschaft / Lippeverband (no year)).

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 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 largest exporter of water technologies in the EU is ***Germany*** with about one third of exports (intra-EU and extra EU in 2010), followed by Italy and the Netherlands (EPEC (2011), p.13f.). Thus Germany has a good technology reputation which is in favor of the Emscher case solution package.

With respect to the ***Emscher case***, a current barrier for SEGNO is that the planning offices do not suggest the use of ADESBA as they would lose a major chunk of their job (competitive character). The basic two systems for sewer optimization are ITWH with Fuzzy controller (which has a 70% market share) and IFAK (SIMBA) which has a 30% market share. ADESBA is based on IFAK, thus it is limited to the 30% market share.

The UFT cross current lamella settlers are usually used in industries where fluids with a high content of suspended particles are common which need to be separated - the usage in CSO detention basins is a new approach. There are a variety of other technologies which are available for the separation of suspended particles from fluids, like sedimentation chambers, various kinds of filters or even chemical precipitation. Most options though require new construction as they cannot be installed inside an existing CSO detention basin, which is not always feasible. Retrofitting detention basins with upflow lamella settlers have shown to be less effective thus the new approach has good chances to find a market niche.

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 packages are estimated.

Current demand

According to market research, ***global*** markets for wastewater-recycling and reuse technologies increased from nearly $6.7 billion to $9.5 billion (2009 to 2012), equivalent to a compound annual growth rate (CAGR) of 12.6%. (BCC Research (2013)).

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).

Total turnover of the EU water and wastewater treatment industry was €95 billion in 2010 (EPEC (2011),p.4)

Within ***Germany***, the sustainable water economy is an important sector, generating a submarket volume of EUR 46 billion in 2011 within the Environmental and Resource Efficiency Technology Markets. Since 1990, more than EUR 110 billion has been invested in this sector domestically (GTAI (2014), p.1). According to VDMA, exports from German companies in water and waste water technologies amounted to EUR 914 million in 2012 – mainly to Russia, followed by France (GTAI (2014), p.3).

With respect to the ***Emscher case***, according to SEGNO, RTC was highly in demand a couple of years back with the WFD being a driver, however, this has currently calmed down. With respect to the lamella settler, the market for stormwater overflow tanks is reported to be saturated. The latest number of stormwater overflows in CSOs amounts to 21,099 (with 300 new overflows that should have been built since 2007 but only 100 tanks being recorded for that period (Brombach (2014), p. 12f.)). UFT assume that nearly all tanks that are needed have been built. In cases where an increased discharge quality is required the retrofitting of the existing tanks could be a promising market.

New developments have not been realised with mixed systems but with modified drainage systems that contain mostly small decentralized infiltration systems for which smaller plants with less technology are needed and for which the lamella settlers would thus not be applicable.

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. The German Council of Economic Experts expects a "two-speed global growth" in 2015 with growth engines being the United States and the United Kingdom and a modest performance in the euro area (Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung (2014)). 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)).

GDP growth in ***Germany*** is generally expected to rise in 2015: Between 2.2% (ifo Institute Munich) to 1.5% (IW Forecast Cologne) (BDA (2014), p.1) is expected by research organisations. The German Council of Economic Experts anticipates a less optimistic rise of only 1% for 2015 (Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung (2014)). With a longer view, the EY Eurozone forecast expects GDP growth in Germany to rise to 2% in 2015, before gradually slowing to 1.5% by 2018, however, with the development of the Ukrainian crisis believed of having an influence (Ernst & Young (2014)).

Stage 2 - industry forecast:

Globally, substantial investments in water infrastructure is required (by 2030) compared across four major infrastructure sectors (Inderst (2013), p.12).

Table 8: Global infrastructure investment needs to 2030 expressed in % world GDP: Inderst (2013), p.12 from OECD (2006, 2007, 2012), WEF (2012)

Water			1.3%
Telecom			0.5%
Transport			0.8%
	Road	0.3%	
	Rail	0.3%	
	Airports	0.2%	
	Ports	0.1%	
Energy			1.5%
	Electricity transmission & distribution	0.2%	
	Electricity generation	0.7%	
	Other energy	0.4%	
	Oil & gas - transmission & distribution	0.2%	
Total			4.1%

Market researchers expect ***global*** markets for wastewater-recycling and reuse technologies to increase from $9.5 billion in 2012 to $23.4 billion in 2017, reflecting a five-year CAGR of 19.7%. (BCC Research (2013)).

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)).

With respect to investments in watersheds (nature not infrastructure) there has been a large increase in the number of projects reporting environmental outcomes (these nearly tripled from 77 in 2011 to 219 in 2013). More than half (54%) of the projects reported on M&E practices for hydrological and other biophysical outcomes in 2013 (compared to 40% in 2011) (Bennett/Caroll (2014), p. v).

As depicted in the table below, the **global** markets for water ESS generally show increasing opportunities.

Table 9: Emerging markets for biodiversity and ecosystem services - potential global growth to 2020 and 2050 compared to present day (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 Germany, the submarket for sustainable water technology solutions has the highest productivity growth levels of all of Germany's green technology lead markets according to a Roland Berger study (financed by BMUB) (GTAI (2014), p.1).

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

Demand for the DESSIN solution package for water quality is likely to increase incrementally as environmental laws have more stringent waste water discharge rules.

E.g., with respect to the ***Emscher case***, the technology provider UFT is active in several German DWA work groups that issue new standards – the tendency towards higher requirements in these groups calls for innovative solutions and has brought the lamella separators into discussion. Also, over time, wherever older installations do not meet the current codes of practice (e.g. "Regeln der Technik" in German), the DESSIN solutions could be in demand. As combined sewer systems are regarded as outdated (and are not used for new installations), there is thus a market for existing installations. There is optimistic, general trade information stating that 95 % of the sewage network operators in Germany revealed that about 20 percent of the public sewage system need to be upgraded in the short or medium run; another 21.5 percent show minor damages and need to be upgraded (U.S: (2008); p.4). DWA estimates the short and medium upgrading needs as 17% of the sewage network kilometers (DWA (2009), p.8). For SEGNO, it is expected that the 3rd cycle of the WFD will be an upcoming driver for the RTC.

5.3 Geographic regions

To narrow down the potential markets geographically, a wider screening for **geographic regions** that could be particularly relevant for the DESSIN solution on water quality is conducted.

Potential application regions for the solution package generally include all regions with CSO, mainly old grown cities with mixed water sewer channels as mentioned in the screening section of this report.

In ***Europe***, combined sewers (and CSOs) are very common. E.g., in Germany nearly half of the communities have combined sewers, in Austria nearly 30%,(DWA (2009), p. 4; Fenzl (2011), p. 21). This also holds true for other places in the so-called industrialised world – e.g. CSOs can also be found in the USA, predominantly in the Northeast and Great Lakes regions (EPA (2014)).

For ***Germany***, there are strong regional disparities regearding CSOs. The regional distribution of CSOs can be divided into a North-South spectrum that has slightly been moving to the South as depicted by below graphic.

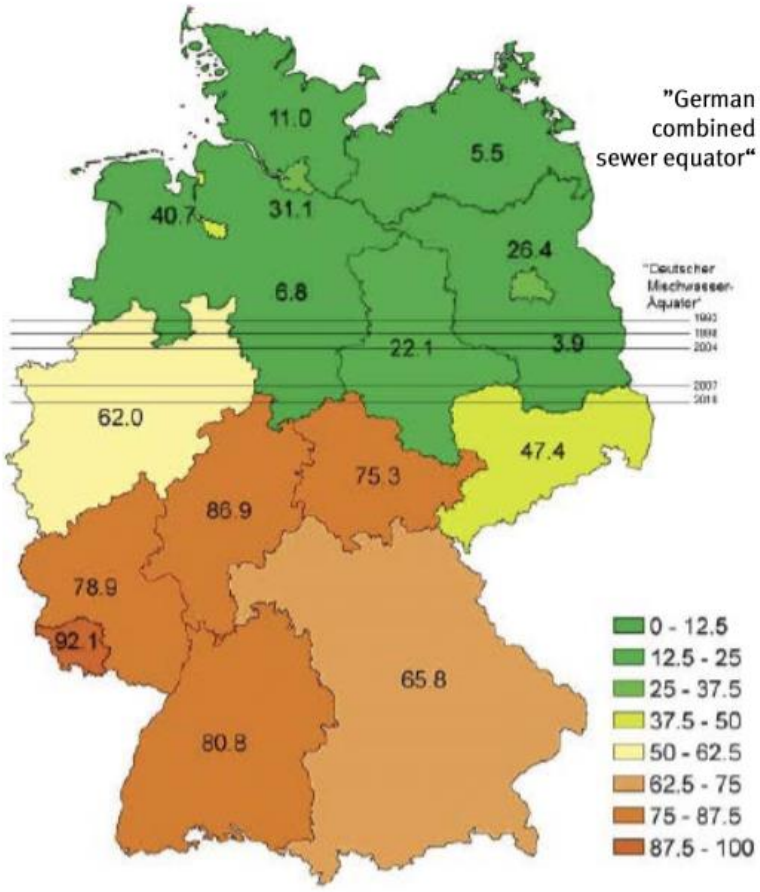


Figure 11: Proportion of the German population connected to CSOs in % (end of 2010), Brombach (2014) p.10

In addition, to be relevant as a solution package for water quality, the status of the water body that is being discharged into is of interest, i.e. the improvement of water quality obviously needs to be an issue locally.

For ***Europe***, a geographic overview of the status of water bodies according to the WFD is provided by the Water Information System for Europe (WISE) database and the WDF Surface Water Viewer - below graphics indicate the ecological and chemical status by country for surface waters counting all water bodies (to zoom into these graphics per country go to: http://www.eea.europa.eu/themes/water/interactive/soe-wfd/wfd-surface-water-viewer).

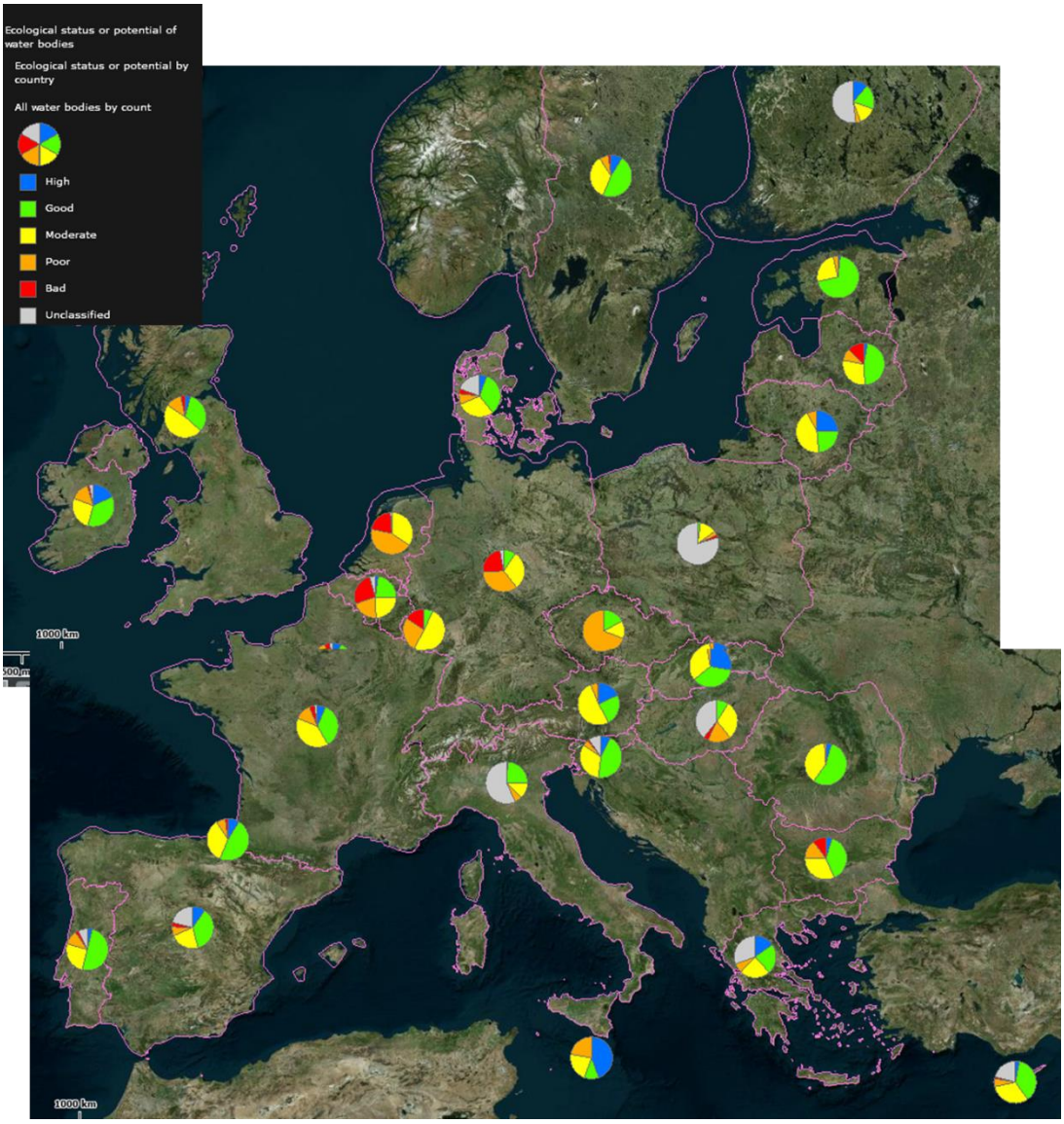


Figure 12: **European surface waters: ecological status or potential of water bodies; EEA Surface Water Viewer (no year)**

In terms of bad or poor *ecological status*, the WFD surface water viewer reveals potential for renaturation in Germany, the Netherlands, Belgium, Luxembourg, Austria, Bulgaria, Latvia. This could partly be attributed to the fact that in those countries that have technically modified their natural water bodies, these waters consequently do not have their original ecological status. Whereas other countries that have not modified or upgraded their natural water bodies logically kept the original ecological status which also implies that the total capacity for ecosystem services might be higher there. E.g. a good ecological status can be found in Northern and Western Sweden, coastal Estonia, Romania, some parts of France, some parts of Spain, some parts of Portugal, some parts of Northern and central Italy and Cyprus. Once a region is selected it is possible to zoom into the respective river for the ecological status (use the above mentioned link).

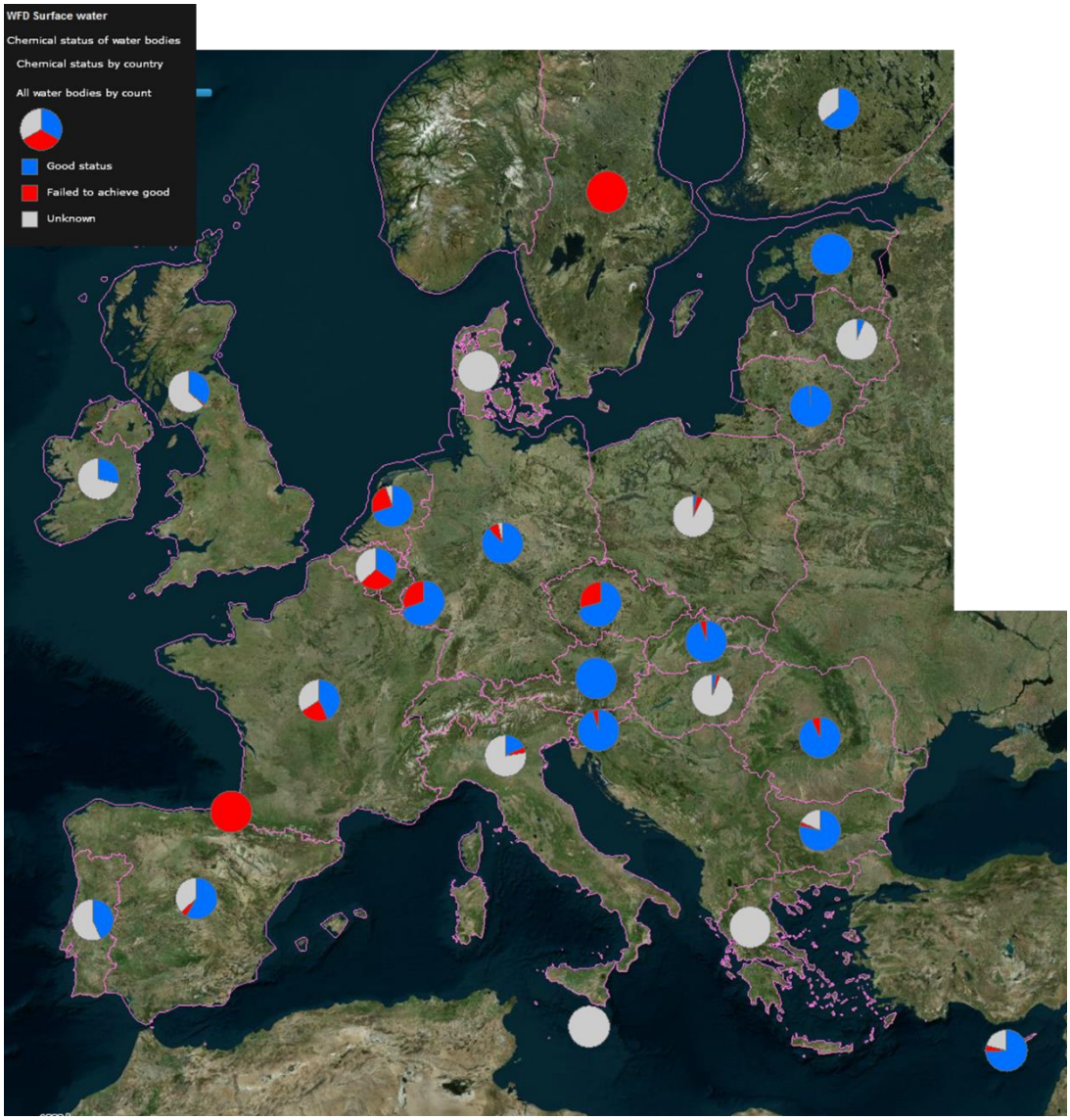


Figure 13: European surface waters: chemical status of water bodies; EEA Surface Water Viewer (no year)

With regard to a poor *chemical status*, the WFD surface water viewer highlights potential (where the status is known) in Sweden, Austria, Belgium, the Netherlands, Luxembourg, northern Spain and France. Those regions with poor chemical water quality should call for an improvement scheme with the DESSIN core solution (whilst those with mediate to good quality might have also entities/ framework in place that allow for the ESA).

I.e. the DESSIN package could provide solutions to situations with a good ecological status combined with a poor chemical status (e.g. Sweden, Luxembourg, France)[3]. The solution could also work in a poor/bad ecological status if combined with renaturation as done for the Emscher case.

[3] It is worth noting that the chemical status for surface waters for several mediterranean countries is « unknown » - they could therefore also be an option.

Below two maps provide further information from the EU member states related to the Water Framework Directive (WFD) implementation reports published in 2007, 2009 and 2012. (Information on Norway can be found here: http://www.environment.no/Topics/Freshwater/)

Similar information as from prior graphics on the ecological and chemical status of surface waters from EEA can be retrieved from the WISE graphics: the hydromorphological pressures in the EU as shown in the next graphic (Figure 13) show up river basins which face challenges with the good ecological status. Point and diffuse source pollution on the other hand show challenges with chemical status. On the basis of these figures and the above concluded criteria firstly Sweden would look like a country in great necessity of the Dessin solution. Further river basins with comparatively better ecological status than chemical status are e.g. in Italy, France and Romania.

Potential market identification on the basis of these maps is though only one criterion, other criteria like local regulations etc. have to be taken into account in addition.

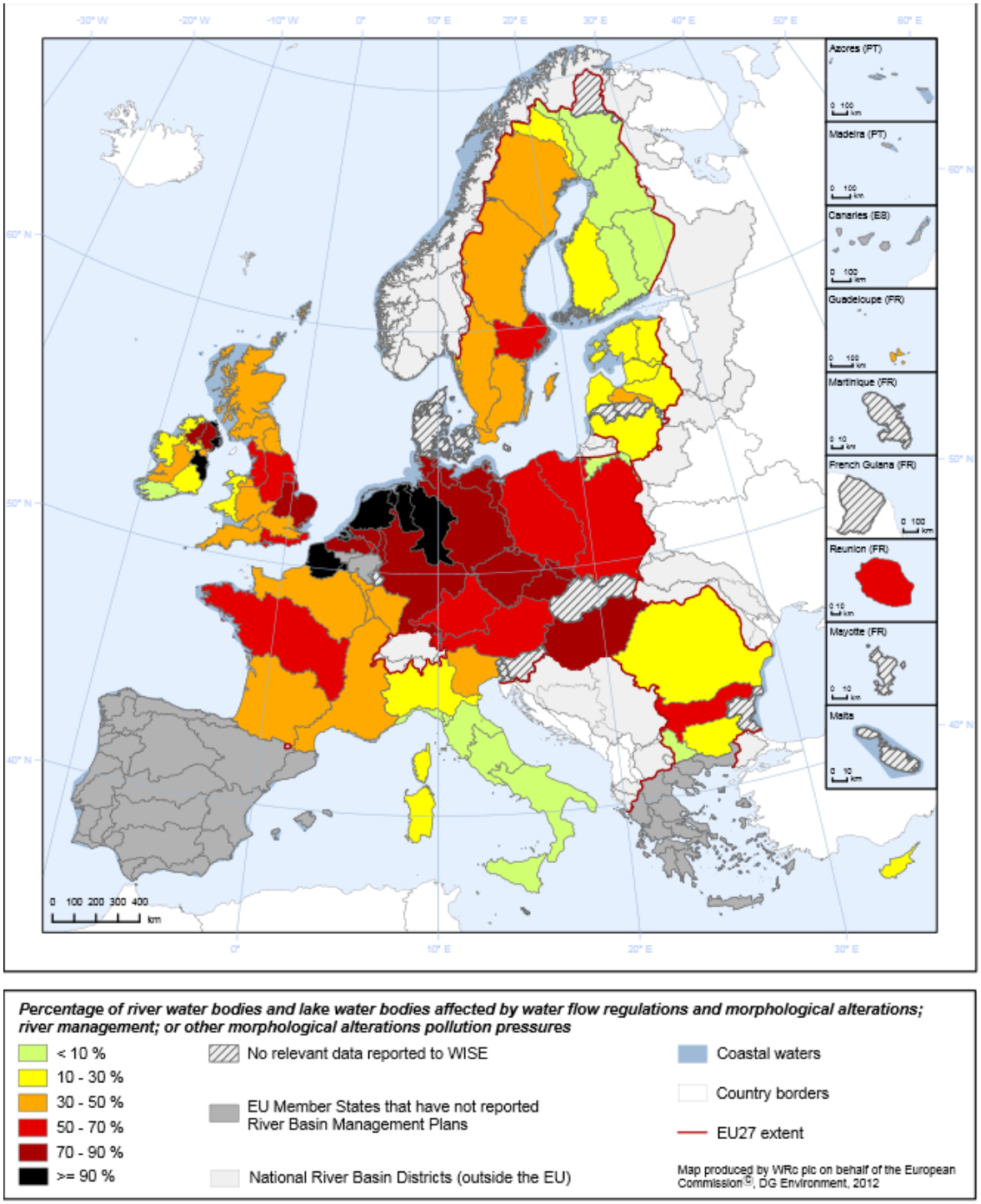


Figure 14: Hydromorphological pressures – rivers and lakes; EC (2007-2012)

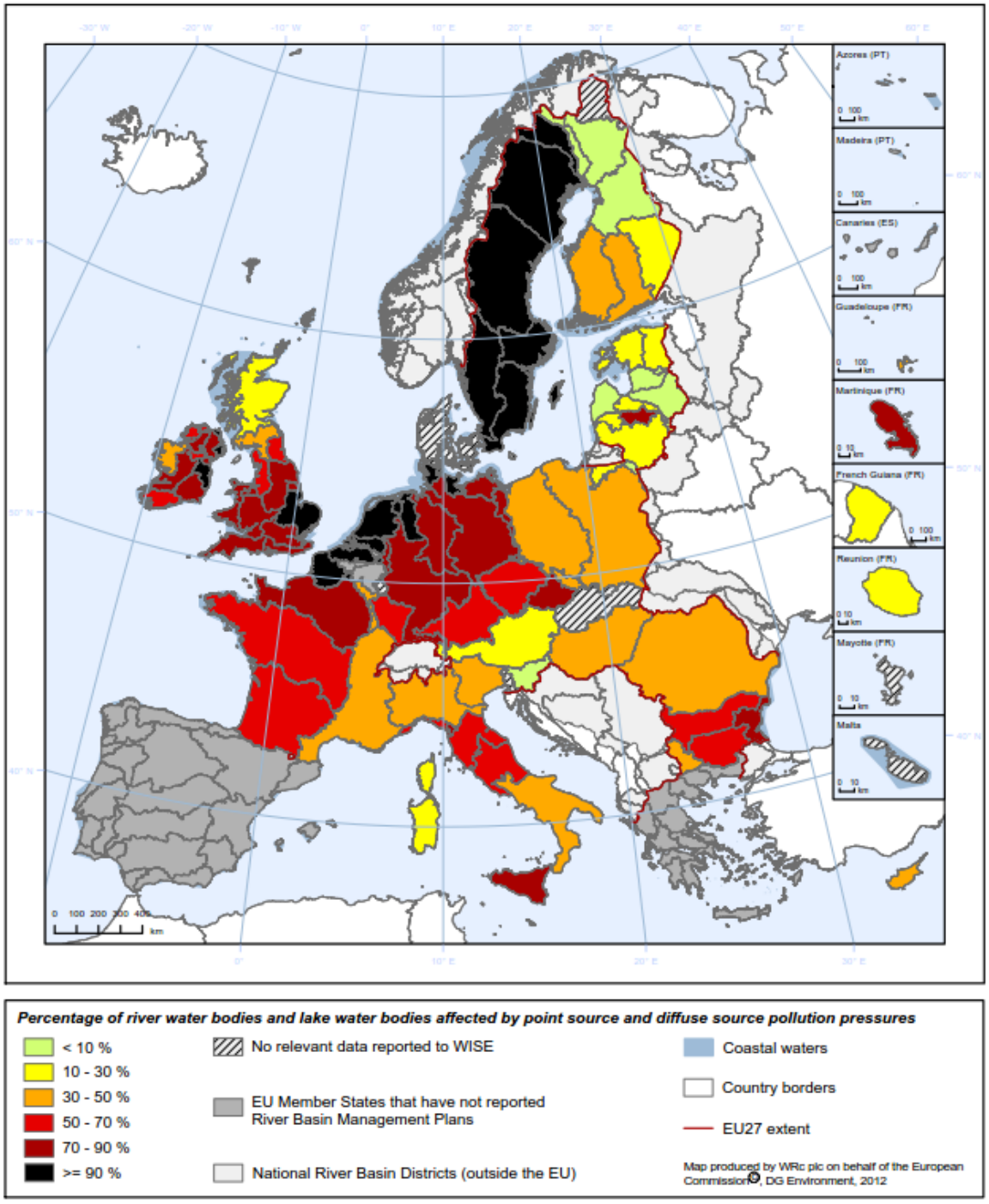


Figure 15: Point and diffuse source pollution – rivers and lakes; EC (2007-2012)

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)

Looking at the technology providers for the ***Emscher case***, clients for SEGNO are municipalities and water corporations in German speaking countries and expansion to countries outside Europe is currently not being thought of. At Emscher, further applications beyond the initial test installations could be an option - e.g. for SEGNO there are 60 other potential spots of which 30 spots could have considerable impacts as per a first rough assessment. For SEGNO, two additional soft factors exist for new target market selection: (1) Preferably, a region which has been strongly affected by extreme rainfall events, (2) preferably, a region where large-scale building measures are planned to counter these.

With respect to UFT, the lamella settler technology is used in some pilot installations in Germany and some other European countries (the Netherlands, France) up to now. For UFT, Germany will at first be a market for the new lamella settler, but DESSIN may help also to awake interest in other countries (e.g. through the application in Norway). UFT has an international network with office in several countries and could thus look into exporting the solution to sites outside of Germany and Europe.

5.4 Potential clients

To fine-tune the group of customers, an initial list of ***potential clients*** for which the ESS solution could be of interest is compiled.

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.

Potential clients for the ESS solution package for water quality generally include:

- Communities / municipalities,
- river basin organisations,
- waste water corporations,
- public works departments,
- generally all decision makers in public infrastructure planning bodies who are in charge of sewerage and surface water management
- small solutions could also work for large industrial companies that discharge wastewater into a natural body (and need to comply with legislation)
- industry interested in trying to enhance their CSR profile

As described previously, for the DESSIN solution for water quality, these clients can probably more often be found in urban areas with systems with CSO in place. However, neither Eurostat nor the European Environment Agency has consolidated data on CSOs in European cities. In Annex B, an overview of the large European cities is provided; the large German cities all still have a mixed sewer system mostly in the old city parts only (however, there is not always data on the number of CSOs available and several cities have reported to have modernised or closed CSOs).

As a public body, Emscher Genossenschaft is not able to sell the DESSIN solution to other customers but can serve as an exemplary application region from which the solution could be transferred. With respect to clients similar to Emscher Genossenschaft, these include the following, amongst others, in neighbouring, preferably ***Germany-speaking countries*** and the second DESSIN application country for the lamella settler, ***Norway:***

Table 10: Potential clients in German-speaking countries; adelphi (2014)

Country	Water cooperative ("Genossenschaft" or similar) or (waste) water cooperations
Austria	• Overview on water cooperations in Austria: http://www.wasserwerk.at/home/wasserwerke And examples: • OÖ Wasser Genossenschaftsverband • Dachverband der Salzburger Wasserversorger • Interessengemeinschaft Wassergenossenschaften Südburgenland

Germany	• Overview over water cooperatives in Germany: http://www.webwiki.de/wasserverband And examples: • Lippeverband • Wasserverband Eifel-Rur • Zweckverband Mittelhessische Wasserwerke
Switzerland[4]	• Wasserwerke Zug • Wasser- und Elektrizitätswerk Steinhausen • e & w dussnang • Wasserverbund Region Bern AG • Wasserverbund Grauholz AG • Wasser- und Elektra-Genossenschaft Wäldi • Wasserverbund Seeland AG • Wasserverbund Kiesental AG • Wasserverbund Region Solothurn AG
Norway	• Overview over cooperatives in Norway: http://www.vannportalen.no/search.aspx?q=samarbeid&m=40354 • List of wastewater treatment plants in Norway: http://www.norskeutslipp.no/en/Lists/Overview-facility/?SectorID=100 And examples: • Godtvann • Fagradet • Nord-Odal Kommune • Sande Kommune • Gimilvann

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 most European countries, the municipalities are orginally responsible for waste water and sanitation. However it is also quite common that they commission the provision of water supply and sanitation services to private companies.

Thus, there are also several private and public-private operators - below graphic illustrates this for several European countries.

[4] Detailed information on stakeholders, legal conditions, the future of wastewater in Switzerland can be found here: http://library.eawag-empa.ch/schriftenreihe/schriftenreihe_21.pdf

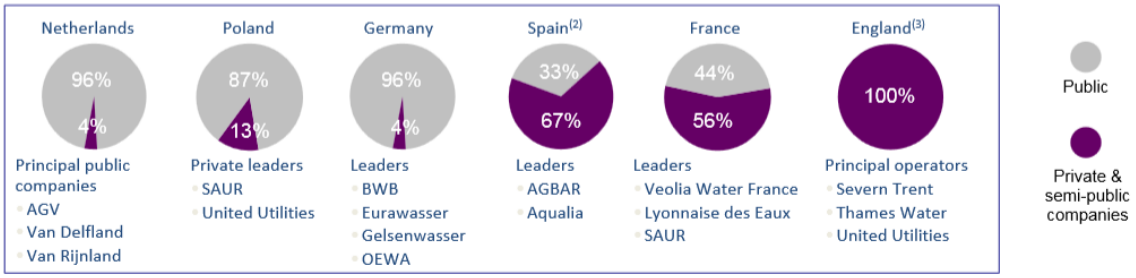


Figure 16: Waste water services public-private market shares in Europe; Agbar (2011), p.16

E.g. in ***France***, there are six river basins, each managed by a representative (Comité de bassin) and an executive agency (Agence de l'eau) - the latter collects fees from the municipalities and grants subsidies for certain projects. The municipalities are responsible for the sanitation and can be organised as community associations. In about half of the cases, the municipalities care for waste water directly; however, privatization (with the public remaining the owner) is increasing and three large companies (Veolia-Environnement, Suez-Lyonnaise, Saur) are dominating the market (Maurer et al. (2012), p. 58f.). In contrast, in ***Italy***, the wastewater sector has traditionally been very fragmented which the "Galli"-law has been trying to change by promoting the regional organisation of wastewater in an optimal area (often a province). The 20-year action plan determinded for that area is then realised by a single company, often a corporation (as in France, few companies such as Italgas and CREA SpA dominate) (Maurer et al. (2012), p. 59).

Below graphic shows an overview of the type of organisation handling wastewater treatment in ***Germany*** – a privatisation trend can also be observed.

Form of Organization	1997	2003
Public firm	44.0%	19.7%
Private firm	30.0%	42.7%
Public Institute (*Anstalt öffentlichen Rechts*)	14.0%	17.0%
Administrative associations/water associations	4.0%	12.8%
Other	8.0%	7.8%

Source: ATV-DVWK and BGW, *Abwasser 2003*

Figure 17: Development of type of organisation in charge of wastewater treatment in Germany; U.S. (2008), p. 3

Generally, the ***EU*** water market is rather mature and innovation is taking place step-by-step, oftentimes when new legislation is ratified. 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).

The key interest of watershed investors by type of buyer could provide an indication of the benefits (ranked 1 to 5) that the different customers are looking for as depicted in below graphic[5].

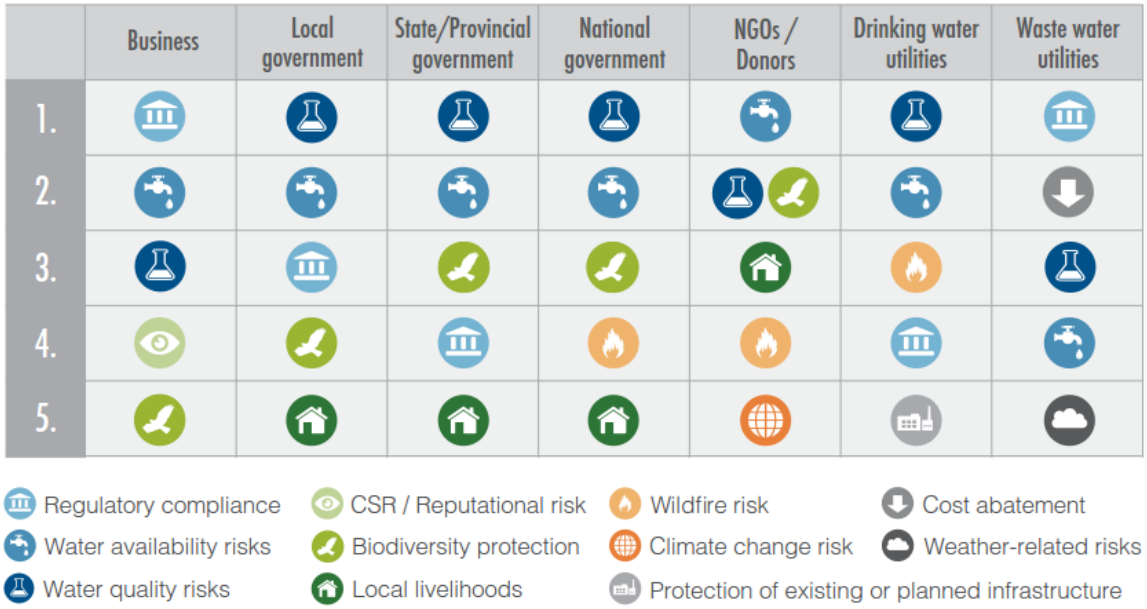


Figure 18: Top investment motivations by buyer sector in 2013; (Bennett/Caroll (2014), p. x

With respect to the technology providers of the ***Emscher case***, current clients for SEGNO include responsible leadership people in the area sewage canal networks of cities, wastewater associations and general drainage planners. One of SEGNOS challenges is finding appropriate end users for the ADESBA box as the end users usually work closely with certain institutions or universities. Potentially, these could be found in larger European cities (population >500,000) with an end user similar to Emscher Genossenschaft and a technical university in place.

For UFT, buyers include sewer system operators (in Germany frequently municipal sewer departments) when building new sewer system structures or retrofitting existing structures (there are frequently separate tenders for construction works and for equipment) and contractors (when in the process a common tender for construction plus equipment is issued, the contractor will ask UFT about a price and make his bid for both). In addition, UFT supply technical advice to consultants as third parties working for sewer system operators or contractors. Additional important stakeholders are the water authorities as they check planning on compliance with current technical rules and issue permits.

According to the SME, a typical planning procedure for a German municipality looks as follows: The municipality that is obliged to invest commissions an engineering firm which calculates the CSO

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

according to the current rules of practice. This planning then seeks approval from the water authority. If there is approval, the engineering firm tenders for the construction work and the equipment - a construction company and a supplier (oftentimes the cheapest) are then selected for the works. Another important mechanism is state subsidies for the construction costs, which can partly be directed politically (e.g. a few years ago there was a program for small sewage treatment plants to be included in larger plants).

Customers of the ESS solution package can thus generally rather be seen in public institutions which could opt for the solution due to regulations. Private players might decide for the solution as part of their services for public institutions.

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 grant programmes***. For example, the EIP provides the following list 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[6]. Indirect funding per EU country can also be accessed online, i.e. through the relevant funding authorities[7]. Generally, the EU wants to relate European subsidies to national and regional funding programmes.

National and international ***funding sources for climate change adaptation*** projects might also be sought (e.g. with respect to flood control). 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 ***subsidizing or guaranteeing credit*** used on the project. Loan guarantees could catalyze private financing by absorbing risk that may otherwise be paralyzing ESS finance (Hartwell et al (2010), p. 25).

The ***DESSIN project*** has received funding from the European Union Seventh Framework Programme (FP7/2007-2013). Regarding the entire ***Emscher conversion*** until 2020, a combination of different funding mechanisms is used. Approximately 90% of the costs of the conversion of the Emscher are covered by the Emscher Genossenschaft which collects membership fees including the waste water charges of the state NRW. In 2014, municipalities and communities paid EUR 186,0 Mio. (67,7%), the mining industry EUR 42,7 Mio. (15,5%) and the industrial enterprises EUR 45,9 Mio. (16,7%). Additionally, the conversion of the Emscher is financed through low-interest and long-term loans provided by the state NRW as well as the European Investment Bank. Several concrete projects in the framework of the Emscher conversion are directly funded by the state NRW through different large-scale funding programs.

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. Taking into account the continued privatisation of wastewater services and the large companies being active in the wastewater sector, the involvement of a private international company 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).

[6] EC grant programmes: http://ec.europa.eu/contracts_grants/grants_en.htm

[7] Funding authorities in EU countries: http://ec.europa.eu/regional_policy/manage/authority/authority_en.cfm

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

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

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 (PES)

Following the DESSIN ESS Evaluation Framework (i.e. economic quantification – where achieved), PES could be aimed for with the DESSIN solution package. 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, ecosystem services could be traded.

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

In the end, the price for a particular ESS is 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.

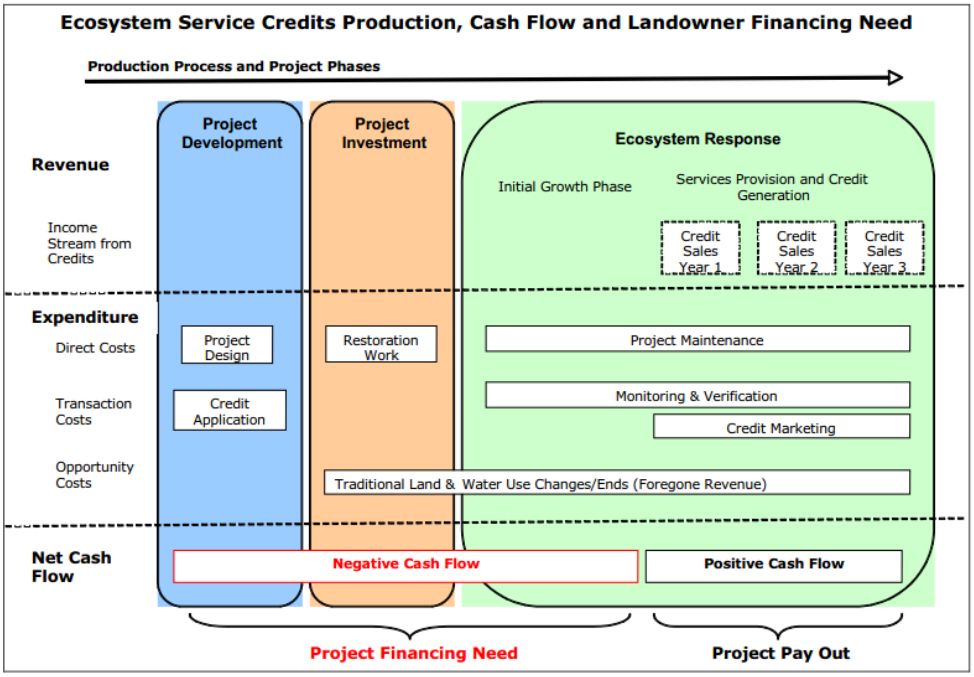


Figure 19: Ecosystem Service Credit Production, Cash Flow, and Landowner Financing Need – Rural ESS Example; Hartwell et al. (2010) , p. iv

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

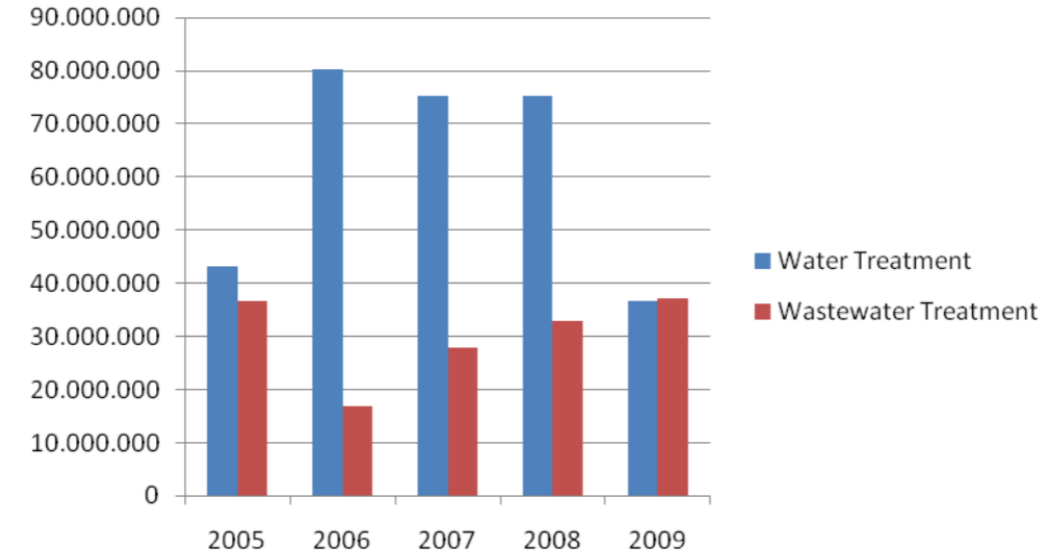
With respect to institutional investors from which infrastructure project finance has been coming from globally so far, the banking sector still plays a major role. However, folllowing the world economic crisis and the Euro crisis, most European banks now reduce risk by decreasing long-term lending (projects 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 21: VC investments for water and wastewater treatment; EPEC (2011)

For ***Germany***, it is estimated that there are around 110 active venture capitalist firms; with the majority being part of the "Bundesverband Deutscher Kapitalgesellschaften". Next to private companies, public bodies can provide (co-)venture capital (such as "Förderbanken der Bundesländer" or KfW for the entire country) (Für Gründer (no year)).

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 (e.g. such as SIEMENS) 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 is an example of a public-private innovation fund that provides risk finance to innovative SMEs in Europe[8].

[8] 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:

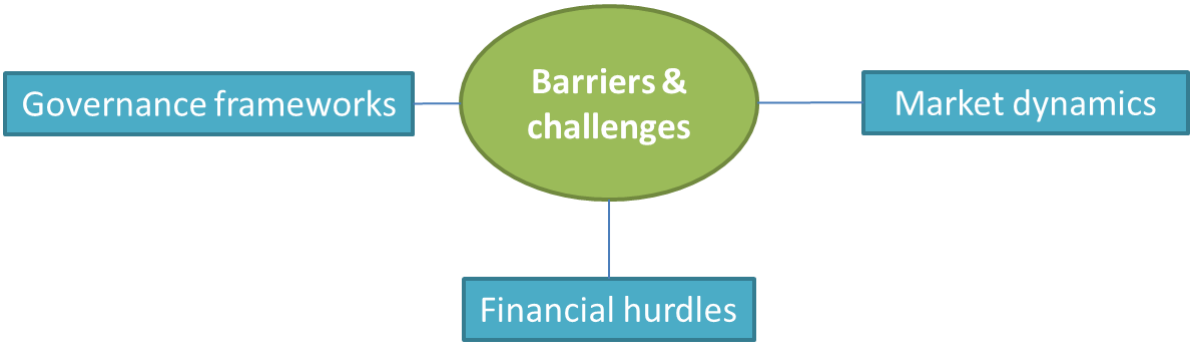


Figure 22: Categories for barriers and challenges; adelphi (2014)

7.1 Governance frameworks

Generally, the 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.). In Germany, the water act generally requires municipalities and utility operators to operate a sewage system according to the codes of practice ("Regeln der Technik"). However, as the sovereignty is with the states, the rules differ somewhat from state to state within Germany.

For the Emscher case, the ***legislative framework has gaps*** in the stringent protection of surface water bodies from wastewater discharge. The law allows wastewater discharge if the calculated rainwater / wastewater mix ratio is 7 / 1. This leads to raw wastewater being discharged into the Emscher river and its tributaries around 15 to 20 times a year on average and up to 50 times a year in years with more intense rain events. Also, technical potentials of re-pumping wastewater from overflow holding tanks back into the sewerage system are not made use of instead the untreated

wastewater mix is pumped into the surface water body. This indirectly leads to the DESSIN solution not being taken up on a broad scale.

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.

Monitoring and measuring is another issue. With respect to the Emscher case, currently the quantity of discharge is only calculated but not really measured. If the discharge quantity would really be monitored, then the DESSIN solutions for really minimizing it would be more preferable In Germany, the federal states designate (district or local) authorities for the monitoring and disposal of sewage.

Also, with respect to the solutions being tendered for, in Germany, engineering firms that provide the technical input to the tender are being paid in accordance to the "Honorarordnung für Architekten und Ingenieure" (HOAI) – this means that their ***fees are in direct relation to the capital investment of the solution*** being constructed (which implicitly does not favour cost-efficient solutions). In addition, they often shy away from the effort to propose to the authority technically unknown solutions (Interview with UFT (2014)).

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 (2014), 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 reported by a DESSIN SME, the operators generally want their obligations to comply with current practice at the least possible effort – generally, they will therefore tend to invest in the minimum solution that complies with technical rules but have no interest in ESS. It was also reported by another SME, that planning offices themselves can be a competitor as they are afraid to lose a major chunk of their job through the innovative technology.

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 and in Germany, investment levels are rather low in EU comparison. The demographic trend of de-urbanisation in the EU also somewhat provides a new shape to the demand side.

For the DESSIN solution for water quality, the technology providers also report that ***current demand is rather saturated***.

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.

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.

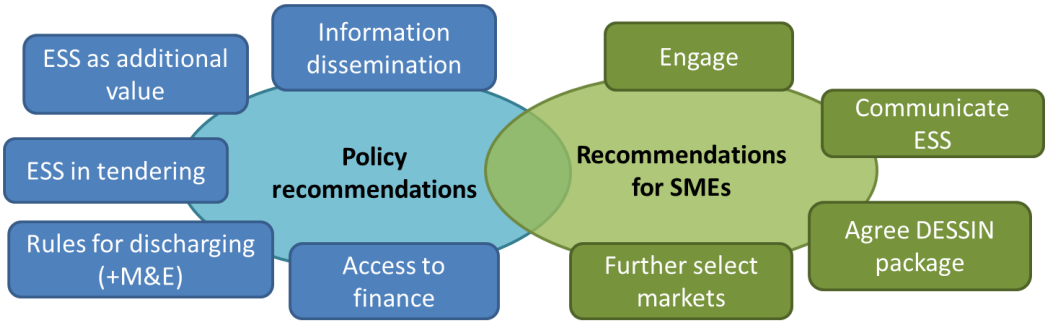


Figure 23: Recommendations derived; adelphi (2014)

8.1 Policy recommendations

As mentioned above, in Germany, the states regulate water issues in line with the national water act. Wastewater infrastructure is then oftentimes financed by the respective municipality with additional financing coming from the state. The state also issues own guidelines on wastewater issues and as such could be looking into the ***additional value generated from investments in the wastewater sector, e.g. through ESS improvement from innovations***, at lower levels (e.g. municipalities). Therefore, informing the respective state authority (e.g. the ministry or its environmental agency) on the additional benefits of taking ESS aspects into account could further foster the implementation of the DESSIN solution package and its technologies. (This would also need to include proofing the technical equivalence (Stand der Technik) of the new solution with respect to the current state of the technology at a lower cost).

In general, for any authority worldwide, firstly the concept of ESS and their value for the public and for the specific mandate of an authority has to be shown. Secondly, wider ***information on the linkage between innovative water technologies and the improvement of ESS*** are important. As another step, ***including ESS aspects in tendering procedures*** (e.g. at EU level) 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).

More stringent rules for discharging waste water into surface water bodies need to be established with the ultimate aim to prohibit the discharge of raw wastewater into water bodies. At least, further incentives for reducing untreated discharge amounts need to be provided. This also includes mandatory ***aspects for monitoring and measuring***.

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 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) – e.g. UFT voluntarily participate in DWA working groups and trainings offered by DWA for public agencies and engineering companies.

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 ***DESSIN solution package***, the internal stakeholders should agree on a lead agency that takes the entire solution to the market. In terms of modularising the package, the specific modules and entities repsonsible for these modules should be agreed upon.

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*** with a single SME. One suggested approach for the Lamella settler is for a given geographic region (e.g. within a state in Germany) to identify single potential clients is to search for locations for which the water law permits expire and for which the technical solution applied does not match the current technical regulations anymore (i.e. further research into the market for existing CSOs). Another approach for the ADESBA is to further research potential end users like Emscher Genossenschaft for given countries for cities with a population greater than 500,000 and a technical university in place (Annex B of this report provides a list of the European cities with more than 500,000 inhabitants and CSOs for German cities as a start[9]).

Generally, the following process could be applied (Innowater (2013), p.7):

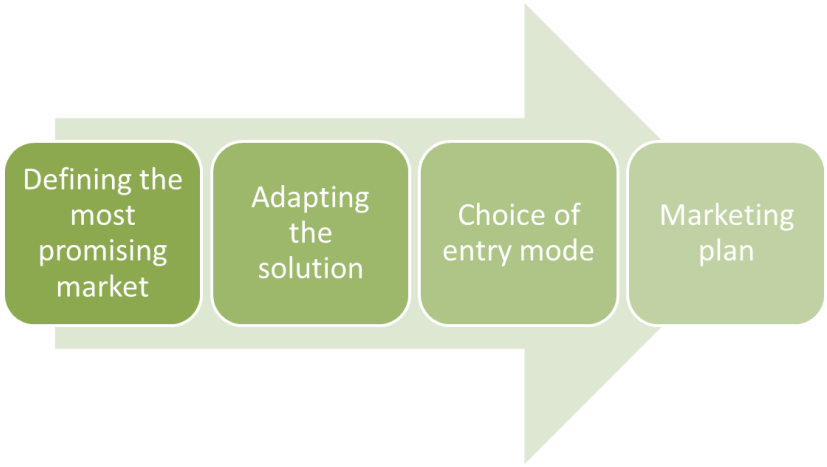


Figure 24: 4 steps for internationalisation; based on Innowater (2013), p.7

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?

[9] eurostat also provides a graphical overview of the population in the EU from its Urban Audit (eurostat (2012)).

- 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*** could be elaborated and comunicated. E.g. it could potentially be looked into linking the arguments from the wastewater sector to the water supplying sector (e.g. less purification costs if source water is cleaner) or the energy sector (e.g. water needs for generation and cooling) or even the agricultural sector (e.g. irrigation needs).

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10. Annex A: Tables for Market Screening

For a market screening, the following criteria could be checked for the DESSIN solution package on water quality (examples have been taken from the Emscher case and the detailed market assessment):

Guideline for product description
Guiding questions: • What is the problem that is addressed by the DESSIN solution? Why is the solution needed? • How is the DESSIN 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 addressed 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. • City has a CSO which discharges into a surface water • Pollution in surface water body has an impact on its usage • Options for refitting separate sewer systems are technically not given • Sewage data availability	
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 → requirement for good water quality status	

Willingness to pay, e.g. • Stakeholders are interested in (or required to) reducing the pollution to the surface water body • Financial mechanisms are in place to reduce the pollution of the surface water body (e.g. in Germany "Abwasserabgabegesetz") • Options for refitting separate sewer systems are more expensive than real time control systems and cross current lamella settlers	

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 current implementation challenges • other relevant EU directives • relevant EU policies • screening of relevant administrative actors and the potential for synergies • detect willingness and commitment of local stakeholders	
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 and the potential for synergies	
Extraction of potential governance solutions, e.g. • existence / development of a "future master plan" • relevant local stakeholders and potential financial contributors are committed	
Assessment of pull effect or shaping effect of European, National or Local conditions, e.g. • contribution to interregional dialogues on possible improvements • communication of successes in approaching institutional / technical /	

environmental / financial hurdles	

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 (urban / rural areas) • screening of status of water bodies and water ESS in the particular area • evaluation of financing environment (investment friendliness) • benchmarking competitors	
Assessment of current and future demand, e.g. • analysis of and demands • analysis of different demand forecasts (macroeconomic / industrial / sales)	
Geographic regions, e.g. • derived from WFD surface water viewer or other maps	
Potential clients, e.g. • once a country has been selected, customers similar to Emscher Genosseschaft (e.g. associations of municipalities) could be searched for • analysis of customers' current needs and characteristics	

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) • Private funding (e.g. tenders from private companies)	

• 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 and gaps in the legislative framework • Public knowledge promotion on the role of ESS • Monitoring and measuring requirements for wastewater • Public tendering and procurement issues	
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 • Current demand is rather saturated	
Financial hurdles, e.g. • Lack of funds for SMEs as major hurdle for innovation • Public budgets in the EU are expected to remain tight	

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 wastewater sector, e.g. through ESS improvement from innovations; include ESS aspects in tendering procedures • More stringent rules for discharging waste water into surface water bodies; monitoring and measuring • 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 state 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 • The advantages of ESS improvements for other sectors could be elaborated and comunicated (e.g. water supplying sector (e.g. less purification costs if source water is cleaner) or the energy sector (e.g. water needs for generation and cooling) or even the agricultural sector (e.g. irrigation needs)) • Further narrow down markets for your SME: (1) Define most promising market, (2) adapt DESSIN solution package, (3) choose entry mode, (4) develop marketing plan	

11. Annex B: Large European cities (with CSOs)

Below table provides an overview of the European cities with a population greater than 500,000. The numbers are based on the eurostat Urban Audit 2012. German cities are shaded in blue. The full database can be accessed online (also in German) at http://epp.eurostat.ec.europa.eu/portal/page/portal/region_cities/city_urban/data_cities/database_sub1

There is no European statistic regarding combined sewer overflows (CSOs) – neither eurostat nor the European Environment Agency have consolidated information on that matter. For below table, the German cities with CSOs have therefore been researched individually (as far as possible from the official city wastewater websites) as a start. All these large German cities have combined sewer systems (mostly in the old part of the city only) – however, the exact number of combined sewer overflows is not always provided. In several of these cities, CSOs are reported to have been modernised or closed down. Further research should provide a more detailed overview.

CITIES	2013	2012	2011	CSOs
Berlin	:	3.501.872	3.460.725	YES
Madrid	:	3.233.527	3.198.645	
Barcelona (greater city)	:	3.202.571	3.184.502	
Milano (Ballungsraum)	:	3.105.489	3.188.206	
Napoli (Ballungsraum)	:	3.103.234	3.124.315	
Roma	:	2.638.842	2.761.477	
Górnoslaski Zwiazek Metropolitalny	:	1.917.482	1.927.787	
Bucuresti	:	1.883.425	1.924.299	
Lisboa (Ballungsraum)	1.849.472	1.860.256	1.863.069	
Hamburg	:	1.798.836	1.786.448	YES
Warszawa	:	1.715.517	1.708.491	
Barcelona	:	1.620.943	1.611.013	
München	:	1.378.176	1.353.186	(YES)
Milano	:	1.262.101	1.324.110	
Praha	:	1.246.780	1.241.664	
Sofia	:	1.208.097	1.202.921	
Bruxelles / Brussel	:	1.159.448	1.136.778	
Helsinki / Helsingfors (Ballungsraum)	:	1.059.631	1.045.263	
Amsterdam (Ballungsraum)	:	1.021.754	:	
Köln	:	1.017.155	1.007.119	(YES)
Rotterdam (Ballungsraum)	:	977.584	:	
Porto (Ballungsraum)	968.905	975.300	978.256	
Napoli	:	959.052	959.574	
Torino	:	872.091	907.563	
Valencia	:	797.028	792.054	
Amsterdam	:	790.110	779.808	

Bilbao (greater city)	:	785.793	785.036	
Kraków	:	758.334	759.137	
Lódz	:	718.960	725.055	
Sevilla	:	702.355	698.042	
Frankfurt am Main	:	691.518	679.664	YES
Zaragoza	:	679.624	678.115	
Palermo	:	654.987	655.875	
Riga	:	649.853	659.418	
Wroclaw	:	631.188	631.235	
Rotterdam	:	616.260	610.386	
Stuttgart	:	613.392	606.588	(YES)
Oslo	623.966	613.285	599.230	
Zürich (Ballungsraum)	:	598.986	590.548	
Helsinki / Helsingfors	:	595.384	588.549	
Glasgow	:	594.100	593.245	
Düsseldorf	:	592.393	588.735	YES
Genova	:	582.320	607.906	
Dortmund	:	580.956	580.444	YES
Essen	:	573.468	574.635	YES
Málaga	:	567.433	561.435	
København	:	559.440	549.050	
Poznan	:	550.742	553.564	
Bremen	:	548.319	547.340	YES
Lisboa	524.282	537.412	548.422	
Vilnius	:	533.279	536.127	
Leipzig	:	531.809	522.883	YES
Dresden	:	529.781	523.058	(YES)
Hannover	:	525.875	522.686	(YES)
Nürnberg	:	510.602	505.664	(YES)
Antwerpen	:	507.368	498.473	
's-Gravenhage	:	502.055	495.083	