DESSIN

DEMONSTRATE ECOSYSTEM SERVICES ENABLING INNOVATION IN THE WATER SECTOR

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D12.2 Report on financing approaches conducive to water sector innovation

Innovative and innovation-friendly modes of governance, financing and payment

Cetaqua (June 2015, revised version November 2017)

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D12.2: REPORT ON FINANCING APPROACHES CONDUCIVE TO WATER SECTOR INNOVATION

SUMMARY

This deliverable reports on current financial instruments conducive to water sector innovation and economic instruments linked to social innovation.

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Table of contents

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List of Figures

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List of Tables

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List of Acronyms and Abbreviations

AEM	Agro-Ecological Measures
BAU	Business as Usual
bn	Billion
CDTI	Centro para el Desarrollo Técnico Industrial
EBRD	European Bank for Reconstruction and Development
ECB	European Central Bank
EFT	Ecological Fiscal Transfers
EFTA	European Free Trade Association
EIB	European Investment Bank
EIF	European Investment Fund
EIP	European Innovation Platform on Water
ELENA	European Local ENergy Assistance
EPEC	European PPP Expertise Centre
EPI	Economic Policy Instruments
ESIF	European Structural and Investment Funds
EU	European Union
EWP	European Water Partnership
GPP	Green Public Procurement
IWRM	Integrated Water Resources Management
IFC	International Finance Corporation
IFIs	International Financial Institutions
JASPERS	Joint Assistance to Support Projects in European Regions
JESSICA	Joint European Support for Sustainable Investment in City Areas
JPI	Joint Programming Initiative
LGTT	Loan Guarantee Instrument for Trans-European Transport Network Projects
MBI	Market Based Instrument
MFI	Microfinance Institution
m	Million
MIGA	Multilateral Investment Guarantee Agency
MRI	Mutual Reliance Initiative
NFM	Natural Flood Management
PCGs	Partial Credit Guarantees
PES	Payments for Ecosystem Services
PF4EE	Private Finance for Energy Efficiency
PI	Policy Instruments
PIDG	Private Infrastructure Development Group
PP	Public Procurement
PPI	Public Procurement for Innovation
PPP	Public Private Partnership
PRGs	Partial Risk Guarantees
PWS	Payments for Watershed Services
SEM	Sustainable Ecosystem Management
SMEs	Small and Medium Enterprises
SPP	Sustainability Public Procurement

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TDR	Tradable Development Rights
TSA	Targeted Scenario Analysis
UK	United Kingdom
USA	United States of America
VAT	Value Added Tax
VPS	Voluntary Price Signals
WFD	Water Framework Directive
WQT	Water quality trading markets

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Executive summary

What you will find in this document?

The DESSIN project aims to demonstrate and promote innovative solutions to water-related challenges with a focus on (i) water quality issues related to the implementation of the Water Framework Directive (WFD), and (ii) water scarcity. WP12 of DESSIN specifically aims at identifying innovative and innovation-friendly modes of governance, financing and payment. The implementation of economic policy instruments (EPIs) in water management has strong potential for creating comparatively rapid changes in the attractiveness and uptake of new technologies by the private sector.The aim of this deliverable is to examine the use of innovation-friendly modes of financing and payments in the context of urban water management. Objectives are i) to define key terms, ii) provide a synthetic overview of the state-of-play and existing experiences, and iii) identify existing gaps. The research is based on a range of secondary sources, including peer-reviewed and grey literature review, and draws on a number of results of past other European projects (e.g. EPI Water, POLICYMIX and CECILIA 2050) and the mature case-studies of WA1 of the DESSIN project (Aarhus, Emscher, Zaragoza).

The introduction provides a general discussion about innovation and economic instruments. A definition of EPIs is provided. The second chapter deals with innovation in the water sector, its trends and economic instruments' effects on it. The third chapter deals with the complex issue of financing innovation, including a discussion about the role of public interventions on incentivising innovation uptake, including public procurements, pricing policies and financing frameworks. The role of the European Investment Bank in financing water innovation is explored. The fourth chapter specifically deals with the use of payments under the ecosystem service approach for innovation uptake in urban water management. The final chapter is devoted to conclusions and some lessons learned.

Most importantly, the Annexes provide detailed reporting on potential economic instruments for supporting innovation uptake in urban water management. Annex A includes descriptions and information related to eight economic instruments used to finance SME. These include:

- *Grant and blending grant*
- *Loan and credit*
- *Microfinance*
- *Venture capital*
- *Equity investment*
- *Insurance and guarantee*
- *Crowdfunding*

Annex B presents a detailed list of water projects financed by the European Investment Bank. Annex C includes a detailed description of some innovative water instruments.

What are innovations in the context of urban water management?

Solutions to water challenges lie, in part, with the development and adoption of innovations. Although there are some specific barriers to the adoption of innovative solutions, lack of financing options is a common problem across EU Member States. As a consequence, the report focuses on financing instruments and their relationship to technological innovation. As such, the report does not only focus on existing and available financing instruments, but also addresses new and innovative financing means (e.g. ecosystem service approach).

The water sector touches upon a very broad range of other sectors (Maxwell, 2009): "steel and concrete pipe manufacturers; specialty chemical producers; measurement, monitoring and testing firms; tank manufacturers; all kinds of treatment equipment manufacturers; new technology developers of all stripes; manufacturer's representatives [...]; engineers and consultants; contract operators of water plants, and many others" - companies which may be quite different, and whose "only real similarity is that they are somehow involved in the process of providing clean water". For this reason, **water innovation could be defined as the technologies, business models and partnerships that increase water supply and decrease demand throughout the water delivery and use cycle** (Heslop and Faulkner, 2013), keeping in mind that water supply management refers here to avoiding leaks and improving the efficiency of the distribution systems, and not building new infrastructures.

Supply-side innovation is mainly linked to water quality and network system with regard to efficiency needs. Digital platforms allowing real time monitoring control of water distribution networks or leak detection, for example, can be such innovations. S*marter* networks allow water suppliers to understand the system and manage losses, and to have assets on-line for improving real time control and monitoring thereby ensuring high quality of data.

On the other hand, **demand-side innovations** are based on incentivizing water users and making the business case for efficiency. However, it is necessary to have in mind that there are numerous types of water users - big or small water users and residential, commercial, industrial or public administration water users. Innovation should provide solutions that decrease water usage without affecting business operations. Innovations linked to residential and commercial use should be devoted to enabling behavioural change or enabling water users to make informed decisions about how to reduce usage using increased data accessibility. In many ways, the key to innovation on the demand-side is to create awareness using available data in order to give information about water consumption. At the same time, in case of industrial water users such as manufacturers, oil and gas activities or power generation, technology needs may be different. The same occurs in the agricultural sector where technology needs are not the same. For this reason, each market will require specialised solutions

What are potential modes of financing and payments for innovations in the water sector?

Companies may use internal sources of funding in order to finance innovation uptake or may borrow money. Bank loans and bank overdraft or credit lines are used in more than fifty per cent of all cases. However, some of these instruments, such as leasing and factoring, cannot be used by innovative

SMEs because investors may not willing to fund a new (unknown) company or because the benefits of the innovation are difficult to quantify and monetise.

A number of additional barriers and bottlenecks exist for innovation uptake in the water sector. Barriers include i) lack of funds for SME, ii) risk aversion of the water sector, iii) the way the water sector is managed, iv) concerns about public health and risks, v) the industry fragmentation, and vi) the complexity of most water systems. Some specific barriers include also low water pricing rates, regulatory restrictions and the absence of regulatory incentives, and lack of access to capital and funding.

Different mechanisms, usually created by the state, exist to incentivise innovation uptake. For supply-side innovations, taxes, collaborative grants and tax reductions have been used. For demand-side innovations, regulations and standards are the most common instruments although some new instruments such as public procurement or direct support to demand are emerging. The next two tables summarise these instruments and their effects on water innovation, distinguishing between direct and indirect (the final objective is not innovation) effects.

Table 1. Policy insturments for supply-side innovations in urban water management. Source: EIO Thematic Report: Water Innovation

Type of policy measures	Instruments	Effects on water innovation
Equity support	Public venture capital funds	• Potential indirect effect • Companies investing in water eco-innovation may benefit from the equity support measures
	Tax incentives for companies investing in R&D	
	Public guarantee funds	
Grants for industrial R&D	Grants for R&D	• Potential direct effect • Companies involved in water eco-innovation may benefit from generic R&D grants • Water issues may be one of the priority areas of R&D industrial grant funding
	Collaborative grants (more than one company and/or business and science partners)	
Support for public sector research	R&D funding	• Potential direct effect • Water issues may be one of the priority areas of R&D grant funding • Research organisations involved in water eco-innovation may benefit from generic R&D grants
	Collaborative grants	
	R&D infrastructure	• Potential direct effect • R&D infrastructure may be used for performing water innovation R&D • Companies and research organisations involved in water eco-innovation may benefit using shared infrastructures
	Research infrastructure sharing	
Fiscal measures	Corporate tax reduction or exemption on R&D	• Potential indirect effect • Companies involved in water eco-innovation may benefit from fiscal measures
	Personal tax incentives for R&D personnel	
Education, training and mobility	Tailored training courses for companies	• Potential indirect and/or direct effect • Companies investing in water eco-innovation may benefit from both generic trainings in innovation managements and entrepreneurship as well as from the tailored measures supporting recruitments of innovation personnel
	Entrepreneurship training	
	Placement schemes for students	
	Support for R&D workers recruitments	
Networks and partnerships	Competence centres, clusters, science-technology parks	• Potential indirect effect • Companies involved in networks and partnerships relevant for water eco-innovation may benefit from the collaboration by sharing information and creating shared visions that may also lead to concrete collaborations
	Technology platforms and innovation networks	
	Foresight and common vision building	
	Market intelligence and other forms of information sharing	

Table 2. Policy insturments for demand-side innovations in urban water management. Source: EIO Thematic Report: Water innovation

Type of policy measures	Instruments	Effects on water innovation
Regulations and standards	Regulations and standards (including targets)	• Potential indirect effect • Performance standards and targets related to water quality and use drive (both technological and organisational) innovation efforts within companies and utilities as well as support wide diffusion of eco-innovation solutions
Public procurement	Public procurement of goods and services	• Potential direct effect • Public sector can procure goods and services giving an explicit preference to innovative water efficient solutions
	R&D procurement	• Potential direct effect • Public sector can procure R&D on innovative solutions explicitly preferring water efficiency
Technology transfer	Support for technology adopters (advisory services)	• Potential indirect or direct effect (diffusion) • Companies may benefit from the generic technology transfer advise and/or specific advice on preferable water eco-innovation
	Support for technology adopters (grants for purchasing new technology)	• Potential direct effect (diffusion) • Companies may benefit from the grant purchasing water eco-innovation solutions
Support of private demand	Regulations (e.g. water charging)	• potential indirect effect • faced with higher prices for water use, households seek water efficient (technological and non-technological) solutions
	Tax incentives for consumers (e.g. for purchasing environmentally efficient products)	• potential indirect effect • policy measures reducing the cost of environmentally efficient goods and services to consumer may influence the consumer's decision to purchase these goods or services, which in turn supports the producer and may indirectly support their eco-innovation activity
	Tax reductions for products and services (e.g. VAT reductions)	
	Demand subsidies (including eco-vouchers)	
	Awareness raising and information provision (including labelling schemes)	• potential indirect effect • measures aiming at providing the information on environmental performance of products allow consumer to make informed choices; assuming that consumer makes a choice to purchase eco-innovative good or service this supports the eco-innovative producer and may indirectly support their innovation activity

The table below summarises existing financial instruments based on previous information (more information is provided for each instrument in Annex A).

Table 3. Existing financial instruments.

Type of policy measures	Instruments	Effects on water innovation
Grant and blending grant	Grant is a non-repayment required fund disbursed by one party, often a government or trust, to a recipient for an innovation purpose or requirement that is sometimes proposed by the recipient. Blending grant is a mix of financing consisting in a loan and a grant in order to support a single project.	• No budget limit • Available for early-stage projects Big structure needed to capture fund • Continous feedback to supervisor • Suitability with EU purposes • Time of the acceptance process
Loan and credit	Loans and credits are debts provided by one entity to another at an interest rate as a payment to use the money. While a loan is an amount of money that is fully taken by the borrower who gives back the amount of money in future periods, a credit is a limited quantity of money that is put to the borrower's disposal by the lender.	• No budget limit • Faster than alternatives • No accountability • Payback is required • Some guarantee is needed
Microfinance	Microfinance is a funding source for entrepreneurs and small businesses; it provides smaller amounts of money (e.g. €25.000 in the EU), at a lower interest than under other funding schemes.	• Mentoring, training, advising, consulting • Dedicated to small businesses • Fragmented market along EU
Venture capital	Venture capital is a form of equity investment focused on early stage projects, which almost always means high-risk. It focuses on innovative goods or services.	• No budget limit • Different kinds of funds that suit different projects • Advising and knowledge of the new stockholder/s • Ensures a focus on innovation • Leads to new company stockholder/s • Transfer some decision capacity
Equity investment	Equity investment is the practice of buying a fraction of a company in the form of equities.	• No budget limit • Leads to new company ownership
Insurance and guarantee	Insurance is the transfer of the risk of loss from one entity to another in exchange for payment. A guarantee is an agreement serving as security for the formal pledge to pay another person's or company's debt.	• No budget limit
Crowdfunding	Crowdfunding is the practice of funding a project or venture by raising many small amounts of money from a large number of people, typically via the internet.	• Small and medium budget projects • No initial requirements • Cost associated with project dissemination, and crowdfunding platform

What role for Europe and the European Investment Bank in supporting innovation through economic policy instruments?

The main EU level actions contributing to promote innovation uptake in the water sector are mainly R&D mechanisms: JPI Water, Water Supply and Sanitation Technology Platform, EUREKA and EUREKA Acqueau Cluster, European Water Partnership (EWP), European Innovation Partnership (EIP) for "Water Efficient Europe", ERA-NET and a lot of specific projects under European Commission financing**.**

The European Investment Bank (EIB) represents also a powerful means to support innovation uptake. EIB is the European Union's bank and it is the only bank owned by and representing the interests of the EU Member States. The EIB has an important role to play in European policy by acting as a source of investment for many projects and infrastructures, and it closely supports the implementation of EU policy. It is complemented by the European Investment Fund (EIF), the specialist arm providing SME risk finance. The instruments of the EIB are, basically, project loans and intermediated loans as well as venture capital and microfinance to support SMEs of different sectors. The table below presents some of the financial products provided by the EIB that are relevant for financing innovations in the water sector.

Table 4. EIB financial products. Source: EIB.

Lending	Blending	Advising
Project loans (over 25 M EUR)	Structured finance (additional support to priority projects) European Structural and Investment Funds (ESIF) Financial Instruments	Public-private partnership optimisation (EPEC)
Intermediated loans (via local banks)	Guarantees (helping to attract new investors) Urban development technical assistance (JESSICA)	Infrastructure project advice for new EU members (JASPERS)
Venture capital (for high-tech and growth SMEs)	Project bonds (unlocking infrastructure funding) The Mutual Reliance Initiative (MRI effective partnering for growth & development)	Sustainable energy: maximising investment (ELENA)
Microfinance (subcategories)	InnovFin – EU Finance for Innovators Private Finance for Energy Efficiency (PF4EE)	European Structural and Investment Funds (ESIF)
	Transport infrastructure (cash flow guarantees LGTT) Natural Capital Financing Facility (NCFF) (combined with LIFE program)	Green-tech demonstration support NER300
	Flexible SME funding (JEREMIE finance and financial engineering for SMEs) Guarantee Fund for Greek SMEs	
	Equity & fund investment (to catalyse further activity)	

What about using Payments for Ecosystem Services for supporting innovation uptake in urban water management?

Most of the mechanisms described in the previous sections are well established funding or incentives that can contribute to innovation uptake. Non-technological innovations can play a key role in the promotion of technological innovation. Payments for ecosystem services (PES) have been the focus of much recent research on environmental management. The current report thus investigated the potential for PES to support innovation uptake.

PES aim to provide incentives to increase or maintain the level of ecosystem provision. These incentives are usually in monetary forms or, in some cases, in-kind. The URS Scott Wilson Report (2011) states: *"*the PES approach provides opportunities to link up those involved in 'supplying' ecosystem services more closely to those benefiting from those same services and, in doing so, it potentially provides cost-effective ways of developing new streams of financing for conservation". PES may thus have most potential in promoting the uptake of environmentally-friendly measures such as green infrastructures.

The next table provides a review of the type of payments recommended depending on the type of ecosystem goods and services provided. The use of PES is recommended in all cases except when ecosystem services that are rival and non excludable. In addition, property rights must be allocated at the same scale as benefits.

Table 5. Recommended payments. Source: Adapted from Kemkes et al. (2010).

Type of good	Characteristics	Recommended Payments
Public good (clean air, biodiversity, climate regulation)	Non rival Non excludable Global scale	Payment by a global institution acting as single buyer using public funds
Market good (raw materials, food products)	Rival Strong property rights: excludable Any scale	Individual payments
Common pool resource (ocean fisheries, waste absorption capacity)	Rival Difficult to exclude Property rights at the same scale of benefits	Payments are not an effective policy Tradable permits: Market
Toll or club good (recreational services)	Non rival Excludable Congestible Local or regional scale	Entrance fees as one-time payment by individuals

1. Introduction

The DESSIN project aims to demonstrate and promote innovative solutions to water-related challenges with a focus on

(i) **water quality** issues related to the implementation of the Water Framework Directive (WFD), and
(ii) **water scarcity**.

It also aims to **demonstrate a methodology for the valuation of ecosystem services as catalyser for innovation in water management**. DESSIN takes into account the need to meet the requirements of "daughter directives" (e.g. drinking water, groundwater, urban wastewater, bathing water) as well as other European policy initiatives (e.g. EU Commission's Communication on Water Scarcity and Droughts; Blueprint for Safeguarding European Waters). DESSIN aims to promote more sustainable, adaptive and cost-effective urban water management.

WP12 of DESSIN aims specifically to identify **innovative and innovation-friendly modes of governance, financing and payment.** This Deliverable DL12.2 provides an analysis of financial models and funding mechanisms encouraging uptake of innovative and sustainable measures, with consideration of ecosystem services valuation uptake. It presents an analysis of financing and payment approaches conducive to water sector innovation.

The introduction provides a general discussion about innovation and economic instruments. The second chapter deals with innovation in the water sector, its trends and economic instruments' effects on it. The third chapter deals with the complex issue of financing innovation, including a discussion about economic instruments and their impact on innovation and the role of the European Investment Bank in financing water innovation. The fourth chapter specifically deals with the use of payments under the ecosystem service approach and the use of payments for innovation uptake in urban water management. The final chapter is devoted to conclusions and some lessons learned.

Most importantly, the Annexes provide detailed reporting on potential economic instruments for supporting innovation uptake in urban water management. Annex A includes descriptions and information related to eight economic instruments used to finance SME. These include:

- *Grant and blending grant*
- *Loan and credit*
- *Microfinance*
- *Venture capital*
- *Equity investment*
- *Insurance and guarantee*
- *Crowdfunding*

Annex B presents a detailed list of water projects financed by the European Investment Bank. Annex C includes a detailed description of some innovative water instruments.

1.1 Defining innovation

The Organisation for Economic Cooperation and Development created the Oslo Manual (OECD, 2005) in search of greater conceptual uniformity as well as understanding of innovative processes and standardisation in the use of data on innovative activities of industry. The manual contains both the concepts and classifications, and a set of guidelines and policies for the measurement of innovation in the international arena. In the manual, **innovation is defined** as "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations." At the same time, innovation activities are "all scientific, technological, organisational, financial and commercial steps which actually, or are intended to, lead to the implementation of innovations" (OECD, 2005). Concerning the type of innovations, the manual includes: product innovations, process innovations, marketing innovations and organizational innovations.

Therefore it is important to highlight that innovation is not only devoted to technological improvements, but also to institutional and social innovations. This report considers the following:

- Technological innovations. In DESSIN these include, for example, treatment of sewer overflow, restoration of the hydro-morphology of a river (Emscher), combined sewer overflows (Hoffselva), aquifer recharge recovery and desalinisation (Westland), sewer mining with ICT solutions (Athens), deep injection system in drinking water treatment plant (Llobregat), improved wastewater treatment through investment in capacity and real-time monitoring (Aarhus).
- Institutional innovations, following Raffaelli et al. (2013), defined here as "novel, useful and legitimate change that disrupts, to varying degrees, the cognitive, normative, or regulative mainstays of an organisational field". They may refer to new norms, rules and organisations that shape interactions among public and private actors or just among private ones.
- Social innovations, heredefined as a "novel solution to a social problem that is more effective, efficient, sustainable, or just than existing solutions and for which the value created accrues primarily to society as a whole rather than private individuals" *(*Phills et al. 2008). Examples such as changing the behaviour regarding the use of water or the adoption of new practices for sharing rights on water usage can be seen as specific kinds of social innovation.

Innovations contribute to competitiveness and, as table 1 presents, the contribution depends on the degree of innovation. If the degree of innovation is disruptive, the competitive advantage is the creation of new (economic) value. In case of a radical degree of innovation, the advantage lies in pricing; in case of a complex innovation degree, the advantage lies in the establishment of new entry barriers; and, finally, in case of continuous incremental innovation, costs are changing continuously.

Table 6. Innovation and competitiveness. Source: Adapted from Tidd (2001).

Degree of innovation	Competitive advantage

Disruptive	Rewriting the rules of the competitive game, creating a new (economic) value
Radical	Offering a new product or service, premium pricing
Complex	Increase the entry barriers
Continous incremental innovation	Constant changing cost/performance

The degree and type of innovation defines the space to be managed (Tidd, 2001) and to be financed. In this sense, Hall et al. (2009) investigate the financing of R&D and innovation based on the idea that R&D and innovation activities are difficult to finance due to non rivalry of the knowledge resulting in market failure. This is one of the reasons for public interventions through the intellectual property system, government support of R&D or R&D tax incentives (Hall et al. 2009). Uncertainty and information asymmetry associated with innovative activities also complicate financing. More recently, Acharya et al. (2013) investigate on how innovation depends on the access to stock market financing and the need for external capital. They found that public listing characteristics benefits innovation of firms depending on external finance and these come likely from the access to public equity. It is necessary to explore further the potential of financial instruments in pushing innovation in the water sector. This aspect is examined in the next chapter.

1.2 Defining and classifying economic Instruments

We differentiate between two related concepts that sometimes are misused and interchanged: **Policy Instruments (PI)** and **Economic Policy Instruments (EPI)**. PI refer to all policy instruments that may be used to obtain **a desired policy goal** and EPIs are a PI subset. Public policy can use also other instruments such as regulations or soft instruments such as education. EPIs refer to those instruments which only use **economic incentives** to attain a desired policy goal, providing monetary and near-monetary rewards, and thus supplying the necessary motivation to people to change their behaviour or uptake technological innovations (e.g. for water conservation).

Three previous European research projects have specifically examined the use of economic instruments in environmental policy.

The EPI-WATER project [1] (Evaluating Economic Policy Instruments for Sustainable Water Management in Europe) was an EU FP7 funded project (01.2011-12.2013). The projects aim was to assess the effectiveness and the efficiency of Economic Policy Instruments in achieving water policy goals, and to identify the preconditions under which they complement or perform better than alternative (e.g. regulatory or voluntary) policy instruments.

The POLICYMIX project[2] is an EU FP7 funded project (2010-2014) with the objective of assessing the role of economic instruments in policy mixes for biodiversity conservation and ecosystem services provision in forests. The project aims to contribute to achieving the EUs goals of reversing trends in biodiversity loss beyond 2010 through the use of cost-effective and incentive-compatible economic instruments and to evaluate the implementation processes and outcomes for a selection of economic

[1] http://www.feem-project.net/epiwater/
[2] http:policymix.nina.no/./

instruments in seven case studies in Europe and Latin America (Barton et al., undated). It is important to remind that in economic terms, a policy-mix is defined as the contemporaneous joint state of monetary and fiscal policy (Brimmer and Sinai, 1986).

The CECILIA2050 project[3] (Choosing Efficient Combinations of Policy Instruments for Low-carbon development and Innovation to Achieve Europe's 2050 climate targets) is a three-year research project funded by the European Union's 7th Framework Programme for Research. The project explores ways to improve the economic efficiency and environmental effectiveness of the instrument mix, and to address constraints that limit their performance or feasibility, which include public acceptance, availability of finance and the physical infrastructure, but also the administrative and legal framework[4]. In this project we can find the taxonomy of Policy Instruments including a classification. "At the most aggregate level, the instruments are classified into two main categories (Görlach, 2013):

- **Market-based instruments**: Market-based instruments are policies that address market externalities by "closing the (welfare-reducing) gaps between private and social costs (and/or benefits) [of private actor-driven] market activities" (de Serres et al., 2010). Market-based instruments incorporate the external costs of production or consumption in the price. They are also referred to as economic instruments.

- **Non-market-based instruments**: "all instruments that do not work through changing prices, but by imposing obligations (command-and-control) or by encouraging /discouraging certain behavior through non-monetary incentives" (Görlach, 2013).

It can be concluded, that **there is no common definition or classificaton of economic instruments among latest FP7 projects.** Thus a common definition for the use in the DESSIN project will be derived on the basis of reviewed definitions and classifications of economic instruments.

Focusing on water and based on the FP7 EPI Water project, they are defined as "incentives designed and implemented with the purpose of adapting individual decisions to collectively agreed goals" (i.e. WFD) (Delacámara et al., 2014). The methodology lies on a framework for assessment and evaluation (ex-ante and ex-post) of some economic instruments, lessons learned and water policy implications. Economic instruments included in the project are: incentive pricing, trading schemes, cooperation (e.g. payments for environmental services), and risk management schemes. Delacámara et al. (2014) highlight that can have a number of benefits, such as creating a permanent incentive for technological innovation, stimulating the efficient allocation of water resources, raising revenues to maintain and improve the provision of water services, or indeed promoting water use efficiency. "EPIs for sustainable water management are consequently designed and implemented both **to induce some desired changes in the behaviour of all water users in the economy (being individuals, firms or collective stakeholders) and to make a real contribution to water policy objectives**, in

[3] http://cecilia2050.eu/.
[4] Taken from http://cecilia2050.eu/about/1

particular reaching the [broad] environmental objectives of [water policy (e.g. EU Water Framework Directive or US Clean Water Act)], at least cost for society (Delacámara et al., 2014).

It is important to note that in the general literature, economic instruments and incentives are the same. However, in economic terms, economic instruments "can be used to internalise externalities of economic activities. In other words, every incentive that aims to induce a change of behaviour of economic agents by internalizing environmental or depletion cost is qualified as an economic instrument" (Schanzenbacher, undated).

From an **economic point of view**, there are three potential objectives for using economic instruments:

1. **Correcting externalities**: From a theoretical perspective, economic instruments are designed to correct market failures: full social and environmental costs are not easily monetised and accounted for in economic transactions. Economic instruments can ensure that these costs are taken into account, usually using a charge equal to marginal damage costs. Adding social cost to private cost will contribute to achieving efficiency. At the same time, using this incentive, a change in behaviour may be provoked.
2. **Providing incentives** for targeted outcomes: Economic instruments can provide incentives for the achievement of desired social outcomes. The use of charges, taxes or subsidies are examples.
3. **Raising public revenues**: Economic instruments that have an environmental objective often have a secondary effect such as raising public revenues.

The destination of these revenues moves from recovering costs to financing innovation. However, revenues generated do not explicitly have a fixed use or allocation. It is important to highlight the economic incentives' role in water policy and their use in recent years in order to achieve an efficient use of water.

We can see in table 2 the existing instruments that are been used in water and aquatic environment management in Europe. Strosser et al. (2009) and Salvetti (2014) include four major types of economic instruments: taxes and fees, subsidies, voluntary agreements (Payments for environmental services) and markets for environmental rights trading. The latter is not implemented in Europe although there are ongoing discussions in Sweden, Norway and Denmark (Salvetti, 2014). For that reason, markets with payments are addressed in chapter 4.

Table 7. Economic Instruments for water management. Source: adapted from Strosser et al. (2009) and Salvetti (2014).

Type of instrument		Main objective	Application in water
Taxes and charges and fees	Water tariffs	Collect revenues to cover the cost of a water service	Tariffs for drinking water and sanitation paid by customer Price of water for irrigation
	Environmental tax	Internalise negative environmental impacts Modify behaviours.	Tax on pollution discharge Groundwater tax

		Collect funds for budget	
	Environmental fee	Internalise negative environmental impacts Modify behaviours. Collect funds for environmental projects	Abstraction fee Rainwater charge Pollution fee Pesticide fee
Subsidies	On products	Incentive to produce "green " products	Tax reduction for acquisition of rainwater collection device
	On practices	Promote the implementation of practices and production processes limiting negative impacts on water resources or generating positive environmental externalities	Tax reduction for rainwater collection device Subsidies & grants for water conservation and wastewater reduction actions/investments
Voluntary agreements		Contractual arrangements in which the maintenance or provision of ecological service is at the heart of a voluntary monetary transaction conducted between recipient(s) and supplier(s) of the ecological service	Perrier (Vittel) and local farmers Evian company & local farmers; New-York city & local farmers; Munich & local farmers;
Compensation mechanisms		Develop mechanisms by which environmental degradation like extensive use of water induce a financial contribution that will fund alternative actions or compensate for damage	Coca Cola investment in enhance aquifer recharge
Markets for water trading	Water emission trading	To ensure pollution reduction through optimal allocation of pollution across sectors	
	Water use trading	To ensure optimal allocation of water resources between sectors (including natural & aquatic environment)	Some states in USA, Chile, Australia, Mexico

In some cases, economic instruments are referred to as Market Based Instruments (MBIs) (see Pirard, 2012). Eftec (2012) highlights that these instruments refer to incentive systems and tools that operate only via a market establishing prices. However, as indicated in table 2, not all economic instruments are based on the market. Thus it is necessary to distinguish between MBIs and economic instruments.

An EEA report (2005) stated that MBIs "such as taxes, charges, subsidies and tradable permits help to realise simultaneously environmental, economic and social policy objectives by taking account of the *hidden costs* of production and consumption to people's health and the environment, in a cost-effective way." MBIs aim to provide incentives "to consumers and producers to change their behaviour towards more eco-efficient use of natural resources" (EEA, 2005). This behaviour change can be reached "by reducing consumption per se, by stimulating technological innovation and by encouraging greater transparency on how much we pay for what" (EEA, 2005). A theory and practice

review of using MBIs for flood-risk management as means for autonomous climate change adaptation can be found in Filatova (2014). The paper provides a systematised overview and synthesis of the theory and practice of MBIs, distinguishing between **price based instruments** (taxes, subsidies and insurance) and **quantity based instruments** (marketable or tradable permits system). Pirard et al. (2014) suggest a distinction of the following: a) funding mechanisms (carbon markets, water funds, biodiversity offsets), b) incentive mechanisms (subsidies, certification) and c) allocation mechanisms (reverse auctions).

In this current report, a difference is made with the level of public intervention and the balance between government-led and private (market)-led approaches. For example, tariffs, environmental taxes and environmental fees (as subsidies) are clearly publicly driven instruments. Voluntary agreements without any kind of public intervention are private driven instruments. Water trading markets where public intervention is required for setting the initial conditions, allocation of property rights and regulation of the market are considered to be public-private driven instruments because initial public intervention is required prior to the use of market mechanisms.

Taking into consideration the above points, we suggest a new classification relying on:

- **Public driven instruments**, if there is a solution based on public intervention exclusively.
- **Private driven instruments** if there isn't any kind of public intervention, only market based solutions.
- **Public-private driven instruments** if there is a mix between public intervention and market based solution.

Annex C provides examples for the suggested classification. Instruments such as taxes or public procurement are covered by the first category, while others, like Payments for Ecosystem Services (PES), are considered to be private-driven instruments. Markets and trading, for example, are classified as public-private driven instruments because of the need for public intervention before using market forces. Specifically, VAT differentiation, efluent taxes, public procurement and public procurement innovation are included as public driven instruments. Private driven includes PES, Voluntary Price Signals (VPS), Payments for Watershed Services (PWS), Voluntary agreements for river restoration services, and Payments for flood risk mitigation Natural Flood Management (NFM). Finally, public-private driven instruments included in Annex C are reverse auctions and some cases of water markets. A more detailed discussion about payments and innovation uptake in urban water management can be found in chapter 4.

2. Innovation in the Water Sector

One of the objectives of this WP is to discuss some innovation-friendly modes of financing. For this reason we include a discussion about water innovation stressing not only technological ones and including references about different types of innovations in the sector. Innovation financing is closely linked to a major problem faced by utilities: the difficulties in generating revenues while costs are increasing. For this reason, companies need to go to the market in order to get financing on their own. This chapter presents a set of available financing instruments.

2.1 Defining the water sector

It is important to first note that it is not easy to define what **the water industry or water sector** actually is. Maxwell (2009) suggests that it includes a very broad array of sectors: "pipe manufacturers; specialty chemical producers; measurement, monitoring and testing firms; tank manufacturers; all kinds of treatment equipment manufacturers; new technology developers of all stripes; manufacturer's representatives who sell all of these things to different end users; engineers and consultants; contract operators of water plants, and many others" - companies which may be quite different, and whose "only real similarity is that they are somehow involved in the process of providing clean water."

The publication *Global Water Intelligence* (GWI) is one of the most well known sources in terms of water markets. The authors propose the following division (Research and Markets, 2015):

a) project type: water and wastewater treatment plants, water and wastewater networks, water resources, desalination plants
b) equipments: pipes, pumps, valves, screening/grit removal, agitation/mixing/settling, aeration, non-membrane filtration, disinfection, chemical feed systems, automation and control systems, testing and laboratory analysis, meters, low pressure membranes (MF/UF), high pressure membranes (RO/NF), thermal process equipment, ion exchange/ EDI/adsorption, sludge thickening/dewatering, anaerobic digestion, sludge drying/ thermal sludge treatment processes
c) by service: water, wastewater
d) by expenditure on water treatment chemicals: coagulants and flocculants, corrosion / scale inhibitors, biocides, activated carbon, ion exchange resins , pH and
e) by industrial sectors: oil and gas, refining and petrochemicals, power, food and beverage, pharmaceutical, microelectronics, pulp and paper or mining.

Although it is difficult to have good data concerning water-related businesses (e.g. drinking water, etc), these economic activities are involved in the process of providing clean water. For this reason, particular attention is paid to water companies as end-users and the urban water cycle.

There are typically two potential urban water management approaches in the water sector: either **supply-side**, meeting demand with new resources and, as a consequence, new infrastructures or **demand side**, managing consumptive demand itself to postpone or avoid the need to develop new

resources (Butler et al., 2006). Implementation of a demand side approach can be considered as an important innovation in the water sector, which pushes for more efficient use of water. In other words, the evolving paradigm for managing water is based on using the available resource in the best way.

In the literature, two interpretations exist for managing water demand. The strictest refers to any type of intervention that helps make more efficient and better use of a resource that is limited. This, in general, implies stable or lower consumption growth. The broadest and more common interpretation refers to interventions that influence both water demand and the increased supply of non-traditional sources of water (desalination and regenerated water). This broader interpretation fits into the philosophy of Integrated Water Resources Management (IWRM). Thus it is important to ensure that both aspects (demand management and non-traditional supplies) are fully incorporated into water management policies and strategies.

Water demand management approach is, as a consequence, based on water conservation and involves the adoption of policies by governments or investments by water utilities to achieve efficient water use by all water users. Instruments of water demand management policy take different forms: **educational campaigns and communication (moral persuasion), economic and financial incentives (prices, taxes, and water markets), direct interventions in operational areas and maintenance (leaks, repairs, infrastructure investment, domestic savings and quality facilities) and regulatory instruments (restrictions on use, compulsory saving mechanisms)**. Indeed, solutions to the growing water challenges lie not only on policy instruments but on the development and adoption of new innovative technologies.

2.2 Defining innovation in the water sector

Water innovation could be defined as the technologies, business models and partnerships that increase water supply and decrease demand throughout the water delivery and use cycle (Heslop and Faulkner, 2013). In line with the previous chapter, water supply refers here to avoiding leaks and improving the efficiency of the distribution systems, and not building new infrastructures. A detailed and interesting list of innovations can be found in the EIO Thematic Report (2011). It contains different categories of innovative technologies, including technologies that: a) provide alternative water resources such as reclaimed and desalinated water or rainwater use b) are more water efficient and conserve water and c) inform citizens in order to trigger behaviour change.

As a consequence, **supply-side innovations** are linked to the improvement in the effectiveness and efficiency of the drinking and wastewater water network. For example, they include technologies used for purification or waste water treatment purposes, such as nanomaterials, reverse osmosis, ultrafiltration etc. They allow for producing different levels of water quality for different uses. These technologies can also support groundwater quantity and quality recovery and river salinisation prevention. Supply-side innovations include also i**nnovations around how to exploit opportunities from using wastewater**, such as reuse and resource recovery technologies. In fact, there is a lack of understanding around scale, decentralised versus centralised models, and the types of waters that

can be reused. Technologies may also not be analogous across industries or regions since wastewater effluent streams vary dramatically. Thus, the main challenge is to transform wastewater from an issue of risk management to a source of value. As Heslop and Faulkner (2013) note

> "*Creating potable water (regulation matters) of wastewater seems the most important innovation in this area but, although technologies exist, challenges such as strict regulatory requirements, an effective business model for recovery, infrastructure adaptation and negative attitudes towards reuse ask for important efforts in innovation*."

Some supply-side innovations are linked to the use of a large amount of information coming from smart metering and an increased use of sensors. This allows water companies to work in a better management (leak detection, fraud detection), better knowledge of water consumption (smart metering) and better knowledge of customers using open data and data coming from social networks. These innovations can help tackle the challenge associated with the use of digital platforms, allowing real time monitoring and control of water distribution networks. At the same time, these software platforms can include functions to detect leaks and increase energy efficiency (see, for example, EFFINET project[5]). S*marter* networks allow water suppliers to understand the system and manage losses, and to have assets on-line for improving real time control and monitoring thereby ensuring high quality of data.

On the other hand, **demand-side innovations** are based on incentivising water users and making the business case for efficiency. However, it is necessary to have in mind that there are numerous types of water users - big or small water users and residential, commercial, industrial or public administration water users. Innovation should provide solutions that decrease water usage without affecting business operations. Innovations linked to residential and commercial use should be devoted to enabling behavioural change or enabling water users to make informed decisions about how to reduce usage using increased data accessibility. In many ways, the key to innovation on the demand-side is to create awareness using available data in order to give information about water consumption. At the same time, in case of industrial water users such as manufacturers, oil and gas activities or power generation, technology needs may be different. The same occurs in the agricultural sector where technology needs are not the same. For this reason, each market will require specialised solutions.

Dechezleprêtre et al. (2015) used patents (over 50.000 patents filed worldwide in various water-related adaptation technologies) between 1990 and 2010 to distinguish between those related to water availability (supply) and water conservation (demand) technologies. They show that, although technology in water has increased during this period of time, it has mainly focused on supply-side technologies. This suggests that water demand technologies need to be supported in order to foster innovation in the water sector.

[5] http://effinet.eu/.

2.3 Factors influencing innovation uptake in the water sector

In recent years, water innovation has been increasingly included in policy agendas. Water related issues have been included in the Horizon 2020 programme, the European Innovation Platform on Water (EIP), the Joint Programming Initiative of EU Member States on Water (JPI Water) and the Strategic Research and Innovation Agenda of the Strategic Forum for International Science and Technology Cooperation of the European Commission and Member States. Concerning this, European Commission points out that "Advanced and innovative water technologies are now seen as absolutely essential for creating an optimised and truly integrated water-management framework in Europe, as well as for contributing to the Eco-innovation Action Plan and Europe 2020's Resources Efficient European and Innovation Union flagship initiatives. Therefore better research, technological development and innovation in the water sector can also present new opportunities for European businesses, contributing to the competitiveness of the EU's water industry and supporting the green growth of its economy" (EC, 2013a).

The development and application of new technologies do present in the water sector, yet in a limited way. There are a number of reasons for this limited application of technologies. Organisational capacity and culture of innovation are key points considering the risk aversion level of companies. Innovation uptake also appears to be driven mainly by regulations requiring greener production, especially in the case of purification and distribution in water sector (EC, 2014b). The impact of environmental factors in innovation uptake appears limited. A study result (Dechezleprêtre et al., 2015) that seems to contradict the expected trend is that "over 70% of innovation worldwide happens in countries with low or moderate vulnerability towards water scarcity.Countries with severe water issues do not appear to specialise in water-related technologies (with the notable exceptions of Australia, Spain and Israel)". Thus, being a significant market for water related technologies is not necessarily directly linked to water stress situations.

In this context, a number of barriers and bottlenecks have been highlighted by the EIP (2014): for example **lack of funds for SME and risk aversion of the water sector**. Ajami et al. (2014) point out that "primary barriers to innovation are related to **the way that the water sector is managed**, **concerns about public health and risks, the industry fragmentation, and the complexity of most water systems"**. It is important to highlight that service innovation requires skills in elaborating new business models or work organisation, and this knowledge is not easily transferred. Moreover, knowledge transfer of science to the water services industry is less developed than knowledge transfer to the manufacturing industry. Some companies have transformed the way of doing business with an increasingly dynamic role for the final user, either for products or for services. Customer wishes and needs are incorporated rapidly into new products, erasing the classical separation between product lines with services providers (EC, 2014a).

Innovation in tariffs as peak and off-peak designs or seasonal tariffs or increasing block tariffs is commonly not considered nor implemented. **Some specific barriers are low water pricing rates; regulatory restrictions and the absence of regulatory incentives and, finally, lack of access to capital and funding (**Ajami et al., 2014)**.** Other reports (EIO, 2011) suggest that for companies in the industry

sector, **uncertain demand from the market, lack of funds in the enterprise and lack of incentives provided by existing regulations and structures** are the main barriers to innovation. The report says that "the prevalence of below-full-cost pricing of water, regulation, ownership and governance and absence of market competition are seen as deterrents to innovate and illustrate the special nature of water as a common good as well as a commodity "(EIO, 2011).

In any case, there is a paradox in the water sector. On the one hand, conservation policies designed by public policy and by utilities are an incentive to use less water but utilities need to maintain stability in their revenues and in their financial risk. Lower water sales do not imply lower costs because operating costs for personnel, electricity (basically for pumping) and chemicals account for the largest share, and their prices are increasing. At the same time, infrastructure investments are capital-intensive. As Standard & Poor's (2012) show, capital expenditures are typically 35% to 70% debt-funded for most municipal utilities rated by S&P.

A case study of Barcelona, for example, shows that the cost recovery evaluation is strongly influenced by the demand evolution. Despite costs raised according to the quality requirements imposed by regulatory agents, demand has decreased significantly, affecting the water cycle incomes. For example, in 2005, the overall domestic demand in Barcelona was 120.3 litres/ (inhabitant*day), descending to 109.8 l/(h*d) in 2008, representing a decrease of 8.7%. In absolute terms, the aggregated demand of Barcelona in that period was reduced from 109.6 Hm3 to 100.2 Hm3 (Cetaqua, 2010). **This affects the level of variable revenues that are linked to the level of water sales**.

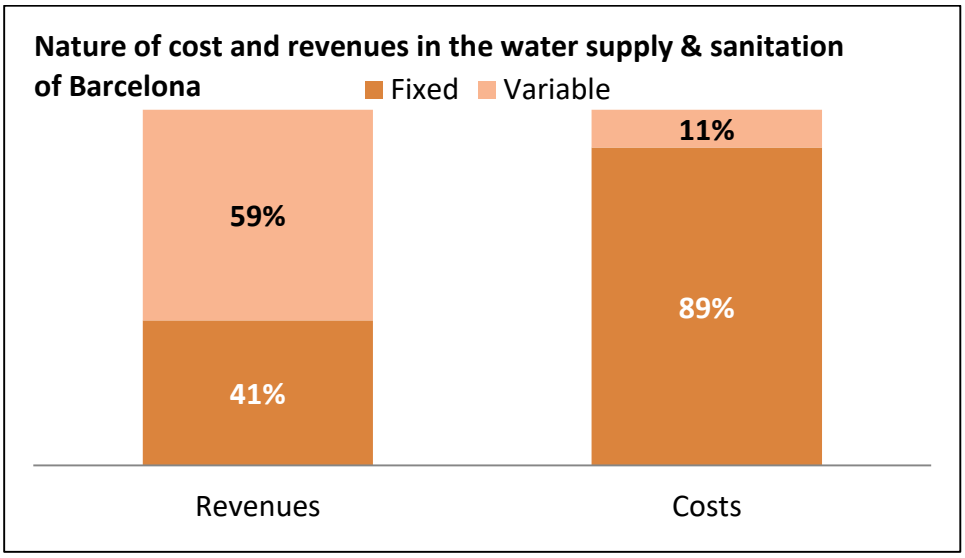


Figure 1. Nature of costs and revenues in the water supply & sanitation of Barcelona. Source: Cetaqua (2010)

A more difficult situation was found in Bordeaux during the same period. In this case, due to the structure of the water cycle and the way the water and sanitation cycle is financed, a larger part of the **revenues was variable**, **while an important part of the costs was fixed**.

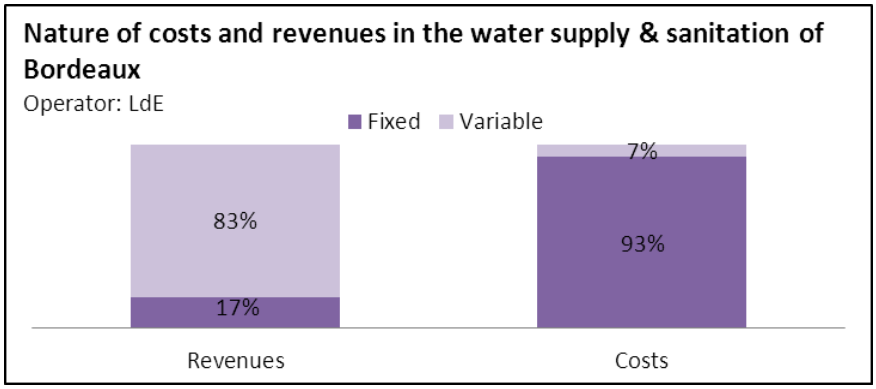


Figure 2. Nature costs and revenues in the water supply & sanitation of Bordeaux. Source: Cetaqua (2010)

The cost recovery of most urban water management systems faces a crucial funding gap. As EEA (2013) notices: "unfortunately, profit margins for these companies seem to be low. This indicates that water companies cover costs with a profit but have limited extra funds available to handle potential renewals and/or replacement of existing infrastructures". Other modes of financing suggested in the literature, such as the 3Ts approach (Lago et al. 2011), do not only include tariffs and taxes but also subsidies and transfers from national or European funds. For all these reasons, **it is difficult to allocate specific funds to innovation.**

Moreover, there are competing demands for funds than in the clean energy and electricity sectors, which have a similar market structure. In terms of patents, the water sector has lower innovation rates comparable to the clean energy and electricity sectors, (Ajami et al. 2104). Additionally, we can observe that the clean energy and electricity sectors attract one order of magnitude of difference above the water sector. However, if we look at the distribution of financial sources, the distribution in the water sector is almost the same as that in the clean energy and electricity sector, as seen in Figure 3. The characteristics of the market also have to be taken in consideration: market fragmentation, unrealistically low water rates, regulatory limitations, lack of access to capital, concerns about public health and possible risks associated with innovation, the conservative culture of the industry, and the long life expectancy, size, and complexity of most water systems (Ajami et al. 2014).

Figure 3. Distribution of financial sources. Source: Ajami et al., 2014.

To overcome barriers, policy reforms are feasible in order to rethink pricing, regulation and finance in the water sector to encourage and reach innovation in water sector (Ajami et al., 2014). The next chapter will examine some financing instruments that are promising for the sector.

3. Financing innovation in the water sector

This chapter focuses on economic instruments and their effect on innovation. Some of these public economic instruments have direct effect on innovation as grants, tax incentives for R&D, R&D funding, etc.

3.1 Economic Policy Instruments and innovation

Impact of economic policy instruments in innovation seems to be determined by their design features rather than by instrument types (Bergquist et al., 2013; Brouillat and Oltra, 2012; Kemp and Pontoglio, 2011). In some cases, the potential effect in innovation is indirect because the final objective is not innovation. Based on the EIO Thematic Report: Water innovation, the following tables present a review of some instruments and their impact on innovation, depending on the supply side or demand side focus.

Table 8. Policy instruments and their impact on innovation. Source: adapted from EIO (2011).

	Type of policy measure	Instruments	Effects on water eco-innovation
Supply side focus	Equity support	Public venture capital funds	• potential indirect effect • companies investing in water eco-innovation may benefit from the equity support measures as any other companies
		Tax incentives for companies investing in R&D	
		Public guarantee funds	
	Grants for industrial R&D	Grants for R&D	• potential direct effect • companies involved in water eco-innovation may benefit from generic R&D grants • water issues may be one of the priority areas of R&D industrial grant funding
		Collaborative grants (more than one company and/or business and science partners)	
	Support for public sector research	R&D funding	• potential direct effect • water issues may be one of the priority areas of R&D grant funding • research organisations involved in water eco-innovation may benefit from generic R&D grants
		Collaborative grants	
		R&D infrastructure	• potential direct effect • R&D infrastructure may be used for performing water innovation R&D • companies and research organisations involved in water eco-innovation may benefit using shared infrastructures
		Research infrastructure sharing	
	Fiscal measures	Corporate tax reduction or exemption on R&D	• potential indirect effect • companies involved in water eco-innovation may benefit from fiscal measures
		Personal tax incentives for R&D personnel	
	Education, training and mobility	Tailored training courses for companies	• potential indirect and/or direct effect
		Entrepreneurship training	

		Placement schemes for students	• companies investing in water eco-innovation may benefit from both generic trainings in innovation managements and entrepreneurship as well as from the tailored measures supporting recruitments of innovation personnel
		Support for R&D workers recruitments	
	Networks and partnerships	Competence centres, clusters, science-technology parks	• potential indirect effect • companies involved in networks and partnerships relevant for water eco-innovation may benefit from the collaboration by sharing information and creating shared visions that may also lead to concrete collaborations
		Technology platforms and innovation networks	
		Foresight and common vision building	
		Market intelligence and other forms of information sharing	

	Type of policy measure	Instruments	Effects on water eco- innovation
Demand side focus	Regulations and standards	Regulations and standards (including targets)	• potential indirect effect • performance standards and targets related to water quality and use drive (both technological and organisational) innovation efforts within companies and utilities as well as support wide diffusion of eco-innovation solutions
	Public procurement	Public procurement of goods and services	• potential direct effect • public sector can procure goods and services giving an explicit preference to innovative water efficient solutions
		R&D procurement	• potential direct effect • public sector can procure R&D on innovative solutions explicitly preferring water efficiency
	Technology transfer	Support for technology adopters (advisory services)	• potential indirect or direct effect (diffusion) • companies may benefit from the generic technology transfer advise and/or specific advice on preferable water eco-innovation
		Support for technology adopters (grants for purchasing new technology)	• potential direct effect (diffusion) • companies may benefit from the grant purchasing water eco-innovation solutions
	Support of private demand	Regulations (e.g. water charging)	• potential indirect effect • faced with higher prices for water use, households seek water efficient (technological and non-technological) solutions
		Tax incentives for consumers (e.g. for purchasing	• potential indirect effect

		environmentally efficient products)	• policy measures reducing the cost of environmentally efficient goods and services to consumer may influence the consumer's decision to purchase these goods or services, which in turn supports the producer and may indirectly support their eco-innovation activity
		Tax reductions for products and services (e.g. VAT reductions)	
		Demand subsidies (including eco-vouchers)	
		Awareness raising and information provision (including labelling schemes)	• potential indirect effect • measures aiming at providing the information on environmental performance of products allow consumer to make informed choices; assuming that consumer makes a choice to purchase eco-innovative good or service this supports the eco-innovative producer and may indirectly support their innovation activity

As we can see in table 3, economic instruments can provide incentives for behavioural change; they can generate revenues for financing further investments and can promote technological innovation. In this sense, the previous table allows us to realise the range of current instruments depending on types of policy measures. In some cases, the main objective is to promote innovation but, in other cases, promoting innovation is not the priority, but may occur indirectly. The use of grants, tax incentives, fiscal exemptions or reductions plays an important role. Concerning the rest of the instruments, more detailed information is available in the next section and in Annex A and B.

The promotion of technological innovation has been analysed in the case of environmental policy and the "side-effects" of environmental policy instruments in terms of their impact on innovation in energy and automotive industry (Bergeck et al., 2014). Economic sectors differ with regard to general framework conditions for innovation, such as infrastructural requirements, capital intensities, technological linkages, performance parameters, as well as with regard to the resulting patterns of technical change (Malerba, 2002; Pavitt, 1984). While this is not the goal of this report, it might be useful to carry on a comparative analysis between environmental policy instruments and their effects on innovation in other sectors to provide more information for more informed decision-making and policy debates in water sector.

3.2 Financing innovation in Europe

One of the most important questions for companies wanting to finance innovation measures is how to get to know fund providers in case internal funds are insufficient or not available. Firms typically prefer to use internal financing rather than external financing as the latter can be very costly. The main internal financial source is retained earnings that can be defined as profits, which have not been returned to shareholders, and accumulated over time. As a result, there are projects that firms would choose to undertake if they had sufficient internal resources available, but which will not be taken forward if firms need to access external finance to develop them. In this sense, the publication Facts and Figures points out that "around 75% of corporate financing in the EU is obtained from banks,

compared to about 30% in the US. This situation reflects the relative lack of development of other commercial and market sources of finance for smaller businesses in the EU, for a variety of historical reasons. The financial crisis has highlighted the fact that this structural difference can be a source of vulnerability for EU companies" (European Banking Federation, 2012).

Concerning different instruments, SAFE (Survey on the Access to Finance Enterprises, 2014), carried out by the European Commission and the European Central Bank, analyses the types of financing used by SMEs in EU-28. As we can see in Figure 4, bank loans and bank overdraft or credit line are financial instruments used in more than fifty per cent of all cases.

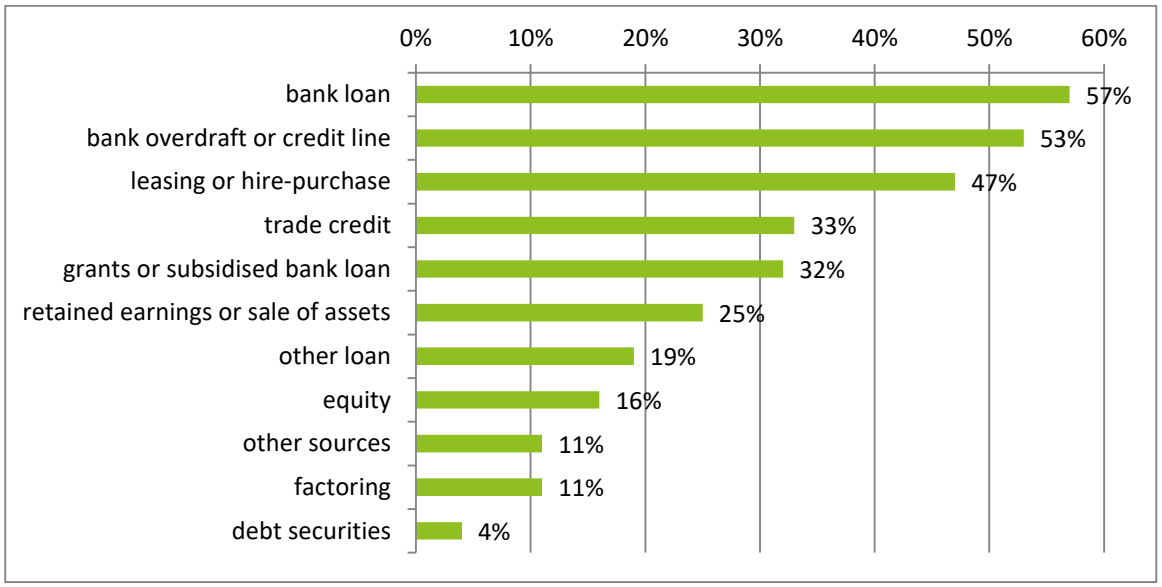


Figure 4. Types of financing used by the SMEs in EU-28, 2014. Source: Doove et al. 2014.

However, some of these instruments, such as leasing and factoring, cannot be used by innovative SMEs because investors may not willing to fund a new (unknown) company or because the benefits of the innovation are difficult to quantify and monetise. More detailed information about these instruments is included in Annex A.

As demonstrated in the previous chapter, water companies are facing conservation issues with cost recovery in a context of relevant capital expenses (depreciation and financial charges) and increasing importance of sanitation costs. This is one of the main issues concerning the innovation uptake difficulties. In addition, difficulties are not linked to identifying financing needs but to fulfilling them. The water sector is characterised by a complicated financial system with a mix of public and private financing (Stanley et al. 2012). Actually, municipalities often face significant restrictions for investments in new infrastructure due to reduced budgets and the long payoff time for such investments. At the same time, orientation towards "green growth" implies structural changes and innovation requirements. Start-up companies in sectors such as IT, software and biotech play an important role in that regard, although the environmental technology sector is also gaining importance.

Nevertheless, as indicated in the previous chapters, private equity financing of companies involves challenges too, due to long investment periods, regulatory uncertainty, decreasing demand in the case of water sector etc. Accordingly, it is necessary to develop new ways of financing depending on the combination of both, the technology risk and the capital intensity. Based on this combination, we realise that venture capital should be taken into account as a way of financing innovations in case of high technology risk. For this reason, venture capital can help in promoting disruptive innovations in water sector. Usually, water sector is more focused on incremental innovations such as efficiency improvements technologies. However, many water startups provide incremental improvements that are still extremely important.

As Criscuolo et al. (2014) point out, one of the most distinctive characteristics of environmental technology investments, compared to risk financing in other sectors, is that their profitability prospects often depend on public regulation. Ghosh and Nanda (2010) explain, as exemplified in Figure 5, the appropriateness of funds depending on capital intensity and technology risk level. Following this approach, bank debt or company funds might be the more appropriate source of funding for projects with low capital and low risk profiles, while the best option for projects with high capital intensity and low risk would be project finance. In contrast, venture capital plays an important role in the case of i) high technology risk and low capital intensity, ii) projects that can show rapid commercial viability (3 to 5 years), and iii) projects that can be sold within the life of a fund (about 10 years). The challenge is to diversify their high-risk portfolio and increase the chances of positive "tail" outcomes in their investments' portfolio. Finally, projects with a long time horizon or that are unable to ensure a successful end, are very difficult to fund and are named "Valley of Death".

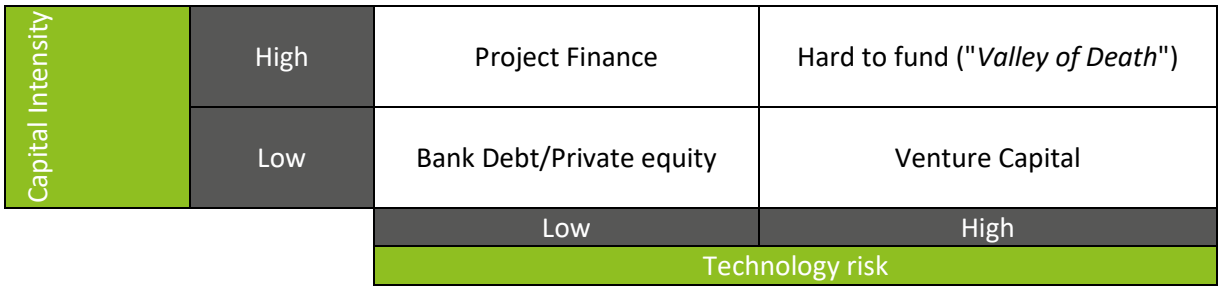


Figure 5. Focus on venture capital. Source: Adapted from Ghosh and Nanda (2010).

Throughout Europe there exist many different models of innovation support and stimuli with respect to the water sector. There are some **actions at European level**, as well as **national initiatives**. The main EU level actions are: JPI Water, Water Supply and Sanitation Technology Platform, EUREKA and EUREKA Acqueau Cluster, European Water Partnership (EWP), European Innovation Partnership (EIP) for "Water Efficient Europe", ERA-NET and a lot of specific projects under European Commission financing**.** Some interesting explanations related to different national policies in European countries can be found in EIO Thematic Report Water (2011), also concerning some important initiatives in Israel, Australia, Singapore and the United States.

In Europe, the EU financing programmes are generally not designed as direct funding measures because they are channeled through local, regional or national authorities, or through financial

intermediaries such as banks and venture capital organisations that provide funding through financial instruments. These intermediaries can be found in the EU Access to Finance portal. Direct aid is only available to projects that specifically contribute to the implementation of an EU programme or policy; the way to access it is via the calls for proposals. The calls for proposals are public and can be found on the European Commission's website.[6]

The following table summarises current financial instruments based on previous information and on the information provided in Annex A.

Table 9. Financing instruments summary table. Source: Cetaqua (2010).

Type of policy measures	Instruments	Effects on water innovation
Grant and blending grant	Grant is a non-repayment required fund disbursed by one party, often a government or trust, to a recipient for an innovation purpose or requirement that is sometimes proposed by the recipient. Blending grant is a mix of financing consisting in a loan and a grant in order to support a single project.	• No budget limit • Available for early-stage projects Big structure needed to capture fund • Continous feedback to supervisor • Suitability with EU purposes • Time of the acceptance process
Loan and credit	Loans and credits are debts provided by one entity to another at an interest rate as a payment to use the money. While a loan is an amount of money that is fully taken by the borrower who gives back the amount of money in future periods, a credit is a limited quantity of money that is put to the borrower's disposal by the lender.	• No budget limit • Faster than alternatives • No accountability • Payback is required • Some guarantee is needed
Microfinance	Microfinance is a funding source for entrepreneurs and small businesses; it provides smaller amounts of money (e.g. €25.000 in the EU), at a lower interest than under other funding schemes.	• Mentoring, training, advising, consulting • Dedicated to small businesses • Fragmented market along EU
Venture capital	Venture capital is a form of equity investment focused on early stage projects, which almost always means high-risk. It focuses on innovative goods or services.	• No budget limit • Different kinds of funds that suit different projects • Advising and knowledge of the new stockholder/s • Ensures a focus on innovation • Leads to new company stockholder/s • Transfer some decision capacity
Equity investment	Equity investment is the practice of buying a fraction of a company in the form of equities.	• No budget limit • Leads to new company ownership
Insurance and guarantee	Insurance is the transfer of the risk of loss from one entity to another in exchange	

[6] http://ec.europa.eu/growth/access-to-finance/index_en.htm.

	for payment. A guarantee is an agreement serving as security for the formal pledge to pay another person's or company's debt.	
Crowdfunding	Crowdfunding is the practice of funding a project or venture by raising many small amounts of money from a large number of people, typically via the internet.	• Small and medium budget projects • No initial requirements • Cost associated with project dissemination, and crowdfunding platform
Business Angels	BA provide both financial and managerial experience to start-ups	• Individual investor • Invest directly, in some cases its own money • Invest with a medium to long term •

3.3 European Investment Bank (EIB)

The EIB is the European Union's bank. It is the only bank owned by and representing the interests of the EU Member States. It is complemented by the European Investment Fund (EIF), the specialist arm providing SME risk finance. It works closely with other EU institutions to implement EU policy. In contrast to the EIB, the European Central Bank (ECB) only represents the euro area. "The ECB is the central bank for Europe's single currency, the euro. ECB's main task is to maintain the euro's purchasing power and thus price stability in the euro area" (European Central Bank, 2015).

The EIB supports projects that make a significant contribution to growth and employment in Europe, and focus on four priority areas[7]:

- Innovation and skills
- Access to finance for smaller businesses
- Climate Action
- Strategic Infrastructure

The EIB thus specifically funds innovation activities.

Products

EIB has different types of financing products that can be classified in **lending, blending and advising**. Lending is providing debts by one entity to another at an interest rate as a payment to use the money, and it is by far its principal activity, accounting for around 90% of its total financial commitment. Blending is a mix of a loan and a grant or a guarantee while advising is giving financial and non financial counsel. It lends to clients of all sizes to support sustainable growth and jobs. Its support is often central to attracting other investors. In fact, on average lending makes up "30% of the total cost of water projects, split more or less equally between public and private sector borrowers" (Lago et al. 2011). Sometimes "it can lend up to 50% of the investment costs of individual projects, but

[7] http://www.eib.org/about/.

financing may be combined with EU grants depending on the scope and definition of the individual project" (Lago et al. 2011).

The activities of the EIB can be summarised as follow.

Table 10. EIB financial products. Source: EIB.

Lending	Blending	Advising
Project loans (over 25M EUR)	Structured finance (additional support to priority projects) European Structural and Investment Funds ESIF Financial Instruments	Public-private partnership optimization (EPEC)
Intermediated loans (via local banks)	Guarantees (helping to attract new investors) Urban development technical assistance (JESSICA)	Infrastructure project advice for new EU members (JASPERS)
Venture capital (for high-tech and growth SMEs)	Project bonds (unlocking infrastructure funding) The Mutual Reliance Initiative (MRI effective partnering for growth & development)	Sustainable energy: maximising investment (ELENA)
Microfinance (subcategories)	InnovFin – EU Finance for Innovators Private Finance for Energy Efficiency PF4EE	European Structural and Investment Funds (ESIF)
	Transport infrastructure (cash flow guarantees LGTT) Natural Capital Financing Facility NCFF (combined with LIFE program)	Green-tech demonstration support (NER300)
	Flexible SME funding (JEREMIE finance and financial engineering for SMEs) Guarantee Fund for Greek SMEs	
	Equity & fund investment (to catalyze further activity)	

It makes “technical and financial expertise” available to [its] clients to develop and implement investment projects and programmes, and to improve institutional and regulatory frameworks. When complementing EIB loans, advisory services strengthen the economic and technical foundations of an investment and catalyse funding from other sources.

In delivering advisory services, [it relies] on the unique expertise developed by [its] staff, both inside and outside the EU, in key areas such as infrastructure financing, climate change mitigation and adaptation, urban development and SME support” (European Investment Bank, 2015).

EIB in figures

The EIB had contributed more than 340.345 mn EUR from 2010 in all the sectors where it is enrolled. In the water sector, the amount is larger than 17.873 mn EUR, representing more than 5% of the total budget (Table 9).[8]

Table 11. EIB funded projects by sector. Source: EIB.

Sector(s)	From 2010 To 2015
Agriculture, fisheries, forestry	2.727.103.982 €
Credit lines	94.046.046.101 €
Energy	56.507.247.895 €
Industry	33.939.549.904 €
Solid waste	1.419.174.439 €
Transport	70.184.848.653 €
Water, sewerage	17.873.966.904 €
Total Amount	**340.345.695.371 €**

EIB (2010) notes: "in the five-year period 2005 to 2009, EIB direct lending for water-related projects, excluding hydropower and irrigation, was almost 15 bn EUR for a total of 126 major water supply and sanitation projects. 90% was in the EU-27, making the EIB the biggest lender to the water sector within the EU. The Bank has significantly increased its support for the sector from an average of 1.6 bn EUR annually in the ten-year period 1996 to 2005 to 2.9 bn EUR on average for the period 2006 to 2010".

The graph below illustrates an aggregation at country level of EIB individual loans for water supply and sanitation projects in the EU and the EFTA countries. A total of EUR 9.1bn was lent to the water sector by the Bank in the time period from 2003 to 2007.

[8] The list of the projects in the water sector financed by EIB can be found in Annex A. There are projects directly related to technology innovation, social innovation and other types of innovation, mixed with infrastructure projects.

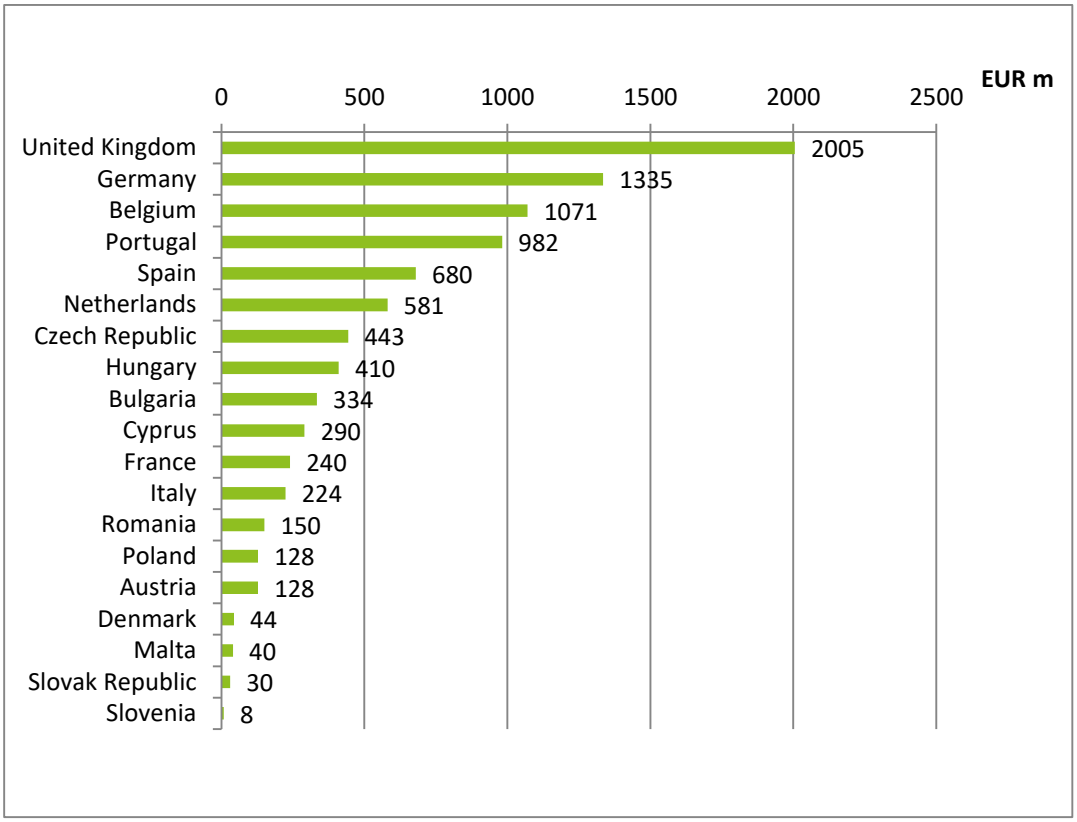


Figure 6. EIB loans in the water sector per countries. Source: EIB.

Examples of the types of projects financed by the EIB include a EUR 160m loan in 2007 with Aigues Ter Llobregat for various investments (including a desalination plant) to improve the quality and the security of supply of drinking water in the Barcelona region in Spain. As another example, the EIB lent EUR 15.3m to the City of Plzeň in the Czech Republic to support its 5-year municipal investment programme for water and wastewater facilities, including the refurbishment and extension of drinking water networks and reservoirs, the construction of drainage and storm water retention facilities, and the upgrading of a treatment plant and extension of sewer networks.

Currently, there are 30 projects in the water sector approved, but not signed yet, and 25 more under appraisal by the EIB. So, the EIB will keep on funding projects related with water.

3.4 Financing innovation in mature sites of DESSIN

This chapter ends with a review of the financing modes in the mature sites of DESSIN project using information from Rouillard et al. (2015). It will be useful to identify how innovation projects are financed in practice.

Aarhus financing

The main financing instrument used in the Aarhus case was an increase of the water price paid by consumers, which was decided by the City Council. There was a small, gradual tariff increase – 0.26 EUR per cubic water - which was not controversial, since it was for a good (blue/green) cause. But

during the project other sources were used. A small part of the funding for the real-time control and warning system was gained through participation in the EU project PREPARED. It was a grant from the EU that covered about 10% of the budget, approx. 200.000 EUR. As a result of the project realisation, other sources of financing appeared. The provision of a license for the kayak rental company and the possibility to give more terrace licenses to restaurants and bars are other sources to finance the project.

Zaragoza financing

In Zaragoza, the financing comes from regional and European funds as well as from revenues generated by reforming water tariff structure. In this case, the own financial resources of the company play an important role for financing innovations. As the water company is public, it devotes some municipal funds to finance some projects related to water; furthermore, increasing tariffs was approved by the City Council. This increase enabled the utility to finance some costs throughout the innovation process.

Emscher financing

In the Emscher case, the most important financial explanation for the success of the project is that the re-financing by marketing of real estate made the project profitable, together with the multi-purpose nature of the lake which enabled the pulling of funding from multiple sources.

To conclude, in this chapter financial instruments to solve the lack of access to finance innovations were explored. However, it seems clear that there is not a common way for financing innovations and different instruments are being applied. These instruments are summarised in Annex B. In the next chapter, payments are assessed as a way to generate funds under ecosystem services approach for innovation uptake.

4. Innovation, payments and ecosystem services

The previous chapters discussed aspects of financing innovation in the water sector. Although not all instruments are devoted explicitly to the financing of innovation, it should be noted that they can be used for that purpose. This chapter discusses the potential roles of Payment for Ecosystem Services (PES) and markets for ecosystem services (MES) to resolve the problem of degradation of ecosystem services and drive innovation uptake. In this sense, PES and MES can be considered as *institutional and social innovations* to drive *technological innovation uptake*. Annex C provides a description of some applications of PES mechanisms as payments for watershed services, voluntary agreements for river restoration services or payments for flood risk mitigation. Then a discussion about payments and innovation uptake in urban water management is developed.

Edquist and Johnson (1997) suggest that institutions can function in three ways to foster innovation. First, institutions can reduce uncertainty by providing information. Second, institutions can actively manage conflicts and foster cooperation and third, institutions can provide incentives for innovation. As a consequence, institutions that have the mentality, capacity, skills and attitude to face innovation challenges are required. However, not only institutions in strictest terms, but different rules and norms are needed to cope with innovation, for example, different ways of thinking in policy, designing innovative economic instruments facing challenges in the water sector. In this context, payments can be considered as social innovation because they promote social change. New ways of resolving problems related to ecosystem services may be seen as institutional innovations (e.g. paying for use and not for polluting ecosystem services). Accordingly, the question is if payments can provide incentives for innovation uptake in urban water management. These questions will be addressed in the next paragraphs after an introduction to the feasibility of different kinds of payments depending on the ecosystem services characteristics.

4.1 Provision and Payments for Ecosystem services

It is difficult to consider benefits provided by ecosystem services in terms of services used in the economy (e.g. legal services, medical services or financial services). However, it is possible to speak about supply and demand of ecosystem services, and for this reason the use of market based incentives can be considered. Depending on their preferences, some consumers change their consumption habits to buy environmentally-friendly products; some farmers change their behaviour due to subsidies and they can modify their preferences related to ecosystem services provision.

This is the rationale that allows thinking in providing incentives in order to increase or maintain the level of ecosystem services provision. These incentives are, usually, compensations in monetary or, in some cases, in-kind terms. At the same time, compensations are reflected in contracts or, in other cases, in voluntary agreements. Ecosystems provide services that are essential to human survival as well as for well being. In this sense, we need to ensure that the supply of these benefits is guaranteed.

The argument is pointed out by Muradian et al. (2013) who underline the importance of the argument of Ferraro and Kiss (2002) stating that direct payment mechanisms are more effective for biodiversity conservation than other instruments. The theoretical base of payments is Coase's theorem which states that "when trade in an externality is possible and there are no transaction costs, bargaining will lead to an efficient outcome regardless of the initial allocation of property rights" (Coase, 1960). As a consequence, it might be possible to set contracts reflecting bargaining between ecosystem service benefits suppliers and beneficiaries assuming that the potential beneficiaries have a level of willingness to pay (WTP) for ecosystem service provisioning and the potential suppliers have a level of willingness to accept (WTA) compensation to cover their opportunity cost. PES contracts might then be realistic as long as the WTP exceeds the WTA. However, some problems might occur in case transaction costs arise and depending of the characteristic of ecosystem service, payments should be used in different ways.

Kemkes et al. (2010) define PES "as voluntary transactions where an ecosystem service is being bought by one or more buyers from one or more providers, if and only if the provider secures the provision of the service." Payment options can be tax expenditures, grant allocation, easement or direct payment. But the point is that as the ecosystem service is in a property, landowerns voluntarily supply them and are compensated for this provision. For this reason, easement and direct payment often require institutions and financing mechanisms. Also PES are an efficient mechanism when transaction costs and implementation costs are low, and when quantifiying benefits is possible. The strategy for reducing the cost of PES programmes should imply the creation of a single buyer or monopsonist and the reduction of a monopoly power by the landowner in the payment arrangement. If we have only a single buyer it is easier to calculate the value of the service and the free-rider problem can be avoided. In case it does not exist, a monopsony can be created at the appropriate scale. In case there are few sellers and buyers, we can apply coasian rules and give payments or compensations depending on the initial property rights allocation.

Monopoly power by the service supplier implies that potential buyers are forced to buy the service from this provider, there is no choice and, depending on the substitutability it will be necessary to use other policy tools such as penalties, for example, in case the provider does not agree to sell the service. In case of only one buyer, the provider can decide an alternative use of the property providing the ecosystem service (in case it is possible) and not to sell to this specific buyer.

For previous reasons funds collection is required and voluntary agreements, taxes or fees are considered. In this situation, the objective of achieving a cost-effective protection is not guaranteed but the objective of a level of conservation is present (Jaeger, 2011). Usually, in case of voluntary agreements, rights are public; in case of PES, property rights are private. The basis of this measure is to use public funds to pay owners of the ecosystem service benefits, for example, landowners whose land provides some kind of ecosystem service to maintain or increase the level of provision. .

In general terms, the provision of goods or services depends basically on their characteristics in terms of rivalry and excludability. Modes of financing are linked directly to these characteristics. The following sections address both characteristics for the provision of ecosystem services and,

depending on it, the use of payments. It is necessary to understand these characteristics in order to manage, maintain, restore or evaluate ecosystem services (Fisher et al. 2009) because one of the key results of the Millennium Assessment was that 15 of 24 ecosystem services are declining (MEA, 2005). As a consequence, the goal "…is to improve incentives and generate expenditures needed for their conservation and sustainable use…" (de Groot et al. 2012). Based on these objectives, the use of available economic instruments needs to be assessed, focusing specifically on cases in which ecosystem services are not private goods but public goods, common pool resources or club goods. In the literature, there are interesting discussions about this topic and market failures (see Randall, 1983, Kemkes et al., 2010, Kumar, 2006, Fisher et al., 2006). However, for the purpose of this study, the main aspect is how to generate sufficient financial resources for conservation and sustainable use of ecosystem services in order to provide the benefits demanded.

As an example, flood regulation, water purification or pollination, among others, can be consumed without decreasing the amount of service available to other people; this is the **non-excludability characteristic.** The **non-rivalry characteristic** means that the use of the ecosystem service, for example a cultural service (aesthetic view), can be shared by all individuals. When a good or service has both characteristics, about it constitutes a public good as is the case with most regulating, supporting and cultural services and it is the reason why markets have not evolved naturally for these services (Kumar, 2006).

In case of some ecosystem services that are public goods (i.e. one cannot exclude other actors from consuming the good), the free rider problem appears leading to undersupply or inefficiency in the supply of these services. Adequate provision may require some forms of payment, and likely government intervention (eg. public sector that will use public funds to pay for providing ecosystem service). Kemkes at al. (2010) discuss the use of the combination of rivalry and excludability to inform whether payments provoke a socially desirable level of provision. Concerning rivalry, they point out that as the marginal cost of use for non-rival ecosystem service is zero and there are many potential users and due to global scale of these services, a global institution financed by public funds should act as a single buyer. In this case, the risk of undersupply is mitigated because the global institution acts using its preferences as social preferences. This is the way to avoid free riding behaviour (that is to benefit from the service without paying for it) and to reduce transaction costs.

The authors deduce that, in this case, one-time payment by a monopsonist (single buyer) is the most efficient solution. However, we think that one-time payment is not a good solution to maintain the level of the service; thus, some payments are considered. Concerning excludability and in the case of ecosystem services, the rationale is that non-excludability will take place only when it is impossible to create property rights. For example, it is impossible to exclude someone from the benefits of water purification. The combination of both characteristics determines whether payments are a desirable instrument.

According to the same authors, the need to add spatial distribution is a key question in order to identify the potential beneficiaries, the institutions providing the service and the transaction costs associated. The combination of excludability, rivalry and spatial distribution determines the scale and

how this single buyer operates. As some ecosystem services are public goods and they operate at a global scale, public intervention is required. Intervention should be implemented by means of a global institution to ensure these ecosystem services are maintained for the public benefit. In case of common pool resource, that is rival consumption but difficult to exclude, the solution relies on property rights allocation in form of permit. Once permits are allocated, a market can be established for trading these permits. In club goods, which are non-rival but excludable, the solution is based on enforcing property rights in order to make exclusion feasible. When property rights are enforced and their allocation is well defined, payments become an effective solution.

The next table summarises these questions.

Table 12. Payments recommendation. Source: Adapted from Kemkes et al. (2010)

Type of good	Characteristics	Recommended Payments
Public good (clean air, biodiversity, climate regulation)	Non rival Non excludable Global scale	Payments by a global institution acting as single buyer using public funds
Market good (raw materials, food products)	Rival Strong property rights: excludable No matter the scale	Individual Payments
Common pool resource (ocean fisheries, waste absorption capacity)	Rival Difficult to exclude Property rights at the same scale of benefits	Payments are not an effective policy Tradable permits: Market
Toll or club good (recreational services, some water services, private ecotourism)	Non rival Excludable Congestible Local or regional scale	Entrance fees as one-time payment by individuals

Muradian et al. (2012) remind us that since direct payments for biodiversity were adopted, the application of payments in ecosystem service enhanced. However, the same authors are cautious about the use of payments. Challenges faced include: i) not all payments could be -included; ii) the final results depended on the design of the institutional set-up, and iii) a good understanding of the behavioural, governance dimensions and equity dimensions.

In short and in practice, PES often involves a series of payments to land or other natural resource managers or owners for management or investment actions to enhance their provision which would not be provided without the payment. As a consequence, payments are made by the beneficiaries of the services.

4.2 Markets for Ecosystem Services (MES)

Traditionally, governments have used some regulations or command and control instruments to limit environmental issues such as air pollution or water abstraction but these instruments have not been sufficient for conserving and protecting the environment. The use of markets to solve some specific

environmental problems like pollution has pushed the question of using markets as a way of promoting sustainability.

Ecosystem services as public goods suffer from the free rider problem and some individuals benefit from positive actions generating positive externalities. Conversely, individuals can damage ecosystem services without paying for them. Coase provide a solution based on the allocation of property rights and, as shown in the previous paragraph, can be used as starting point for considering the potential of market mechanism for ecosystem services (Jaeger, 2011). According to Coase, it is possible to achieve an efficient allocation negotiating and compensating different actions if property rights can be assigned to service suppliers or service users and if transaction costs are inexistent. So, once property rights are allocated to suppliers or to users, the supplier can be compensated to maintain the ecosystem service or the user would have to pay to consume ecosystem service. Markets for ecosystem services work better when property rights over the ownership of the services are well-defined, as Kumar (2006) notes.

Regulatory markets (Jaeger, 2011) are a market mechanism based on creating or allocating a limited quantity of property rights by government followed by trading them in a market. The economic rationale lies in limiting or creating supply but imposing a limit on the level of pollution, environmental degradation or resource extraction (see the water abstraction markets in Annex 3).

These regulatory markets are being used in cap-and-trade programmes and the government sets a limit that can modify selling and buying these rights. Firms decide how to manage their rights comparing the costs for pollution or extracting ecosystem service and the price of the right. In some cases, this kind of market includes offsetting or compensating actions in order to mitigate environmental harm. For example, if one company is going to destroy a wetland, it can create or improve another wetland in other location. These actions represent a way to achieve the desired level of ecosystem service provision. Coca Cola is doing precisely this in several parts of the world, contributing to, among other actions, watershed protection (Coca Cola 2012).

Markets for Ecosystem Services (MES) are defined as mechanisms that create a market for ES in order to improve the efficiency in the way the service is used (Kumar, 2006, p.4). In this case, property rights are in the user side. Some examples include tradable quota systems, tradable development rights, eco-labelling etc. In the ecosystem service approach, the market will give us the level of use of ecosystem service. For this reason, it is not based on the polluter pays principle but on the user principle. According to this principle, users should pay proportionally to the extent they use the ecosystem service. Although economic efficiency can be achieved, it is not clear whether the sustainable provision of ecosystem service is ensured unless property rights reflect the public interest.

Finally, one of the main obstacles for creating markets for ecosystem services is their value. This is not an abstable where ecosystem services have a market, such as food or timber market, as the value is provided by existing prices. Giving values to ecosystem services that are public goods is more complicated and require the use of specific methodological approaches.

4.3 Payments and innovation uptake in urban water management

As highlighted previously, PES are payments to compensate for actions undertaken in order to maintain and increase the level of ecosystem services provision. The final objective of these payments is to enhance the level of the delivery of existing ecosystem service provision. As is stated in URS Scott Wilson Report (2011), "the PES approach provides opportunities to link up those involved in 'supplying' ecosystem services more closely to those benefiting from those same services and, in doing so, it potentially provides cost-effective ways of developing new streams of financing for conservation". However, the link between payments and the final destination of these payments is missing. In other words, the question about the payments allocation for innovation uptake is not included in this literature source. In developing countries, PES schemes can contribute to poverty reduction and, for that, payments are devoted to maintain income levels (Rodriguez et al.2013).

In urban environments, urban ecosystems provide several services for their inhabitants (Gómez-Baggethun and Barton, 2013) and the use of payments could also be applied in this context allowing technological innovation uptake in urban water management. Although there are interesting discussions about ecosystems services and technology (Honey-Rosés et al. 2014) it is possible to find cases where a technological innovation or improvement changed the value of ecosystem services as in the case of the Barcelona treatment plant (Honey-Rosés et al. 2014) where the new membrane technologies coexist with water purification ecosystem services. The same authors argue that both ecological and technological solutions should be considered in order to solve water problems because new technologies will generate a demand for new services and both will remain complementary.

From 2011 to 2013, the Department of Environment, Food and Rural Affairs (DEFRA) in the UK and based on PES Action Plan (DEFRA, 2013), commissioned 11 PES pilot studies over two rounds of funding. Although the experiences of the DEFRA PES Round 1 and 2 pilots are an excellent source of insights and ideas, information about innovation uptake was not included. As an example and adopting the ecosystems approach, the report says that "a water company might invest in water catchment management schemes ('green infrastructure') as a cost-effective alternative to end-of-pipe solutions ('grey infrastructure'); or a local authority might invest in action to prevent sediment entering a river upstream so reducing the costs of dredging ('invest to save')". Based on this, it seems feasible to induce that technological innovation was not the focus when the PES pilots were developed. For example, in the Fowey River pilot [9] an auction-based PES mechanism was implemented. Exhaustive information is given about the cited mechanism but specific information devoted to capital investment needed to reduce impacts on water quality is limited to "soft measures" (University of East Anglia/Westcountry Rivers Trust, 2013).

In the case of Pilot of Flood Regulation in Hull, the report focuses on the introduction of sustainable

[9] http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=18245; The Fowey River is of particular importance to South West Water since it is the source of the vast majority of water for the County of Cornwall.

drainage systems (SuDS) which alleviate flood risks while also delivering wider ESs. Some measures or potential treatments for SuDS such as meadow grassland, disconnecting downpipes, rain gardens, water butts, green roofs for buildings etc. are explained including cost and benefits in terms of ecosystem services improvement (MacGillivray et al., 2013).

In the same line, the Pitt Review also defended working with natural processes and rural land-use options rather than exclusively relying on larger hard defences (e.g. dykes, walls) (Pitt, 2007).

In all pilot projects, the traditional engineering approach is substituted by a green infrastructure approach. Green Infrastructure (GI) "stands to improve quality of life in many ways, through its environmental, social and economic credentials, based on the multifunctional use of natural capital" (SEP, 2012) As the State of Watershed Payments report highlights: "Green infrastructure as a substitute for or complement to traditional engineered approaches is gaining currency in the developed world – from using forests as green infiltration galleries in Germany, to using mussel beds to filter nitrate pollution instead of a treatment plant in Sweden, to New York City planning to restore wetlands to its waterfront to deal with storm events" (Forest Trends, 2012)

Although not all measures based on green infrastructures are considered to be technological innovations, they are the most frequently the focus of PES schemes. As a consequence, evidence suggests that PES could help innovation uptake, and more related to green innovation than technological innovation.

As a conclusion, it is possible to think about technological innovation and innovation uptake in urban water management based on ESs approach but there is not enough evidence about PES and innovation uptake yet. Usually, innovation uptake in urban water management is not financed by PES mechanisms but by other financial mechanisms such as those presented in chapter 3. However, as the PES mechanism is gaining interest, it would evolve and become one of the financial instruments in the near future providing funds for technological innovation uptake in urban water management. PES may have most potential in promoting the uptake of environmentally-friendly measures such as green infrastructures.

5. Conclusions and lessons learned

This report is part of the DESSIN project, specifically WP12, and its objective is to provide an analysis on financing approaches conducive to water sector innovation and also the use of payments in ecosystem service approach.

Water demand management is taking more weight in water management and it implies considering water efficiency and water conservation. The emphasis should be shifted towards managing water demand by best using the available water. Opportunities for conservation and water saving technologies are even open. Innovation in services including information services to the citizens requires new business models and changes in company organisation but it has only started. It seems that water innovation is related, basically, to technology implementation and funded as investment except in pre-market phases. Nonetheless, it is necessary to remember that technology alone cannot be relied upon to solve water problems.

Concerning economic instruments, there is a variety with different main purposes but there is a lack of knowledge about a good combination of them, specifically, in the case of restoration and conservation of ecosystem services. Traditionally, the most frequently used instruments for financing innovation are tax incentives, grants and loans. The European Investment Bank has been the largest source of loan to finance the global water sector to date, compared with other international financial institutions. The Bank has significantly increased its support for the sector from an average of 1.6 bn EUR annually in the ten-year period 1996 to 2005 to 2.9 bn EUR on average for the past five years.

The European Investment Bank as a bank of the European Union might foster the use of traditional instruments in demand side innovation projects. Some innovation may be done in services as the case of EMSCHER where a new residential demand market is created as a result of the project. Financing innovation in water sector may take advantage of venture capital but the key is to find suitable funds for each project. The use of insurances and guarantees is related to risk mitigation. These instruments are used by a variety of institutions in the water sector. Applications of microfinance are not common inside the EU and the water sector so far.

Related to ecosystem services approach, payments are an important mechanism for sustaining or recovering the natural capital that provides ecosystem services. Although payment programmes are diverse and there is no one-size-fits-all arrangement for the successful implementation of a PES programme, payments seem to be good to target conservation. In addition they are based on low implementation costs.

Depending on the characteristics of ecosystem services in terms of rivalry and excludability, different forms of payments may be used. In case of common pool resources there is an opportunity for Markets for Ecosystem services as the property rights allocation allows the use of permits. In other cases, entrance fees or individual or global payments may be a good solution.

Concerning the use of payments for innovation uptake in urban water management, a lack of evidence is highlighted. However, in theory, the uptake of some technological innovations such as

green or hybrid grey-green infrastructures in urban water management could be supported by the establishment of PES.

Grant and blending grant

What is it?

Grants are defined as non-repayable funds disbursed by one party, often a government or trust, to a recipient for a particular purpose or requirement that is sometimes proposed by the recipient. It is the **main financial instrument used by the European Comission** to fund projects in the water sector.

Where is it used?

In the EU, there are various grant projects focused on water. The water sector has independent sections in programmes such as LIFE[10] or H2020[11]. In the LIFE programme, environmental sector has been granted more than EUR 3.4 bn. At the end, granting is the **most important way of financing innovations** in the water sector. H2020 has a total budget of EUR 80 bn for the period 2014-2020. A brief explanation of LIFE and H2020 programmes is provided below.

LIFE	H2020
• **4.171 projects** co-financed and **€ 3.1 billion** funded between 1992 and 2013. • For the period 2014-2020, the budget amounts to €3.4 billion.	• From 2014 to 2020. • 22 areas of **research and innovation.** • **€ 80 billion** of funding available. • Calls through participant portal.[12]

LIFE & H2020 main characteristics. Source: Cetaqua.

Grants are **the most frequently used** instrument of finance for utilities and researchers today and the most known as well. Grants can be accessed by proposing projects in the calls for proposals or by submitting a candidature in a project the European Commission wants to develop.

How is it implemented?

Blending grant is a mix of financing consisting in a loan, normally from an international financial institution, and a grant to support a single project. The main purpose of blending is to use grants so as to attract repayable financing that would not have been provided otherwise.

In some cases, a combination of different financial instruments is preferred for the purpose of financing water projects (van Bork et al., 2015). There are two typologies of blending:

- ***Institutional level blending***. Consists in a mix of different instruments in one financing institution or funds. It has the advantage that different types of funders do not have to gather, so there are savings in terms of transaction costs. Some examples of institutional level blending are ACP-EU Water Facility and Private Infrastructure Development Group (PIDG).
- ***Project level blending***. Combines financing instruments usually provided by several donors or international financial institutions (IFIs)

[10] LIFE European Programme: http://ec.europa.eu/environment/life/.
[11] H2020 European Programme: http://ec.europa.eu/programmes/horizon2020/en/what-horizon-2020.
[12] Participant portal H2020: http://ec.europa.eu/research/participants/portal/desktop/en/home.html.

	specifically for a project. An example is the "Maji Ni Maisha project"[13], which has the purpose of increasing access to clean and reliable water supply for rural communities in Kenya. This project is funded by a blend of commercial finance and a World Bank subsidy. Blending had been used to fund various innovative and development aid projects successfully. For instance, at the project level the EIB led the financing of a project in Maputo, Mozambique, through a loan whilst other donors, such as the EU Water Facility or the Agence Française de Développement, provided grant financing (OECD 2010). At the institutional level, there are numerous European examples, such as ACP-EU Water Facility from the EU, as well as national level examples, such as the Bulgarian Fund for Local Authorities and Governments (FLAG). On the one hand, grants and blending grants, especially from EU institutions, ensure the continued implementation of projects in the early stages. EU funding schemes are designed to fund big projects and to deal with high risk technology, in other words, there is no limitation if the project is interesting for the EU institutions. On the other hand, grants and blending grants need a structure to capture the funds from the institutions. At the end, this mean that some money has to be invested to capture the funds and some time needs to be spent as well. Finally, the project has to suit the institutions' purposes that sometimes are different than the ones of the companies.

[13] "K-Rep Bank's Maji ni Maisha programme provides loans for water infrastructure to communities where consumers are willing to pay for clean and safe water. Investments financed under the programme can include: development or rehabilitation of small piped water systems; development of water sources such as boreholes, springs or rivers; construction of water purification and storage facilities; and installation of metering, billing, technical and financial management systems to improve the efficiency of water supply services" (K-Rep Bank, 2010).

Loan and credit	
What is it?	**Loans and credits are debts provided by one entity to another at an interest rate as a payment to use the money.** Loans provide a certain, specified amount of money that is used up by the borrower who gives back the amount of money in future periods. Credits determine a limited amount of money that is put to the borrower's disposal by the lender. In the case of credits, the borrower can decide whether or not to use the money and will pay only for the actual amount of money used.
Where is it used?	These instruments are the oldest and most common sources of financing and are used in all economic fields. They are a **common way to finance innovation** but usually only used by well established companies given that credits and loans are based on the confidence that the borrower is going to return the money lended. Accordingly, newly established companies have difficulties accessing money through loans or credits because they do not have the financial background or goods required to guarantee the return of the capital. Venture capital institutions appeared to solve this situation; they provide loans or credits to new companies.
How is it implemented?	**The largest backer** in Europe is EIB[14]. The bank lent a total of 9.1 bn EUR to the water sector in the period 2003 to 2007. The distribution between countries can be found in the same section. Other funds include those that finance regional policy. The purpose of EU regional policy is to reduce the significant economic, social and territorial disparities that still exist between Europe's regions. Regional policy funds amounted to 347 bn EUR between 2007 and 2013. The funds are mainly targeted towards economic growth and job creation in these regions, by, for example, improving transport links to remote regions, boosting small and medium-sized enterprises in disadvantaged areas, investing in a cleaner environment and improving education and job skills. "The construction costs of water supply [and waste water] systems are eligible for assistance under the Cohesion Policy[15], from the European Regional Development Fund (ERDF) and the Cohesion Fund (CF), varying from 25% to 85% of eligible expenditure, and, in the period 2000-2006, such support totalled €4.05 bn EUR, with four Member States (Greece, Italy, Portugal and Spain) accounting for nearly 90% of all the funding" (European Scrutiny Committee, 2011).[16] A positive aspect of credits and loans is that they entail a significant reduction of the time needed to obtain funds compared with grants. Furthermore, time and money could be saved. A negative aspect is that payment is required as a return for the loan or credit, and which will be difficult to pay for new companies. Guarantees needed to capture the credit will be also difficult to obtain in the early stages of most projects. However, loans can be combined with a guarantee from an institution; yet in this case, more time will be spent

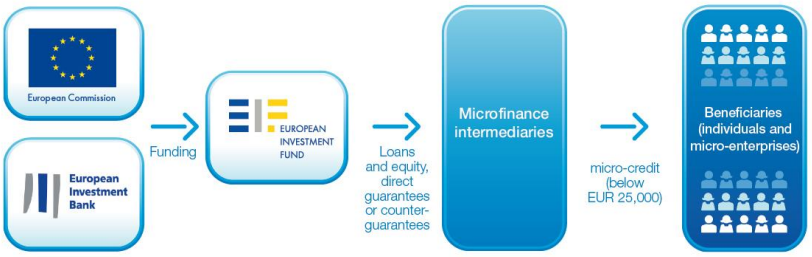
[14] More information on the EIB website: http://www.eib.org/index.htm.

[15] The three cohesion instruments employed by the European Commission are: the European Regional Development Fund (ERDF), the European Social Fund (ESF) and the Cohesion Fund.

[16] From http://www.publications.parliament.uk/pa/cm201011/cmselect/cmeuleg/428-xiii/42816.htm.

	for capturing funds. Another negative aspect is that it is very difficult to access credits and loans in times of crisis - even if good solvency can be proven.

Microfinance

What is it?	Microfinance is a source for entrepreneurs and small businesses lacking access to small amounts of money at a lower interest than under normal conditions. The main **objective** is to **provide access to banking and related services to those who get excluded from mainstream financial institutions due to the small size of the business or to their short career**.
Where is it used?	Microfinance products are usually available with flexible collateral conditions and offered by specialized micro-finance institutions such as Adie[17] in France or Finnvera[18] in Finland. They are also applied in developing countries, normally related to water access and sanitation. However, microfinance is not a means to lend small amounts of money; it almost always also entails non-financial support, such as mentoring, training, advisory assistance, etc. An example is the Water Credit project developed through water.org. WaterCredit is a programme that connects financial institutions with communities in nine developing countries, such as Bangladesh or Ghana, to enable access to safe water and sanitation in the poorest communities. To differentiate between the two main applications of microfinance, the European Microfinance Network categorises it as microenterprise lending and social inclusion lending. However, sometimes the projects are covered by in both categories. In the case of innovation uptake it can be more reliable to talk about microenterprises lending.
How is it implemented?	**In Europe, a loan is considered a microcredit when it is smaller than EUR 25.000**. There are several microfinance institutions intermediating behind beneficiaries and fund sources. There are also support programmes for intermediaries owned by the EU institutions. One of them is JASMINE, a programme managed by the European Investment Fund that supports non-bank microfinance institutions which in turn offer microfinance to beneficiaries. The relationship is shown in the Figure below. The European Commission and the European Investment Bank provide funds to the EIF, which gives the money to microfinance institutions. Finally, these MFIs spread the financing through the beneficiaries.  **Microfinance funding flow in Europe. Source: EIF**

[17] Adie is a microfinance institution created in 1989 to promote self-employment in France copying the "Banks of the Poor" from developing countries.

[18] Finnvera is a microfinance institution owned by the State of Finland that provides financing for creating, expanding and internationalizing companies from Finland.

However, for several reasons it is quite difficult to find applications of microfinance inside the EU. One reason is that there is **no common microfinance business model in the EU**, so that the institutions tend to be small and less known than they could be. In Eastern Europe, the instrument is more developed. It could be applied in numerous projects, but currently it is usually focused on improving social standards in the communities in need, for example women, inmigrants and young people. Some beneficiaries can be seen in the statistics below:

Beneficiaries	
Woman	44%
Ethnical minorities	2%
Immigrants	12%
Young	12%
Disabled	1%

Microcredit beneficiaries in the EU (2007). Source: Kraemer-Eis and Conforti (2009)

All percentages included in the table are higher than the respective representation of each category in the creation of new companies. In summary, it can be applied in projects that have a small budget or projects that are able to do the first step with small capital. It is a limited tool, but can be useful for other projects, such as those that come from water utilities.

Venture capital

What is it?

Venture capital is provided in early-stage, high-potential, high-risk companies. It is used when the company is not able to attract capital in the public markets through, for example, a bank loan or a debt offering. **The venture capital provider earns money by owning equity in the companies he invests in**. The tool is focused on innovation, either technological innovation or innovative business models. Venture capital is well-known in the USA but not in the EU, where it is less frequently used as a financial source. It can be applied at different stages of the companies' lifetime, from the seed capital to a later-stage venture. Thus there are numerous venture capital investors that focus on different stages, sizes and markets.

Where is it used?

Venture capital is currently used by Vento, funded by Aqualogy, a large company in the water sector, and CDTI (Centro para el Desarrollo Tecnológico e Industrial), a Spanish Government institution that promotes innovation and development and belongs to the INNVIERTE Programme. It is a very new fund and is focused on environmental and innovative companies. Another example is the Aqua Resources Fund from the isle of Guernsey that is a company specialized in investments in water-related companies.

The European Private Equity & Venture Capital Association (EVCA) collects statistics about venture capital and other types of private equity. The results of 2013 are quoted below:

Investment in private equity, Europe 2013		
	% of amount	Companies
Venture Capital	9,80%	60,96%
Buyout	79,83%	16,32%
Growth	10,37%	22,72%
Total	€ 34,7 bn	4.977

Investment in private equity, Europe 2013. Source: EVCA.

If we look at the amount of money, the venture capital share only represents 9.8% of the total amount. However, looking at the number of companies that received money from venture capital, the percentage rises to 61% of the equity investment in companies. This means that the mean amount of money per company is about 1, 12 m EUR. In comparison to other sources, venture capital is more appropriate for big projects that need huge amounts of money.

How is it implemented?

It is crucial **to find the suitable fund for each project**. At the same time, it is important to analyse the following: what kind of venture capital investment is needed for the company, what amount of money is required, how many times is the capital needed, in which stage is the company is etc. Some funds do not only put the money at the company's disposal, but will provide advice as to how to achieve the objectives. Thus, as mentioned above, it is important to find a fund that is suitable for each respective project.

Equity investment

What is it?	Equity investment is **the practice of buying a fraction of a company**, in the form of equities, to take profit when it begins having benefits. It implies taking some control of the company in terms of executive or voting decisions as a part of the shared ownership of the company.
Where is it used?	The figure below shows the volume and value of European private equity buyouts for the period 2009-2014. The trend of volume in private equity seems to change in the financial crisis period and even though the total volume remains stable, the value is decreasing.

Volume and value of European private equity buy-outs (primary & secondary), Q1 09 to Q1 14. Source: White&Case (2014).

As can be seen in the previous figure, the volume of private equity buyouts increased between 2009 and 2011. However, in 2011 the tendency changed and the volume started to decrease due to the effects of the financial crisis.

An example of application of equity investment in water sector is the European Bank for Reconstruction and Development (EBRD). EBRD is a public sector bank created with the objective of financing development currently in more than 30 countries from central Europe to central Asia and the southern and eastern Mediterranean. EBRD funds companies of several sectors, including the **water sector**. One of its instruments for lending money to companies is **equity investments in private water companies**. The table below shows the operations financed by EBRD between 1991 and 2009.

	EBRD finance 1991-2009	Of which equity investments
FCC/Aqualia	80	80
Suez	42	0
United Utilities (now Veolia)	111	17

Veolia	263	175
TOTAL	496	272
Veolia – non water (Dalkia, Connex)	208	141

EBRD finance for private water from 1991-2009 in m €. Source: EBRD investments 1991-2009[19]

The following table summarises the EBRD equity investments in water in comparison to equity investments in private companies in all sectors.

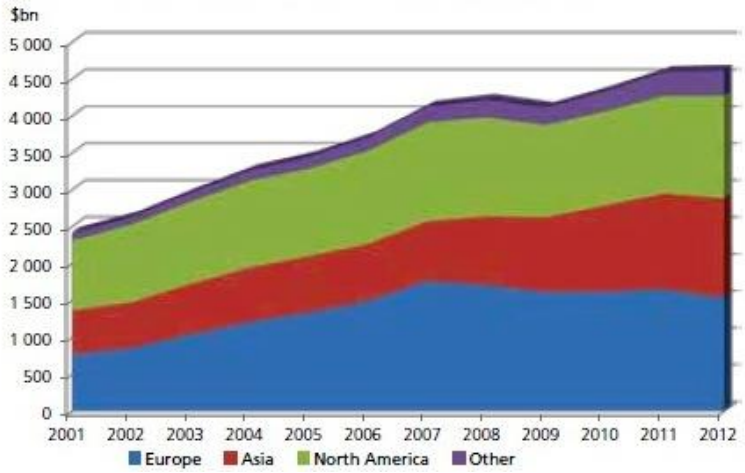
		€ million	% of total
TOTAL EBRD equity investments 1991-2009		10021	100.0
of which	Al municipal infrastructure	426	42.5
of which	Water sector	272	27.2

EBRD equity investments 1991-2009: heavily weighted to water. Source: EBRD investments 1991-2009.

Equity investment in water represents a high percentage of all EBRD equity investments. Therefore, water companies can resolve their needs of finance by using this mechanism of the EBRD.

[19] **http://www.ebrd.com/downloads/research/annual/invest09.xls**

Insurance and guarantee

What is it?	**Insurance is the equitable transfer of the risk** of loss from one entity to another in exchange for payment (Zeckhauser 2008); a **guarantee is an agreement serving as security** for a formal pledge to pay another person's or company's debt. Both are designed to facilitate access to finance for companies that cannot do have access under market conditions. The insurance instrument is used in less risky projects. Moreover, guarantees are a barely used economic instrument in the water sector, in comparison with other sectors, due to the intrinsic characteristics of this sector (determinants of tariff reform, low cost recovery, and the level of governance of water services).
Where is it used?	In 2012, the European insurance industry was the largest in the world with a market share of 33%, followed by North America (30%) and Asia (29%). The figures below show the worldwide distribution of insurance premiums for the year 2012 and the evolution of worldwide premiums over the period 2001-2012.  **Insurance markets. Source: Swiss Re Sigma. Note: "Europe" includes Russia and Ukraine (which together account for less than 1% of worldwide premiums)**  **Insurance distribution per continents. Source: Swiss Re Sigma. Note: "Europe" includes Russia and Ukraine (which together account for less than 1% of worldwide premiums)**

	Europe's share of premiums expanded from 32% to 43% during the period 2001-2012.
How is it implemented?	**Insurance companies** usually provide long-term funding through capital markets, but they also **fund innovation** via investment in private equity and direct lending to small and medium-sized enterprises and they also fund large public government projects. These funds allow business and governments to take part in large projects which need many years to be completed. Without these funds, the risk associated with many projects would make them unviable. **Insurances and guarantees** are used as a **risk mitigation instrument** by a variety of institutions in the water sector. However, compared to other sectors, these instruments have not been used on a large scale in the water sector. Some examples of the use of these instruments in the **water sector** are summarised below (OECD 2010). • ***Partial Credit Guarantees (PCGs)***. This instrument covers parts of the debt. The International Finance Corporation (IFC) supplied PCGs to the city of Johannesburg in South Africa and to the Tlalnepantla[20] water project in Mexico. • ***Partial Risk Guarantees (PRGs)***. This instrument has been used for covering commercial lenders in private projects for the full amount of the debt. The difference between these two instruments is that PCGs are usually used for funding public investment projects, while PRGs are usually utilised to fund private sector projects. The Multilateral Investment Guarantee Agency (MIGA)[21] is a member of the World Bank Group and its objective is to foment investment in developing countries in order to support economic growth, reduce poverty and improve people's lives. For doing so, MIGA provides guarantees against particular risks to investments in developing countries in water and sanitation projects, among others. For example, MIGA takes part in the Seawater Desalination Project in Ghana, providing a total guarantee of $179.2 m with the objective of building a desalination plant.Next, three particular cases of implementation in the water sector carried out by the World Bank in collaboration with other partners are briefly mentioned. ***Flood risk management and financing in agriculture***. The World Bank recently investigated the practicability of implementing index-based insurance for agricultural flood losses in the pilots of Thailand, Vietnam and Bangladesh.

[20] The project involves rehabilitating and improving water and sanitation activities of the Municipality of Tlalnepantla de Baz, Mexico. http://ifcext.ifc.org/ifcext/spiwebsite1.nsf/ProjectDisplay/ERS20361.

[21] http://www.miga.org/.

	• ***Addressing drought risk***. The World Bank also conducted a project with the objective of developing and evaluating index insurance contracts for smallholder farmers in Malawi, Tanzania, and Kenya for covering the risk of rainfall deficit. • ***Monsoon-indexed lending and insurance for smallholders***. Another research carried out by the World Bank consists in an integrated crop loan insurance and risk management product for Indian rural finance and agriculture, with the objective to facilitate farmers' access to crop loans and their capacity to manage risk. (Hess, 2003) However, it is important to stress **the limited used of guarantees in the water sector**. This fact opens the door to further investigation in order to assess what can be done to increase the use of insurances and guarantees as risk mitigation instruments in water sector innovation projects.

Crowdfunding

What is it?

Crowdfunding is the practice of funding a project or venture by raising many small amounts of money from a large number of people, typically via the internet (Oxford Dictionary). There are different types of crowdfunding.

Crowdfunding types

Types	Description
Reward	Backers receive a return from the promoters, usually the product or service that are backing.
Equity	The return is in form of equities of the companies.
Debt	The return is in form of interests to the capital lent.
Donation	When there is no return at all.

Where is it used?

There are several platforms like Kickstarter[22] or Indiegogo[23] based in different countries that have supported water crowdfunding projects. Furthermore, there are numerous examples of projects financed by **crowdfunding platforms**, but the majority are charity projects related to development in poor countries. Indiegogo enabled several projects related to water and technology. There are also a few examples of reward based projects; one example is the UK project Desolenator.[24]There are also other projects such as Noocity[25].

How is it implemented?

Crowdfunding in the water sector is mainly used for charity projects. It is difficult to establish projects based on rewards to the backers, because commonly the projects focus on improving the environment or the water in a river, so there is no product to sell. One of the main problems of crowdfunding is that it is a very new source to finance. It means that there is a lack of knowledge on how to build up a successful project. This might explain why Kickstarter, for example, successfully backs less than 38% of all projects.[26]

Crowdfunding types. Source: Cetaqua (2010).

22 Kickstarter : http://www.rockethub.com/projects?query=water.

23 IndieGoGo: https://www.indiegogo.com/.

24 *Desolenator: transforming sunshine into water will provide families with the ability to turn salt water and contaminated water into pure drinking water. The technology has the potential to provide water independence for up to a billion people living in coastal and water stressed areas - using the power of the sun alone.* For more information, please visit the Desolenator project website: https://www.indiegogo.com/projects/desolenator-transforming-sunshine-into-water.

25 For more information, please visit the Noocity funding website: https://www.indiegogo.com/projects/noocity-growbed-turn-unused-urban-space-green#home.

26 Kickstarter statistics accessed on 03/20/2015: https://www.kickstarter.com/help/stats?ref=footer.

Business Angels	
What is it?	Business angels or angel investor is, usually a former entrepreneur or professional who provides starting capital or growth capital in promising ventures and also gives advice and contacts based on your own knowledge and professional experience. Usually they operate alone or in small groups. Family and friends should not be included as Business Angels. A business angel is a private individual, often of high net worth, and usually with business experience, who directly invests part of his or her personal assets in new and growing private businesses. Business angels can invest individually or as part of a syndicate where one angel typically takes the lead role. Besides capital, angel investors provide business management experience, skills, and contacts for the entrepreneur. Experienced angels also know that they may have to wait for a return on their investment. They can therefore be a good source of 'smart and patient' capital [27] There is no single settled definition of a Business Angel. DG Enterprise defined a Business Angel as follows: "A knowledgeable private individual, usually with business experience, who directly invests part of his or her personal assets in new and growing unquoted businesses. Besides capital, Business Angels provide business management experience for the entrepreneur."[28]
Where is it used?	Business angels play an important role in the economy. In many countries, they constitute the second largest source of external funding in newly established ventures (after family and friends). They are increasingly important in providing risk capital, as well as contributing to economic growth and technological advances. Tools to promote business angel investment are the responsibility of EU countries. They should create incentives for private individuals who are willing to invest in enterprises. This should include the use of public funds to target co-investment with business angels. • The European Trade Association for Business Angels, Seed Funds and Early Stage Market Players (EBAN) represents the early stage investor community in Europe, including Business Angels networks and angel investors themselves. • Business Angels Europe (BAE) represents European business angel federations and trade associations Seraphim Fund in the United Kingdom.[29]

[27] https://ec.europa.eu/growth/access-to-finance/funding-policies/business-angels_en
[28] This DG doesn't exist but its influence in current definition seems clear.
[29] OECD https://www.oecd.org/sti/outlook/e-outlook/stipolicyprofiles/competencestoinnovate/financingbusinessrdandinnovation.htm

How is it implemented?	The fundamental natire of the BA market is informal. Usually, angels likes to be anonymus and no explain their investments. They are important for the creation and maintenance of informal economy but more data is needed. There are some networks that facilitates the matching between both sides.

ANNEX B: EIB financed Water and sewerage projects

Projects funded by EIB since 2010. Source: EIB.

From 2010 to 2015. Sector: Water, sewerage.				
Name	Region	Country	Signature date	Signed Amount (€)
SEVERN TRENT CLIMATE ACTION	European Union	United Kingdom	26/02/2015	725.927.955 €
SPGE V - WALLOON REGION WASTEWATER TREATMENT	European Union	Belgium	23/02/2015	200.000.000 €
UPPSALA MUNICIPAL INVESTMENTS	European Union	Sweden	29/01/2015	27.025.578 €
EU FUNDS GALICIA CO-FINANCING 2014-2020	European Union	Spain	21/01/2015	40.800.000 €
UKRAINE EARLY RECOVERY	Eastern Europe, Southern Caucasus and Russia	Ukraine	22/12/2014	30.000.000 €
AQUAFIN WASTE WATER TREATMENT IX	European Union	Belgium	16/12/2014	100.000.000 €
EU FUNDS CO-FINANCING (ANDALUCIA)	European Union	Spain	15/12/2014	37.400.000 €
STOCKHOLM MUNICIPAL INVESTMENTS	European Union	Sweden	12/12/2014	7.932.225 €
EVIDES WATER SUPPLY	European Union	Netherlands	12/12/2014	175.000.000 €
AEP NIAMEY	Africa, Caribbean, Pacific countries + OCT	Niger	11/12/2014	21.000.000 €
DEVELOPMENT BANK ENERGY AND ENVIRONMENT LOAN	Enlargement Countries	Turkey	09/12/2014	5.000.000 €
IREN SERVIZI IDRICI GENOA AND PARMA	European Union	Italy	09/12/2014	150.000.000 €

SETTORE IDRICO TORINO III	European Union	Italy	28/11/2014	100.000.000 €
BULGARIA EU FUNDS CO-FINANCING 2014-2020 (SPL)	European Union	Bulgaria	27/11/2014	136.000.000 €
TSKB ENERGY AND ENVIRONMENT LOAN	Enlargement Countries	Turkey	24/11/2014	15.000.000 €
WELSH WATER AND WASTEWATER AMP5 - II	European Union	United Kingdom	17/11/2014	293.273.829 €
ZENATA URBAN DEVELOPMENT PROJECT	Mediterranean countries	Morocco	13/11/2014	7.500.000 €
IRISH WATER INVESTMENT PROGRAMME	European Union	Ireland	29/10/2014	100.000.000 €
BRUSSELS SEWAGE NETWORK (HYDROBRU) - PHASE II	European Union	Belgium	23/10/2014	250.000.000 €
CAP HOLDING SETTORE IDRICO MILANO	European Union	Italy	13/10/2014	70.000.000 €
EAU ET ASSAINISSEMENT II	European Union	France	18/09/2014	50.000.000 €
VASTERAS MUNICIPAL INVESTMENTS	European Union	Sweden	03/09/2014	2.945.733 €
SBGE - BRUSSELS SOUTH WASTEWATER TREATMENT PLANT	European Union	Belgium	04/08/2014	100.000.000 €
NORTH MOLDOVA WATER	Eastern Europe, Southern Caucasus and Russia	Moldova, Republic of	31/07/2014	10.000.000 €
ACEA SETTORE IDRICO ROMA II	European Union	Italy	31/07/2014	200.000.000 €
KRAKOW URBAN INFRASTRUCTURE	European Union	Poland	23/07/2014	702.463 €
VIVERACQUA HYDROBOND	European Union	Italy	21/07/2014	145.800.000 €
VERITAS ACQUA E RIFIUTI	European Union	Italy	09/07/2014	18.000.000 €
VERITAS ACQUA E RIFIUTI	European Union	Italy	09/07/2014	12.000.000 €

ULAANBAATAR WWS	Asia and Latin America	Mongolia	30/06/2014	10.150.000 €
ULAANBAATAR WWS	Asia and Latin America	Mongolia	30/06/2014	7.350.000 €
DHAKA ENVIRONMENTALLY SUSTAINABLE WATER SUPPLY	Asia and Latin America	Bangladesh	30/06/2014	100.000.000 €
WATER SECTOR COMMUNAL INFRASTRUCTURE	Eastern Europe, Southern Caucasus and Russia	Armenia	27/06/2014	25.500.000 €
YEREVAN WATER SUPPLY IMPROVEMENT	Eastern Europe, Southern Caucasus and Russia	Armenia	27/06/2014	5.144.411 €
KAFR EL SHEIKH WASTE WATER TREATMENT (EGYPT)	Mediterranean countries	Egypt	05/06/2014	77.000.000 €
TRENTO INFRA RENEWABLE ENERGY & OTHER PRIORITIES	European Union	Italy	30/04/2014	26.100.000 €
FORESTRY & COASTAL MANAGEMENT	European Union	Spain	27/02/2014	64.800.000 €
SALVAGUARDIA VENEZIA - SISTEMA MOSE	European Union	Italy	13/02/2014	200.000.000 €
ACCIONA RDI 2	European Union	Spain	07/02/2014	12.000.000 €
LAHTI URBAN INFRASTRUCTURE	European Union	Finland	07/02/2014	3.000.000 €
LV WATSAN - MWANZA	Africa, Caribbean, Pacific countries + OCT	Tanzania	23/12/2013	45.000.000 €
AEP OUAGADOUGOU III	Africa, Caribbean, Pacific countries + OCT	Burkina Faso	20/12/2013	33.000.000 €
UNITED UTILITIES WATER & WASTEWATER (AMP5-2)	European Union	United Kingdom	19/12/2013	600.420.294 €
CHISINAU WATER	Eastern Europe, Southern Caucasus and Russia	Moldova, Republic of	19/12/2013	24.000.000 €
DEPOLLUTION INTEGREE BIZERTE	Mediterranean countries	Tunisia	19/12/2013	20.000.000 €
GRUPPO HERA-ACEGAS APS SETTORE IDRICO	European Union	Italy	19/12/2013	50.000.000 €

GRUPPO HERA-ACEGAS APS SETTORE IDRICO	European Union	Italy	19/12/2013	50.000.000 €
AQUANET WATER AND WASTEWATER II	European Union	Poland	19/12/2013	71.326.676 €
ANGLIAN WATER & WASTEWATER AMP5-I	European Union	United Kingdom	18/12/2013	300.210.147 €
IWSP II (UPPER EGYPT)	Mediterranean countries	Egypt	17/12/2013	57.000.000 €
ZAMBIA WATER AND SANITATION PROJECT	Africa, Caribbean, Pacific countries + OCT	Zambia	17/12/2013	75.000.000 €
SWDE WATER SUPPLY II	European Union	Belgium	16/12/2013	75.000.000 €
KABALA AEP BAMAKO	Africa, Caribbean, Pacific countries + OCT	Mali	16/12/2013	50.000.000 €
EU FUNDS CO-FINANCING (ANDALUCIA)	European Union	Spain	12/12/2013	37.400.000 €
NORTHUMBRIAN WATER & WASTEWATER AMP5-I	European Union	United Kingdom	11/12/2013	120.084.059 €
BRAUNKOHLESANIERUNG LAUSITZ	European Union	Germany	10/12/2013	30.000.000 €
WATER SUPPLY AND SANITATION PROGRAMME	Asia and Latin America	Nicaragua	05/12/2013	59.717.875 €
WESSEX WATER AND WASTEWATER AMP 5-II	European Union	United Kingdom	04/12/2013	240.168.118 €
EXTREMADURA GROWTH & INNOVATION FL	European Union	Spain	28/11/2013	16.187.500 €
EAU ET ASSAINISSEMENT II	European Union	France	08/11/2013	150.000.000 €
SANTANDER INFRASTRUCTURE AND PPP FL	European Union	Spain	04/11/2013	40.000.000 €
KOELN ABWASSER UND UMWELT	European Union	Germany	30/10/2013	200.000.000 €
EMSCHER RENATURIERUNG	European Union	Germany	01/10/2013	450.000.000 €

GRUPPO HERA-ACEGAS APS SETTORE IDRICO	European Union	Italy	30/09/2013	200.000.000 €
EU FUNDS CO-FINANCING GALICIA	European Union	Spain	09/09/2013	7.800.000 €
WATER INFRASTRUCTURE MODERNISATION II	Eastern Europe, Southern Caucasus and Russia	Georgia	20/08/2013	40.000.000 €
EAU ET ASSAINISSEMENT II	European Union	France	03/07/2013	200.000.000 €
AQUA BURGENLAND SOPRON	European Union	Austria	12/06/2013	39.000.000 €
AMENAGEMENT SEINE AVAL	European Union	France	12/06/2013	600.000.000 €
SUSTAINABLE TOURISM & EE GLOBAL LOAN	Enlargement Countries	Turkey	25/04/2013	3.000.000 €
SUSTAINABLE TOURISM & EE GLOBAL LOAN	Enlargement Countries	Turkey	24/04/2013	3.000.000 €
NORTHUMBRIAN WATER & WASTEWATER AMP5-I	European Union	United Kingdom	08/04/2013	59.129.612 €
SALVAGUARDIA VENEZIA - SISTEMA MOSE	European Union	Italy	18/03/2013	75.000.000 €
AQUAFIN WASTE WATER TREATMENT VIII	European Union	Belgium	15/03/2013	150.000.000 €
SALVAGUARDIA VENEZIA - SISTEMA MOSE	European Union	Italy	12/02/2013	500.000.000 €
WATER INFRASTRUCTURE - ACUAMED	European Union	Spain	21/12/2012	150.000.000 €
SLOVENIA EU FUNDS 2007-2013	European Union	Slovenia	21/12/2012	105.000.000 €
FLOOD PREVENTION AND PROTECTION	Enlargement Countries	Turkey	20/12/2012	100.000.000 €
REHABILITATION URBAINE TUNISIE	Mediterranean countries	Tunisia	20/12/2012	3.500.000 €
ANGLIAN WATER & WASTEWATER AMP5-I	European Union	United Kingdom	14/12/2012	185.002.467 €

PROGRAMME NATIONAL ASSAINISSEMENT PNA	Mediterranean countries	Morocco	14/12/2012	20.000.000 €
EU FUNDS CO-FINANCING 2007-2013 (PT)	European Union	Portugal	07/12/2012	63.000.000 €
THAMES WATER CLIMATE ACTION	European Union	United Kingdom	04/12/2012	530.340.405 €
ACQUEDOTTO PUGLIESE	European Union	Italy	30/11/2012	150.000.000 €
EAU ET ASSAINISSEMENT II	European Union	France	29/11/2012	80.000.000 €
CANTABRIA WATER INFRASTRUCTURE	European Union	Spain	28/11/2012	50.000.000 €
IRISH WATER INVESTMENT PROGRAMME	European Union	Ireland	28/11/2012	100.000.000 €
PROVINCIA DI TRENTO-TRATTAMENTO ACQUE	European Union	Italy	23/11/2012	60.000.000 €
ALAVA SUSTAINABLE DEVELOPMENT	European Union	Spain	22/11/2012	21.060.000 €
STADTENTWAESSERUNG HAMBURG	European Union	Germany	22/11/2012	160.000.000 €
EAU ET ASSAINISSEMENT II	European Union	France	19/11/2012	60.000.000 €
COHESION FUND FRAMEWORK LOAN II (HU)	European Union	Hungary	16/11/2012	174.370.000 €
BERLIN ABWASSER UND UMWELT	European Union	Germany	16/11/2012	450.000.000 €
NORTHUMBRIAN WATER & WASTEWATER AMP5-I	European Union	United Kingdom	26/10/2012	62.652.716 €
URGENT FLOOD RELIEF AND PREVENTION	Enlargement Countries	Montenegro	10/10/2012	4.000.000 €
AQUAFIN WASTE WATER TREATMENT VIII	European Union	Belgium	09/10/2012	50.000.000 €
PLAN MAROC VERT PNEEI	Mediterranean countries	Morocco	05/10/2012	42.500.000 €

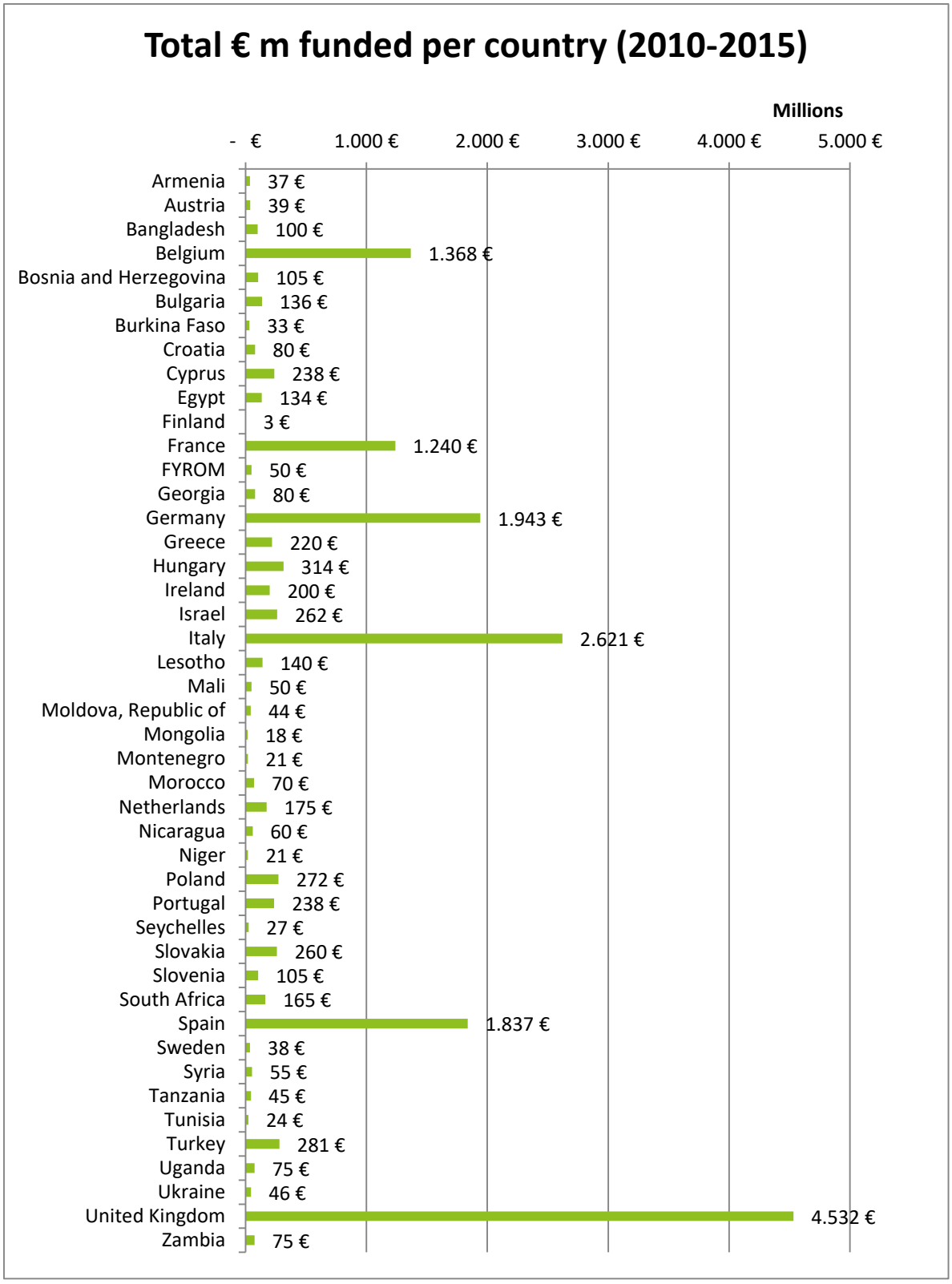
SWDE WATER SUPPLY II	European Union	Belgium	26/09/2012	40.000.000 €
SWDE WATER SUPPLY II	European Union	Belgium	26/09/2012	35.000.000 €
ARMENIA WATER SECTOR PROJECT	Eastern Europe, Southern Caucasus and Russia	Armenia	07/08/2012	6.500.000 €
LIMASSOL SEWERAGE III	European Union	Cyprus	25/07/2012	68.000.000 €
MVV NETZWERKE	European Union	Germany	04/07/2012	22.500.000 €
ILLER BANK ENVIRONMENTAL LOAN	Enlargement Countries	Turkey	28/06/2012	105.000.000 €
FLOODS&RED SLUDGE DISASTER RECOVERY	European Union	Hungary	14/06/2012	22.522.500 €
WATER INFRASTRUCTURE - ACUAMED	European Union	Spain	14/06/2012	350.000.000 €
KRAKOW URBAN INFRASTRUCTURE	European Union	Poland	25/05/2012	575.415 €
LILLE METROPOLE - EAU & ASSAINISSEMENT	European Union	France	23/03/2012	40.000.000 €
SPGE WASTE WATER IV	European Union	Belgium	24/01/2012	100.000.000 €
SEYCHELLES WATER & SANITATION	Africa, Caribbean, Pacific countries + OCT	Seychelles	28/12/2011	26.737.000 €
YORKSHIRE WATER AND WASTEWATER AMP-5	European Union	United Kingdom	19/12/2011	87.637.298 €
EU FUNDS CO-FINANCING 2007-2013 (PT)	European Union	Portugal	16/12/2011	84.000.000 €
SOUTH WEST W&WW 2010-12 (AMP5-I)	European Union	United Kingdom	15/12/2011	70.109.839 €
MEKOROT ASHDOD DESALINATION PLANT	Mediterranean countries	Israel	06/12/2011	120.000.000 €
KATOWICE WASTEWATER	European Union	Poland	05/12/2011	66.548.358 €

UMGENI WATER PROJECT	South Africa	South Africa	25/11/2011	35.000.000 €
LA RIOJA PUBLIC INFRASTRUCTURE	European Union	Spain	24/11/2011	44.800.000 €
SANEAMIENTO ASTURIAS I	European Union	Spain	18/11/2011	158.000.000 €
UNITED UTILITIES WATER & WASTEW AMP5-I	European Union	United Kingdom	03/11/2011	229.068.835 €
ANGLIAN WATER & WASTEWATER AMP5-I	European Union	United Kingdom	31/10/2011	173.080.252 €
EMERGENCY FLOOD RELIEF AND PREVENTION	Enlargement Countries	Bosnia and Herzegovina	27/10/2011	55.000.000 €
MUNICIPAL WATER FINANCING FACILITY	European Union	Croatia	18/10/2011	75.000.000 €
ISLAND&COASTAL INFRASTRUCTURE FACILITY	European Union	Croatia	15/09/2011	5.000.000 €
CASTILLA Y LEON ENVIRONMENT	European Union	Spain	09/09/2011	23.500.000 €
CASTILLA Y LEON ENVIRONMENT	European Union	Spain	09/09/2011	23.500.000 €
REGIONE LOMBARDIA	European Union	Italy	25/07/2011	12.000.000 €
SOUTH WEST W&WW 2010-12 (AMP5-I)	European Union	United Kingdom	14/07/2011	72.018.171 €
EAU ET ASSAINISSEMENT II	European Union	France	14/07/2011	60.000.000 €
WESSEX WATER AND WASTEWATER AMP5 - I	European Union	United Kingdom	05/07/2011	83.097.889 €
COHESION FUND FRAMEWORK LOAN II (HU)	European Union	Hungary	20/06/2011	111.300.000 €
NORTHUMBRIAN WATER & WASTEWATER AMP5-I	European Union	United Kingdom	15/06/2011	57.336.162 €
SANEAMIENTO CA VALENCIANA V	European Union	Spain	31/05/2011	100.000.000 €

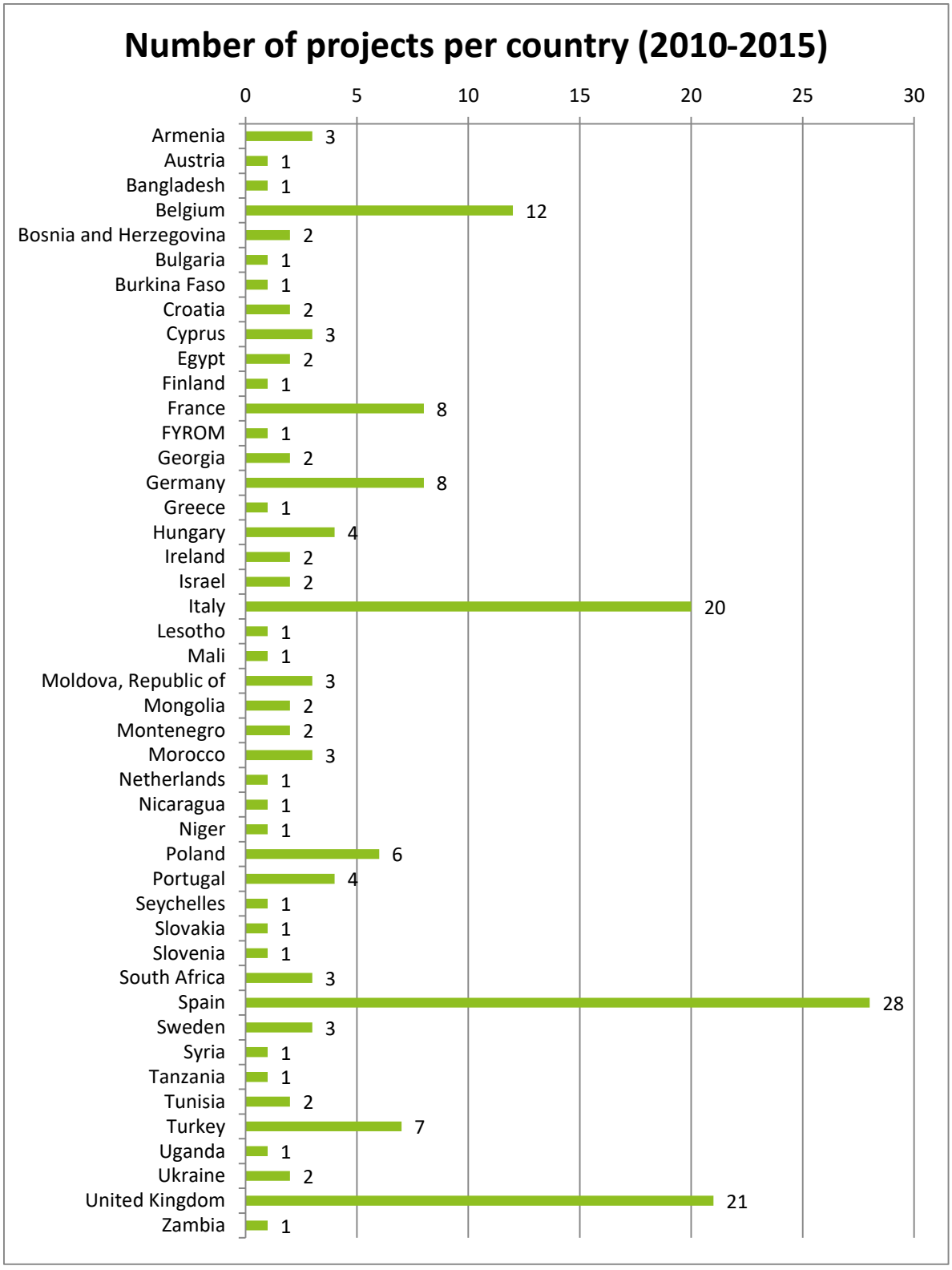
SOREK DESALINATION PLANT	Mediterranean countries	Israel	26/05/2011	142.000.000 €
MOOI-MGENI TRANSFER SCHEME PHASE 2	South Africa	South Africa	16/05/2011	80.000.000 €
SALVAGUARDIA VENEZIA - SISTEMA MOSE	European Union	Italy	29/04/2011	480.000.000 €
LAKE VICTORIA WATSAN - KAMPALA WATER	Africa, Caribbean, Pacific countries + OCT	Uganda	28/04/2011	75.000.000 €
BARCELONA DESARROLLO INTEGRADO	European Union	Spain	14/04/2011	8.000.000 €
GALICIA ENVIRONMNT&RURAL AREA COHESION	European Union	Spain	05/04/2011	10.000.000 €
CASTILLA Y LEON ENVIRONMENT	European Union	Spain	31/03/2011	23.500.000 €
YORKSHIRE WATER AND WASTEWATER AMP-5	European Union	United Kingdom	31/03/2011	87.945.591 €
CASTILLA Y LEON ENVIRONMENT	European Union	Spain	30/03/2011	70.500.000 €
SPGE WASTE WATER IV	European Union	Belgium	18/03/2011	100.000.000 €
EMSCHER UMBAU	European Union	Germany	17/03/2011	450.000.000 €
GIPUZKOA ENVIRONMENTAL PROTECTION	European Union	Spain	14/03/2011	25.000.000 €
WELSH WATER AND WASTEWATER AMP5 I	European Union	United Kingdom	03/03/2011	117.260.788 €
UNITED UTILITIES WATER & WASTEW AMP5-I	European Union	United Kingdom	01/03/2011	234.521.576 €
MADRID WATER MANAGEMENT	European Union	Spain	04/01/2011	200.000.000 €
GALICIA ENVIRONMNT&RURAL AREA COHESION	European Union	Spain	14/12/2010	20.000.000 €
MONTENEGRO WATER AND SANITATION	Enlargement Countries	Montenegro	13/12/2010	16.500.000 €

SYRIA H2020 WATER	Mediterranean countries	Syria	06/12/2010	55.000.000 €
ETHEKWINI WATER	South Africa	South Africa	06/12/2010	50.000.000 €
BRUSSELS SEWAGE NETWORK ENHANCEMENT	European Union	Belgium	03/12/2010	168.000.000 €
SANEAMIENTO ASTURIAS I	European Union	Spain	03/12/2010	67.000.000 €
REGIONAL OPERATIONAL PROGRAMS 2007-13	European Union	Hungary	29/11/2010	6.000.000 €
BURSA WASTEWATER II	Enlargement Countries	Turkey	25/11/2010	50.000.000 €
EU FUNDS CO-FINANCING 2007-2013 (PT)	European Union	Portugal	19/11/2010	63.000.000 €
RECONSTRUCAO MADEIRA FRAMEWORK LOAN	European Union	Portugal	19/11/2010	27.500.000 €
NDP FRAMEWORK LOAN II	European Union	Slovakia	16/11/2010	260.000.000 €
DABROWA MUNICIPAL PROGRAM	European Union	Poland	29/10/2010	50.191.984 €
BIZKAIA ENVIRONMENTAL PROTECTION	European Union	Spain	28/10/2010	96.000.000 €
BERLIN WASSER II	European Union	Germany	18/10/2010	180.000.000 €
PERI-URBAN WASTEWATER PROJECT	European Union	Cyprus	30/09/2010	140.000.000 €
A2A SERVIZI IDRICI BRESCIA	European Union	Italy	30/09/2010	70.000.000 €
WATER AND SANITATION RS	Enlargement Countries	Bosnia and Herzegovina	22/09/2010	50.000.000 €
MOLDOVA WATER SECTOR PROJECT	Eastern Europe, Southern Caucasus and Russia	Moldova, Republic of	16/09/2010	10.000.000 €
WATER INFRASTRUCTURE MODERNISATION	Eastern Europe, Southern Caucasus and Russia	Georgia	15/09/2010	40.000.000 €

REGIONE TOSCANA RISORSE IDRICHE	European Union	Italy	09/09/2010	51.645.690 €
METOLONG DAM AND WATER SUPPLY PROGRAM	Africa, Caribbean, Pacific countries + OCT	Lesotho	12/08/2010	140.000.000 €
AGUAS DE CASTILLA-LA MANCHA II	European Union	Spain	20/07/2010	40.000.000 €
WATER SUPPLY AND WASTEWATER COLLECTION	Enlargement Countries	FYROM	14/07/2010	50.000.000 €
EU FUNDS CO-FINANCING 2007-2013 (GR)	European Union	Greece	01/07/2010	220.000.000 €
MADRID WATER MANAGEMENT	European Union	Spain	04/06/2010	100.000.000 €
LIMASSOL SEWERAGE II	European Union	Cyprus	02/06/2010	30.000.000 €
KRAKOW WATER & WASTEWATER	European Union	Poland	08/03/2010	83.127.613 €
MYKOLAYIV VODOKANAL	Eastern Europe, Southern Caucasus and Russia	Ukraine	02/02/2010	15.540.000 €
THAMES WATER AMP4-II	European Union	United Kingdom	15/01/2010	202.679.878 €
Total:				17.873.966.904 €



Total € m funded per country. Source: adapted from EIB.



Number of projects per country. Source: adapted from EIB.

ANNEX C: Some innovative economic instruments

Public Driven Instruments

The most common economic instruments, such as water tariffs, water taxes and fees as subsidies are clearly public driven instruments. This paragraph only includes some specific instruments that can promote innovation. The main objective of tariffs is to recover costs and revenues generated may be not devoted to innovation. The same occurs in view of taxes, fees or subsidies. For that reason, this section focuses on some specific cases which could be used for financing some kind of innovation. This applies to **VAT differentiation as an environmental policy instrument.** The basic idea is to use reduced differential VAT (Value Added Tax) rates for "greener" products, practices or services in comparison to those deemed "non-greener". VAT may be a tool to promote changes in consumption and innovation, fostering the development of technologies, practices or products (food) reckoned to be environmentally respectful and "desirable" (IES 2008).

In the case of taxes, **effluent taxes** are imposed on industries for their pollution to internalise their related external manufacturing costs (negative externalities). The aim of the EPI may be to:

- **Reduce the quantity of overall discharges of pollutants** in water by reducing point-source pollution on applying the "polluter pays principle". Pollution quantity reduction targets may be variable and selective and addressed specially to the discharge of those pollutants that are particulary harmful such as mercury.
- Create economic incentives to **develop new less pollutant technologies** for manufacturing processes.
- **Raise funds for earmarked investments in water quality** to improve facilities like waste water treatment plants, distributing the related costs among polluters.

Requirements for its application

To achieve the pollution reduction objectives, it is necessary to properly design the tax in order to create the adequate incentives so that firms reduce their pollution and invest in less polluting technologies. Low taxes as well as not adjusting them with inflation will impair the envisioned goal.

A policy instrument which deserves special attention for fostering water innovation is public procurement innovation. Public procurement shows significant possibilities for investing in innovative and sustainable water technologies and its possibilities have not yet been fully exploited.

Public Procurement (PP) and Public Procurement Innovation (PPI)

"Public Procurement is the process whereby public authorities – including all levels of government and public agencies – buy goods and services or commission work." (EC - EI 2014).

Public authorities involved in Public Procurement comprise[30]:

- **Contracting authorities**: National, regional or local authorities and so-called bodies "governed by public law". These are bodies established for the specific purpose of meeting needs in the general interest, but without an industrial or commercial character and for the most part financed, administered or supervised by public authorities (Article 1 of Directive 2004/18/EC).
- **Contracting entities**: All entities operating in so-called "special sectors", namely: water, energy, transport and postal services. Even if the operating entities in those sectors are not necessarily any longer public authorities or bodies governed by public law, they provide public services and remain fairly dependant on public money. They are therefore often subject to similar, albeit less restrictive, rules (see the preamble to Directive 2004/17/EC).

Although the primary goal of Public Procurement is to provide goods or services to satisfy the needs for which they are being commissioned, other considerations such as sustainability and innovation can be included as a favoured issue in tenders made by public suppliers. In view of sustainability, the tool can be called **Green Public Procurement** (GPP) or **Sustainability Public Procurement** (SPP), while the latter could be referred to as **Public Procurement for Innovation** (PPI).

GPP is an instrument which uses the purchasing power of public administrations to foster sustainable consumption and production and despite the fact that it is a **voluntary** instrument, it is gradually turned into a binding instrument in Europe (EC 2008). It is defined by the European Commission as "a process whereby public authorities seek to procure goods, services and works with a reduced environmental impact throughout their life cycle when compared to goods, services and works with the same primary function that would otherwise be procured" (European Commission 2011).

PPI may be defined as **public purchase triggering innovation**, using the innovation concept to broaden and widen that of technology. We can distinguish two different PPI categories (Edquist & Zabala-Iturriagagoitia, 2012)

- **Direct PPI**, when the procuring organization is also the end-user of the procured product and through the acquisition process influence or induce the innovation.
- **Catalytic PPI**, when the procuring organization acts on behalf of other organizations (usually to support "infant" product or industries) and acts to catalyze the development of the innovation, serving as a coordinator and technical resource support.

Innovation has been traditionally influenced and driven by the supply side (firms). However, the demand side can also play a significant role for its promotion and development. At the European level, public procurement ranges between 16% (Uyarra et al. 2009) and 19%[31] of its gross domestic product (about € 2.400 billion a year[32]). Such significant figures imply that, when sustainable and

[30] IRF Working Group Environment, http://www.irfnet.ch/files-upload/events/studyday_june2011/Green_Public_Procurement_Note.pdf.
[31] IRF Working Group Environment.
[32] Ibid.

innovation criteria are taken into consideration positively in public tenders, this can provide firms with certainty on the development and supply of those products, thereby creating proper incentives for firms to develop them. In fact, PPI was an element of the European Commission's Plan to raise R&D expenditure to the 3% Barcelona target and additionally the Lead Market Iniative considered PPI to be one of the key policy instruments for the creation of "lead markets" in Europe (Uyarra et al. 2009).

When choosing projects and technologies with a high social return that would not have been developed in the absence of the public intervention, public administrations do not only contribute to an improvement of the delivery of public policy and services, but also to the development of new markets for environmentally products and services, with increasing social benefits due to the related spillovers (Testa et al. 2012). This may be especially important for firms with limited resources, because public orders provide them with the necessary planning reliability to engage in innovative activities. In addition, the size of public purchases may favor to reach significant economies of scale, thus leading quickly to cost reductions and easing the creation of markets for private demand (Aschhoff et al. 2009).

Despite the benefits of GPP, Testa et al. (2012) identify at least three drawbacks and challenges:

- **Economic**, due to the increased costs perception of green products in comparison to those that are not environmentally friendly
- **Political**, due to the lack of organizational resources (including time and money). Fragmented responsibilities, lack of institutional capacity and lack of legislative mandate pose altogether challenges for decision-makers (Kiparsky et al. 2013).
- **Cognitive**, due to the inadequacy of employees to execute an innovation procurement strategy. This may be due to the lack of training and knowledge from public officers (improper workers adequacy) as well as the lack of proper tools for assessing and controlling the products and project development.

An additional challenge comes from the increased risk perception for products and services, which have not been previously experienced on markets, and regarding which performance is not guaranteed. This can be exacerbated by decision-makers' risk aversion and resistance to change as they may prefer proven technologies (Kiparsky et al. 2013). As a result, investment in innovation procurement is considered to have been sub-optimal (EC 2010).

However, as studies of new product development (Keizer et al., 2007) as well as software development (Bannerman, 2008) show that the odds for project success increase if risks are properly managed. If **PPI involves some kind of risk management**, mitigation of undesirable outcomes can be achieved, increasing the possibilities of PPI as an effective instrument for innovation. Conscious of this challenge, the European Commission (EC 2010) as well as other agencies (GOS 2014) have compiled and published sound recommendations to mitigate the risks associated with PPI and its implementation. In broad terms these may be summarised as:

- **Proper identification of the feasible projects**. Procurement of innovation is not costless and needs investments in project monitoring, information gathering, organization etc. Despite these costs, it is necessary to be conscious that when properly used, innovation investment may accrue more benefits than costs.
- As **early as possible** in the decision making process, it is necessary to **understand and identify which elements act as barriers for the project success** so as to be able to manage them properly. When risks are identified, it is possible to reduce the likelihood of their occurrence on defining actions to mitigate them and integrating their management into the whole procurement process.
- **Risk** (failure to deliver or delayed delivery) **needs to be balanced against the benefits associated with the innovative procurement outcome**. This seems to be of paramount importance due to the fact that the higher the risk assigned, the higher the procurement price will be. It is important to highlight that risk identification is quite important, as well as the public administration and contractor firm's attitudes towards the risk.
- **Implementing an effective awareness-raising action and training employees** to overcome their resilience and risk aversion towards PPI; changing their practice, attitude, and mindsets and overcoming their inadequacy towards innovation procurement. This includes, among others, technical, legal and economic issues and it is important to be aware that implementation of these actions may be difficult because they are strongly interdisciplinary. **Lack of sufficient procurement expertise for complex purchases involving innovation** may pose a significant and key barrier towards the success of the project and officers need to be able to define the requirements, qualify the suppliers, identify the best offer for "sustainable value for money", track the project, etc. Centralisation in an office with the required expertise may be a solution to the capacity restraint issues (Georghiou et al. 2014), especially for small public administrations (Testa et al. 2012), which face higher barriers to adopt GPP and PPI.
- **Procurement regulations should be adjusted to ease procurers' attitude towards PPI and mitigate their risk aversion.** Current procurement processes are highly regulated and driven towards "efficiency", understood as accomplishing the main goal of the procurement process, which lead to officers become engaged in "smooth" and risk reduced processes.
- Within the public administration it is important to **assess and define properly the responsibilities, functions and roles to deal with the PPI and GPP**. In addition, suppliers need to understand the special features and complexity of the institutional context as well as the legal operational constraints.

Stressing these risk mitigation recommendations, an OECD survey investigated the implementation of GPP, finding that the most frequently mentioned barriers were **lack of training for public procurement officers**, **lack of information of environmental benefits** and **lack of information on financial issues** (Testa et al 2012).

Finally, but not least significant, it is important to highlight that an appropriate institutional setting as well as political commitment of the public organisation towards innovation and sustainability criteria, are deemed to be determinants for the implementation success of GPP and PPI.

Private Driven Instruments

According to the Coase theorem, economic agents can make deals and exchange rights in order to improve their mutual welfare if transaction costs remain low and property rights are well defined. In this case, the solution is driven by private actors because non-public intervention is required in some cases. An example are **PES (Payments for Ecosystem Services) – Payments for changing farming practices, e.g. the Vittel example**. Vittel is a French spring water producer, that obtains water from an aquifer that was polluted by nitrates through the percolation of pesticides and fertilisers used by farmers. The increased rate of nitrates due to intensive dairy practices jeopardised Vittel's business activity. As a result, Vittel reached private agreements with farmers so as to change their farming practices towards more ecological and sustainable ones, which could preserve the quality of the aquifer water. **Private agreements** developed practices to take advantage of the capacity of the soil to absorb nitrates, reducing the use of fertilisers and replacing them by manure and animal waste (FAO 2013) (Perrot-Maître 2006).

To provide a solution to the problem it was required:

1. To understand the causal relation between farming practices and the increased rate of nitrates in the aquifer
2. Envision and test new farming practices, which can maintain the rate of nitrates at the desired level
3. Envision proper incentives for farmers to change their working practices.

Another example for private driven instruments are **Voluntary Price Signals (VPS)**. VPS are price settings which allow for the identification of environmentally friendly products in markets and confer them a premium over the market price. Usually these products are identified with some label such as "eco". An example is ecological food; a label facilitates the identification of those products, which have been harvested with natural pesticides and without artificial fertilisers which pollute water bodies due to water percolating through the soil. Examples are forest certification, labels for organic agriculture, norms etc. (EFI 2014).

Another case are voluntary agreements between public and private stakeholders, such as **Payments for Watershed Services (PWS): Voluntary agreements for river restoration services**. A voluntary agreement was coordinated among hydropower companies, the Ebro river water authorities and the scientific community to create programmed and controlled sets of flooding pulses to restore the ecological conditions of the river. Water pulses are generated to remove excess macrophytes (visible algae and other flora species), which are found in the river due to the changing conditions of its hydrology as a consequence of the construction of several reservoirs during the 1960s. Hydrological private firms are financially compensated for the loss of potential revenues that they could accrue

on not releasing water and using it for producing electricity in the seasons were price is higher (opportunity cost)(EPI Water 2011 – Ebro).

Payments for flood risk mitigation Natural Flood Management (NFM) are tools using landscape features, such as woodlands, wetlands and flood plains, to manage flood risks. Their aim is to adopt a catchment scale approach to manage flood risk by enhancing the natural capacity of lands to absorb water, which complements other initiatives such as engineered civil flood infrastructures (Beedell, Morris, Hess, 2012). Funds can come from the public sector but also from insurance companies, which provide funds for the provision of ecosystem services to land managers given that payments to farmers can be cheaper than having to compensate damage costs.

Payments for flood risk mitigation to farmers imply a change or an improvement of the way land is used so that it can retain and drain water during flooding episodes. Different kinds of agreements may be implemented, including:

- **Land purchases**: ensure permanent control but are not the preferred option for land owners who generally do not like selling their land
- **Lease back agreements**: land is purchased but subsequently leased back to the owners providing them with capital and allowing them to continue farming but under the restricted condition that they fulfill the objectives set to diminish the flooding risk. This option is more favoured by farmers but it is more difficult to manage (Beedell et al., 2012).

Public – Private Driven Instruments

In some cases, public intervention may be requested only in same phases of the instrument design or implementation, prior to the use of market forces. This applies, for example, to emission permits, an example for public-private driven instruments. This instrument needs a first intervention in order to allocate property rights and to define the market in which permits may be traded. In this case, public intervention is needed for trading in the market.

The case of **reverse auctions** is more interesting. They are competitive bidding systems where multiple sellers compete to supply a product or a service to a buyer (typically a public administration). This process is equivalent to public procurement and thus they are also referred to as **procurement auctions**.

There are three possible bidding strategies for reverse auctions (WRI 2008):

- **Bid for cost**: bids are ranked according to the cost, i.e. the highest rank is awarded to the bid that entails the lowest cost.
- **Bid for benefits**: bids are ranked according to their total environmental outcomes, i.e. the highest rank is awarded to the bid that entails the greatest environmental outcome.
- **Bid for cost-effectiveness**: bids are ranked based on a combination of both, costs and environmental outcomes, i.e. the highest rank is awarded to the bid that entails the best cost-effectiveness ratio.

Reverse auctions are a means to allocate efficiently scarce conservation funding for purchasing environmental goods or services. When bids are not rated only on a cost basis, the auction outcome is determined by the highest efficiency rather than the lowest cost. Thus, in addition to only ranking bids according to the price, the ranking can relate to the maximum output achieved per unit cost, for example "reduction of phosphorus runoff per currency unit spent" (Greenhalgh, 2010). For that purpose, an index for ranking bids is required; it includes proxy environmental indicators that the bidders engage to deliver. Applications are awarded according to the extent they address the established environmental priority goals (water quality, wildlife habitat etc.) as well as other parameters like the willingness to adopt or install certain recommended conservation practices (Best Management Practices). With this information, an offer index score is created, which provides information on the expected environmental outcomes to be achieved by every bid (WRI, 2007; WRI, 2008).

With this strategy, public administrations can identify the bid which provides environmental outcomes for conservation programmes with a good value for money, and thus use funds in the most cost effective way and with the greatest expected environmental outcomes. As a study developed by the USDA Economic Research Service concluded, competitive bidding coupled with the use of performances-based indices, is the most cost-effective strategy for allocating conservation funding (WRI 2008).

Water quality trading markets (WQT) can take different forms, such as **nutrient trading** (trading for nutrients) or **effluent trading** (trading for pollutant effluents). Water quality trading (nutrient or effluent) works alongside water quality regulations to improve water quality by setting caps on water nutrient levels and issuing rights to pour nutrients into water. Trading rights markets introduce flexibility as well as efficiency on nutrient abatement costs by allowing those peers with lower reductions costs to implement pollution reducing actions and sell rights to the less efficiency ones. (WRI 2009; WRI 2014)

A different case is the **Habitat banking – biodiversity offsetting**. It consists of a **Compensatory mitigation** mechanism to preserve biodiversity and ecosystem services. The basic scheme compensates the impact of destroyed or damaged ecosystem in one area through protection or restoration activities in other areas. There can be different compensatory schemes: (EFTEC, 2010; ICF – GHK, 2013):

- Do it yourself
- Pay into a fund which develops offsetting and restoration practices
- Buy a third-party credit

Some problems arise when it comes to identifying and assessing which areas can be considered equivalent in terms of damaging and offsetting restoration as well as the need of an environmental bank if compensation actions are not done by environmental damaging actors.

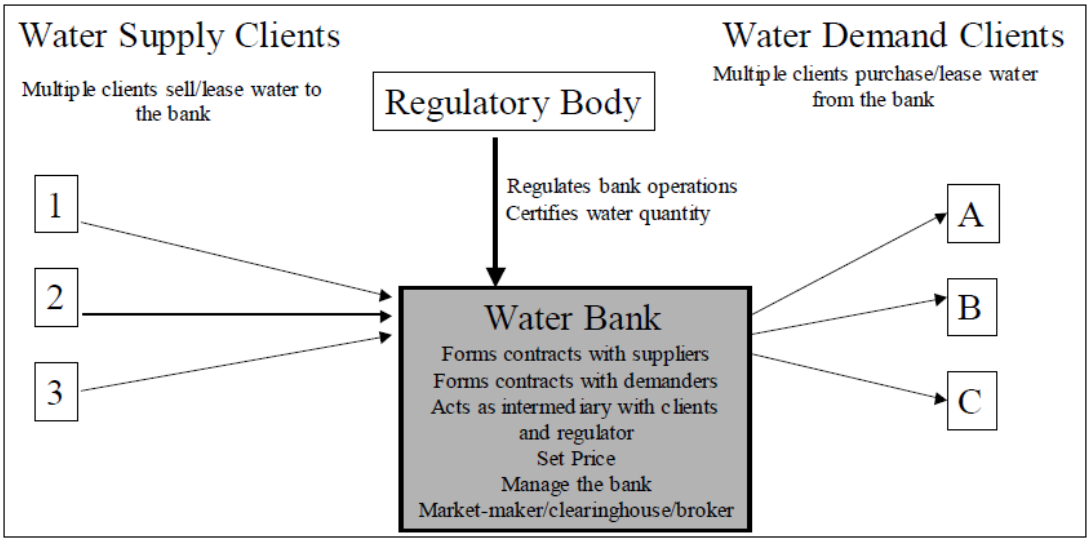
Water banking deserves special attention paid to the institutional innovation aspects it may introduce. Water banking for surface water has been applied for some time now, but its application to groundwater is more recent and innovative. For that reason, it is addressed in more detail below.

Water Banking: Water abstraction markets

As defined in WSDE (2004), water banking is *[a]n institutional mechanism that facilitates the legal transfer and market exchange of various types of surface, groundwater, and storage entitlements* where storage entitlements may adopt the form of water rights or other various forms of entitlements.

Water banks are brokering institutions and there is not a unique mechanism to implement them. Water banking accounts for different water management practices but all instances require an institution, which carries out the tasks of broker, clearinghouse, or market-maker[33] and has the following basic functions:

- **Brokers** connect or solicit buyers and sellers to create sales.
- **Clearinghouse** serves mainly as a repository for bid and offer information.
- **Market-maker** attempts to ensure that there are equal buyers to sellers in a market.



Water Bank conceptual model. Source: WSDE 2004.

In figure 10 we can see the conceptual model for water bank. One of the main goals of water banks is to act as a market mechanism to ease the exchange of water from low-valued uses to higher-valued ones. Additional goals also are:

- Creating reliability in water supply during dry years.
- Creating seasonal water reliability.

[33] http://www.ecy.wa.gov/programs/wr/market/waterbank.html

- Promoting water conservation by encouraging water-right holders to conserve and deposit water rights into the bank.
- Resolving issues of inequity between groundwater and surface-water users.
- Ensuring a future water supply for people, farms, and fish (WSDE 2004).

Trading markets are favoured over other alternative policies such as command and control practices because they rely on decentralised coordination and voluntary participation. Coordination is achieved through the transferable water right prices, which act as a signal for market participants.

Water trading regimes try to overcome the problem of water rights regimes based on queuing allocation, which leads to inefficient allocation of water resources as well as an inadequate allocation of water conservation technologies. Water rights trading improves global water allocation efficiency because those users who have water consumption marginal benefits per water right higher than costs, will be willing to purchase rights from those users who use water in a less efficient and productive way and who will find it more profitable to sell water rights titles than to use them for consumption. Reciprocally, those consumers who can invest in water saving technologies at lower cost, will find it more profitable to sell water rights and invest in water saving technologies to those consumers with higher costs for adopting water saving technologies, thus leading the market to an optimal allocation, which may be deemed as "Pareto efficient" (all water users receive the greatest possible benefit). In particular, through water trading, more water will be allocated to most valuable water.

An initial allocation of rights is needed and it is necessary to be aware of the fact that distribution of entitlements will probably be contentious.

When implementing water trading, a key question that emerges is **what rules and institutions are the most appropriate to address the transaction costs as well as the potential externalities** (third-party effects). Externalities need to be taken into account because the behaviour of upstream users can affect patterns such as salinity, pollution and other related quality aspects. Aspects such as minimum flows need to be taken into account because water availability may damage downstream wetlands on which many wildlife species depend. Additionally upstream usages such as hydroelectric power generation may condition the water availability, creating conflicts between farmers and power firms due to the fact that farmers may need water during the growing season while power firms prefer to release it in winter or summer time when electricity prices tend to be higher.

As a consequence, trading implementation should require prior research to understand the water framework and its reallocation impacts, which includes (Chong & Sunding, 2006):

- Assessing the potential impacts that water withdrawal may have on third parties (externalities) and envisioning the related compensation framework. This question is quite relevant for a successful implementation of trading and bargaining schemes, and may become especially significant on groundwater markets.
- An assessment of the trading regime in order to overcome the occurrence of trading barriers.

- Understanding the heterogeneity among regions in terms of cropping patterns; productivity differences due to factors such as climate, soil quality, precipitation occurrence etc.
- Assessing agriculture responses to water supply reductions such as the possibility to adopt new technologies, water conservation practices or changing crops (climatology differences among regions may impair the adoption of new farming practices). Mitigating and compensatory measures for investing in water saving technologies need to be balanced and impacts of water supply reductions need to be assessed against time, because impact changes with the time planning horizon (responses are much more limited in the short run).
- An assessment about the possibility to use other alternative water sources such as groundwater.
- Farmers' seasonal and permanent fallowing land practices.

Water banking may adopt multiple forms such as "*Callable water-use options*" that allow a city to lease water under drought conditions, "*Water leasebacks*", which are arrangements where a municipality purchases a water right and in nondrought years leases the water back to agricultural users, "*Water right priority exchanges*" which shift the water allocation queue in drought years; or "*Underground aquifers water banking*" which artificially stores water during wet years to be pumped out during dry years (Chong & Sunding 2006; Dinar & Ziberman 1991). But the most frequently mentioned one is "*Markets for surface water rights trading*", which implies the trading of entitlements for diverting water from a surface source such as a channel, a river or a reservoir.

An additional one of newer appearance which deserves to be mentioned and analysed is "*Markets for Groundwater Pumping Rights Trading*", an instrument which, by contrast, does not concede a right to divert water from a flow, but to pump it from the groundwater. Due to its relative novelty implementation, is will be analysed individually in the following.

Markets for Groundwater Pumping Rights Trading

Groundwater markets, unlike some markets for surface water, which involve the physical exchange of water itself, **just involve the right to extract** water from the subsoil (Skurray et al. 2012). Groundwater resources are an important source of water for agricultural and urban users, and represent about a quarter of freshwater withdrawals (Palazzo & Brozovic 2014). Historically, groundwater rights have been attached to land ownership with an unlimited right to pump water from the ground (Chong & Sunding 2006). However, this circumstance can lead to overexploitation of groundwater resources, which may affect negatively the status of the aquifer, not only in terms of accumulation levels but also in terms of quality. When net withdrawals from an aquifer are too high, water depletion levels may lead to increasing costs for pumping water (Skurray et al. 2012) or even to water exhaustion in neighbouring wells. Excessive groundwater extraction may lead, among others, to a drying out of wetlands and springs, a nearby streamflow reduction and declining of lake levels, loss of vegetation and groundwater dependent ecosystems, land subsidence (sinking of ground surfaces) and in coastal areas, to subsoil salt infiltration polluting the underground fresh water (Zektser et al. 2010; Kuwayamaa & Brozović 2013).

To mitigate these problems, groundwater trading may be an appropriate policy response to water scarcity and groundwater extraction, encouraging the efficient allocation of scarce water access between competing users (Skurray et al 2012).

The heterogeneous nature of many groundwater systems means that information and knowledge of the resource is an important pre-condition for trade in these systems. Impacts of the extraction at the new location of use may be quite different in scale, nature, and value from those occurring from extraction at the original place of use (Skurray et al. 2012). The following aspects should be considered:

- **Monitoring** of **aquifer water levels** is needed.
- **Well metering and reporting** must be implemented and enforced. If metering is not possible, an alternative might be to establish rights to irrigate units of land. In areas where reporting of meter data is voluntary and not subject to sanctions, there is little incentive to provide timely or accurate readings (Easter & Huang 2014).
- **Incorporating the relevant aquifer hydrology**. Groundwater trading schemes should be designed and managed with sensitivity to hydrological conditions, as well as to the evolving understanding and knowledge of those conditions. Uncertainty and delay in the environmental and social impacts of groundwater use require flexible and adaptable management regimes, rather than rigid policies based on inadequate hydrological information (Skurray et al 2012).
- **Estimating,** and when possible, **compensating the effects of extractions on ecosystems and human users** (externalities). Some third party effects such as neighbour's altered pumping costs as a result of a nearby pumping may be relatively simple to compensate economically (Skurray et al. 2012). Other negative externalities such as wildlife reduction may not be financially compensable, so command and control actions should be considered.
- I**dentifying and assessing the heterogeneous spatial distribution impacts for each water abstraction points** Impacts depend on the aquifer internal characteristics such as the transmissivity conditions and will vary with the location of groundwater extractions. In highly transmissive aquifers, pumping impacts may be transmitted widely and thus spatially equalised over a short time. Groundwater management policy (including the fundamentals of a trading scheme) should take into account these heterogeneous interactions. Impacts can gradually be equalized and dissipated by recharge and/or sub-surface flows (Skurray et al. 2012).
- When dealing with third effects (externalities) **spatially differentiated policies in opposition to common uniform ones** may yield significant cost savings. Trading schemes be designed in order to encourage trades that change the distribution of externalities through trading ratios. This way, it is possible to reduce externalities' magnitude and impact preventing or mitigating unwanted impacts (Kuwayamaa & Brozović, 2013).
- Defining appropriately the **hydrological boundaries of a trading area** which may be influenced by hydrogeological connectedness, groundwater flow, groundwater quality as well as other properties of the system (Skurray et al. 2012).

- Defining a **sustainable yield** and a **consumptive pool** as the amount of a "specified water resource" that can be made available for consumptive use in a sustainable way over time. Due to the water variability and according to the yearly water availability, it is necessary to define a constant proportional share of a variable quantity for each irrigation season (sustainable yield) in spite of setting a fixed quantity of water abstraction. (Vaughan, Emerson, 1997)
- Enabling **adaptive management** of water resources under fluctuating water availability. Water access entitlements should be assigned in accordance to yearly water availability fluctuations and in proportion to the share of the consumptive pool in a given year. (Skurray et al., 2012)
- Recognizing the environmental protection needs so as **identify the aquifer sustainable yield**.([Skurray et al., 2012)
- Identifying the **intertemporal effects** and **costs**. The time lags between cause and effect depend, among other hydrological factors, on the transmissivity of the particular aquifer, making it its prediction and management more difficult. Future groundwater stocks can be depleted by present-day over-use, but environmental impacts may not emerge immediately. Where the economic valuation of future impacts involves the use of discount rates, potentially temporally distant outcomes may be too undervalued to influence present-day decisions (depending, of course, on the discount rate chosen) (Skurray et al., 2012)
- Implementing **management for dealing with the extraction temporal and spatial impacts**.
- **Assessing the technical, social, and political impediments** which may impair the introduction of effective trading regimes (Skurray et al., 2012).
- **Assessing** the **legal and regulatory transaction costs** (financial and otherwise) which depend on the institutional context as well as the cultural environment. Brokerage, monitoring and enforcement costs may be high and if there is no formal market, search costs will be high, too (Palazzo & Brozovic, 2014)

In sum it can be held that there are more initiatives for integrated solutions for financing and for innovation. Public-Private-Partnership projects are increasing. In addition, BOT (build-operate-transfer) options are becoming the mainstream, as customers want the turnkey solution from a single contractor. Some water companies exist in the position to handle all aspects of a project: planning, design, financing, construction, and operation for a finite period.

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