Evaluating Economic Policy Instruments for Sustainable Water Management in Europe

Research agenda for the design and implementation of economic policy instruments

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Executive Summary

Water security features prominently among the grand challenges of humanity in a quest for sustainable future. The EU Member States, despite the sizeable improvements triggered by the Water Framework Directive (WFD, 2000/60/EC) and other environmental legislation, are off the track in achieving the ambitious EU water policy goals. Decades back, the European Union's policy makers have recognised the potential granted by economic incentives and/or disincentives for driving individual and business behaviour toward achieving sustainable development objectives, including protection of healthy environment and efficient use of water resources. Yet, the 2012 EU Water Policy Review (EC, 2012a, 2012b) has identified some but overall rather insufficient progress in the application of economic principles.

The EPI-WATER research project [FP7; *Evaluating Economic Policy Instrument for Sustainable Water Management in Europe*, January 2011 – December 2013], set out to review recent experiences with the application of *economic policy instruments* (EPIs) in Europe and beyond, and the potential role of EPIs in meeting the European water-related goals. The team produced a large body of evidence about the different types, design features and outcomes of water-related economic policy instruments in place; and the practice guiding their choice and implementation. Compared to other horizontal reviews of environmental EPIs in Europe, the EPI-WATER exclusive focus on water uses and services, and the breadth and depth of the analysis are unique both from the national and the international perspective. *Second*, and equally important, the ex-ante assessments drawing on a meticulous analysis of river basin-wide policy challenges and opportunities, pave the way for an improved regulatory impact assessment. *Third*, the EPI-WATER project energised academic and science-policy debates on the methodological and practical aspects of EPIs, and their role in meeting European water policy goals.

Since the late 2009, when the EPI-WATER project had been designed, the EU policy *environment* underwent some important changes. These changes have extended considerably the scope (breadth and depth) of the EPI evaluation to which the EPI-WATER project was ill-suited to fully respond. *First*, in March 2010, the European Commission (EC) disclosed the Strategy 2020 which includes the flagship initiative Resource-Efficient Europe. This initiative builds upon decoupling resource use from economic development, increasing water security, and promoting adaptation to likely impacts of climate change. The initiative also emphasises the role of economic policy instruments (EPIs) for the above goals, while using the generated revenues for reducing the tax burden on labour. *Second*, the late 2000s economic and financial crisis revealed the high exposure of the EU to economic shocks exacerbated by fiscal and 'other macro-economic imbalances'. The EC responded by promoting a better coordination, surveillance and enforcement of the EU and Members States' economic and fiscal policies. *Third*, in the late 2000s the EC intensified the efforts related to

better regulation. The key tools in the new approach includes an *ex-ante* and *ex-post* evaluation of the legislation, and a strategic assessment of the '*fitness for the purpose*'.

In this document we review the contemporary water research and innovation agenda in Europe, shaped by the Horizon 2020, the European Partnership for Innovation (EPI) on Water; and the Join Programming Initiative (JPI) on Water; and suggest priority areas for further research on EPIs. The proposed agenda refers to six thematic areas comprising the *variety of economic policy instruments and their interplay*; *synergies and dissonance between water, land and energy resources*; d*esign choices and trade-off between multiple goals*; *improving the economic and environmental knowledge base*; *framing the assessment*; and *regulatory and governance environment*.

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1 Introduction

Water *security* features prominently among the grand challenges of humanity in a quest for sustainable future (Bakker, 2012). Repeatedly, the World Economic Forum (WEF) has placed water *supply* crises, in the 2014 report reclassified from societal to environmental risks, among the global risks of highest concerns (WEF, 2014). In terms of potential impacts, water crises are second only to systemic financial/fiscal risks and, only in recent editions, to climate change. The inspirational report of the 2030 Water Resource Group (2009), echoed by other studies, estimated that under fairly conservative assumptions (average economic growth and no efficiency gains), global water demand could exceed the currently *accessible* and *reliable* water supply by 40 per cent by 2030. Worse, extreme weather and climate events connected to water risks, already classified among the most likely global risks by WEF, are likely to be further exacerbated by human-induced climate change (IPCC, 2012), threatening to undermine economic growth and development. Without a *step change* improvement in water resource management, informed by state-of-the-art science and driven by technological improvements, these challenges will not be effectively addressed (OECD, 2013).

The EU Member States, despite the sizeable improvements triggered by the *Water Framework Directive* (WFD, 2000/60/EC) and other environmental legislation, are off the track in achieving the ambitious EU water policy goals. At latest in 2012 it became apparent that the good ecological status would not be met as expected by 2015 for about a half of water bodies in Europe (EEA, 2012a). Next to eutrophication, for the most part caused by nutrients leaching from diffuse sources (EC, 2013a), morphological changes to the form and flow of natural bodies and quantitative status of water ecosystems rise concern (EC, 2012a; EEA, 2012a).

Failed water policy targets are not alone in the track record of the EU environmental underachievement. In 2010 the European Commission (EC) admitted that the biodiversity target (halting decline of biodiversity) has not been achieved as planned (EC, 2010a). Whereas nearly 18 percent of EU terrestrial environment, or 26.000 specific sites, have been designated to conserved under the NATURA 2000 network of the 1992 Habitats Directive (92/43/EEC), some 65 per cent of the analysed habitats and 52 per cent of assessed species are found in 'unfavourable' state of conservation (EEA, 2010). Major drivers of biodiversity loss include land consumption and habitat fragmentation, and unsustainable use of resources including water (*ibid*). The failure to recognise the economic value of the ecosystem services, including regulation of water flow and flood peaks, has contributed to the above negative environmental

status. Since 1950, some 50 per cent of wetlands in Europe were lost to development and agriculture (EC, 2006), while over the same time the land surface occupied by cities almost doubled (EEA, 2006). Urban sprawl and soil sealing have contributed to increased surface run-off and flood risk. During the recent decades, the average annual *direct* cost of floods have been estimated to amount to 3-4 billion Euro (Barredo, 2009; EEA, 2011) and *annual expected damage* (AED) to 5-6.4 billion Euro. These losses can increase by 7.7-15 billion Euro by the end of the century as a result of human induced climate change (Ciscar et al., 2011; Feyen et al., 2012).

Decades back, the European Union's policy makers have recognised the potential granted by economic incentives and/or disincentives for driving individual and business behaviour toward achieving sustainable development objectives, including protection of healthy environment and efficient use of natural resources. The 4th Environmental Action Programme (EAP) of the European Community (1982-86) (EC, 1987) addressed in detail instruments like taxes, charges, state aids, and tradable discharge permits; applied consistently with the *polluter pays* principle that became a cornerstone of European environmental policies in 1973 (Holzinger et al., 2006). The economic policy instruments (EPIs) permeated environmental (including inland and marine water) legislation, with varying success. Simultaneously, efforts have been made to detect and remove environmentally harmful subsidies (EHS; OECD, 2005; Withana et al., 2012). Amidst the *unprecedented* recent financial and economic crisis in Europe, efficient use of natural resources became an integral part of the EU 2020 Strategy, a part of which is a budgetary-neutral shift of the tax burden away from labour and capital to consumption, property and environment (EC, 2011a).

Yet, the 2012 EU Water Policy Review (EC, 2012a, 2012b) has identified some but insufficient progress in application of the economic principles (e.g. cost recovery, water pricing) and encouraged, cautiously, use of market mechanism (e.g. water right trading scheme) where this represent a value-added improvement. The Review lamented '*insufficient use of economic instruments*' (EC, 2012a, p. 8), limited application of '*incentive and transparent water pricing*' (ibid, p. 10), contributing indirectly to increasing magnitude of economic effects of extreme events (such as droughts and floods) (*ibid*, p. 13). Besides, the Review concluded that '*not putting a price on a scarce resource like water can be regarded as an environmentally-harmful subsidy*' (*ibid*, p.10).

2 EPI-WATER research endeavour

2.1 Project in brief

EPI-Water project[1] consortium responded to the 2010 call of the Seventh EU Framework Programme (FP7) for Research and Technology Development, *Cooperation* on *Environment (including climate change)*[2] programme (EC, 2009a), in quest of collecting supporting evidence for the '*current and future*' EU water policies. Implemented by eleven European research institutes[3], the project team set out to review the recent experiences with the application of economic policy instruments (EPIs) in Europe and beyond, and the potential role of EPIs in meeting the European water-related goals. For this purpose, the project analysed the *outcomes* of a large number of different EPIs and the *preconditions* that have to be fulfilled so that EPIs can either *complement* or perform *better* than other policy instruments.

First, the project team designed an *assessment framework* (AF), in order to ensure that all assessments are comparable in depth and breath, and follow the same assessment principles (Weikard and Zetland, 2013; Zetland et al., 2013, 2012, 2011). Policy instruments are typically analysed in terms of *environmental effectiveness* (i.e. capability to meet given environmental objectives or produce positive environmental outcomes), *economic efficiency* (i.e. extent to which the goals are achieved in an economic way), *distributional effects* (i.e. fairness and equity of cost and benefit sharing), and *institutional feasibility* (i.e. legitimacy and acceptance) (Gupta et al., 2007). The EPI-WATER's AF was designed with similar but more articulated scope. It compares the outcomes resulting from an EPI to the outcomes that would have resulted with from no action or an alternative policy intervention. The *outcome*-oriented criteria are discerned from *process* criteria, the latter describing the institutional conditions (legislative, political, cultural, etc.) affecting the formation and operation of EPIs, the transaction costs from implementing and enforcing the EPI, the process of implementing the EPI, and the impact of uncertainty on the EPI (Zetland et al., 2013).

Second, the team conducted an in-depth review of empirical evidence, experiences and lessons learned from the practical application of economic instruments for water management in Europe and in the overseas countries (e.g. Australia, Chile, Israel, United States, and China). The latter were chosen to address instruments not experimented with in the EU and/or as a way of transferring knowledge from

[1] EPI-WATER: Evaluating Economic Policy Instrument for Sustainable Water Management in Europe [January 2011 – December 2013].

[2] Topic ENV.2010.2.1.2-1 Evaluation of effectiveness of economic instruments in integrated water policy.

[3] *Fondazione Eni Enrico Mattei*, Italy; *ACTeON* sarl, France; *Ecologic Institut* GmbH, Germany; *University of Bologna*, Italy; *Wageningen University*, The Netherlands; *National Technical University of Athens*, Greece; *Madrid Institute for Advanced Studies in Water*, Spain; *University of Valencia*, Spain; *Middlesex University, Flood Hazard Research Centre*, United Kingdom; *Aarhus Univerisitet*, Denmark; and *Budapesti Corvinus Egyetem - Regional Centre for Energy Policy Research*, Hungary.

countries with substantial experience in the field of policy innovation. The review examined 30 EPIs in an *ex-post* mode, covering a range of different instruments operating under different environmental and socio-economic conditions (Ancev, 2011; Branth Pedersen et al., 2011; Defrance, 2011; Dinar, 2011; Donoso Harris, 2011; Dworak, 2011; Gómez et al., 2011a, 2011b; Hernández-Sancho et al., 2011; Hernández-Sancho, F. Molinos-Senante and Sala-Garrido, 2011b, 2011a; Howe, 2011; Kan and Kislev, 2011; Kieser and McCarthy, 2011; Kossida and Tekidou, 2011; Kousky, 2011; Mattheiß, 2011; Möller-Gulland and Lago, 2011; Möller-Gulland et al., 2011; Mysiak et al., 2011a, 2011b; Rákosi et al., 2011; Sardonini et al., 2011; Schuerhoff et al., 2011; Ungvári et al., 2011; Viavattene et al., 2011; Yang, 2011; Yates, 2011; Young, 2011; Zetland and Weikard, 2011).

Third, the team performed ex-ante assessment of several economic instruments (compensation payments for flood storage on agricultural land, nitrate tax, water pricing and insurance, water trading and payments for ecosystem services), the application of which was simulated to address different policy challenges (floods, droughts, water quality, or ecosystem services and biodiversity conservation) in five representative river basins (districts) across Europe (Tisza, Tagus/Segura, Seine-Normandie, Odense and Pinios). The comparative strengths, downsides, and potential side effects of the instruments were analysed in depth. The analysis resulted in five comprehensive reports (Defrance et al., 2013; Delvaux et al., 2013; Gómez et al., 2013; Kossida et al., 2013; Skou Andersen et al., 2013; Ungvári et al., 2013). Each ex-ante case study analysed the environmental challenges in the respective river basin area in a holistic way and proposed a reform of the existing interplay of the policy instruments.

Fourth, a set of synthesis reports of which this document is a part summarise the research findings (Delacamara et al., 2013; Møller et al., 2013; Mysiak, 2013; Mysiak et al., 2013b). *Mysiak et al*. (2013) synthetized the design choices, pre-requisites, and potential environmental and economic outcomes of incentive water pricing and trading, (nitrate) pollution tax, payments for ecosystem services, water emission trading and transient flood storage; and discussed the role of environmental taxation and tradable environmental permits in Europe. Furthermore, they addressed issues relevant for choosing an EPI or building a policy portfolio; matching the chosen instrument to the existing institutional framework and the opportunity for change; and ensuring that the EPI contributes to the integration of water and other sectoral policies, or does not produce negative side-effects to these sectors. *Delacamara et al*. (2013) propose a *Guidance* developed to take stock of existing experiences in order to support the further use of EPIs. It aims at supporting decision-makers and experts in the development and implementation of EPIs in water management. *Møller et al*., 2013 pay attention on the use of *national accounts* to support design, monitoring and evaluation of EPIs. They show how a national water resource accounting system can be drawn up, and discuss how the accounting system can be used in supporting policy making.

The consortium liaised with several European funded project addressing EPIs in water, biodiversity and energy fields, namely POLICY MIX (FP7, *Assessing the role of economic instruments in policy mixes for biodiversity conservation and ecosystem services provision*; policymix.nina.no), ENTRACTE (FP7, *Assessment and further development of the European climate policy*, entracte-project.eu), Water Cap & Trade (IWRM-NET, *Water Market scenarios for Southern Europe: new solutions for dealing with water scarcity and drought risk*), THESEUS (FP7, *Innovative technologies for safer European coasts in a changing climate*, www.theseusproject.eu) and GENESIS (FP7, *Groundwater and Dependent Ecosystems: New Scientific and Technological Basis for Assessing Climate Change and Land-use Impacts on Groundwater*, www.thegenesisproject.eu).

2.2 Project's achievements

First and foremost, the EPI-WATER team produced a large body of evidence about the different types, design features and outcomes of water-related economic policy instruments in place; and the practice guiding their choice and implementation. The assessment exercise is one of a few comprehensive and consistent (e.g. employing the same assessment principles) ex-post reviews of EPIs in water resource domain in Europe, and in many cases the first one to have shed light on the use of particular instances of economic instruments across the EU Member States. The project's main reports alone, without counting the ancillary knowledge contained in the supplementary material, comprise more than 2,000 pages. The collected knowledge has informed several major synthesis and advocacy reports in Europe (CEPS, 2012; EEA, 2013, 2012a, 2012b; OECD, 2013; Strosser et al., 2012) and provided timely input for the 2012 EU Water Policy Review (EC, 2012a).

Compared to other horizontal reviews of environmental EPIs in Europe (Bogaert et al., 2012; Bräuninger et al., 2011; Rademaekers et al., n.d.), the EPI-WATER exclusive focus on water uses and services, and the breadth and depth of the analysis are unique both from the national and the international perspective. Some of the EPIs analysed have been repealed, modified or replaced, or plans have been declared to do so, during or shortly after the assessment exercise was completed. The Dutch national groundwater tax (GWT) (Schuerhoff et al., 2013, 2011) and tradable renewable energy certificates (RES) in Italy (Mysiak et al., 2011a) are case in point. The GWT has been revoked for '*for being fiscally inefficient and environmentally unhelpful*' (Schuerhoff et al., 2013) while the Italian RES scheme has been phased out and replaced by feed-in tariffs and reverse auction mechanism after the market with green certificates literally stagnated and government intervened through floor prices which substantially increased the costs of the schemes, eventually paid by consumers. The frequent policy changes make difficult the maintenance of EPIs inventories such as the OECD/EEA database on instruments used for environmental policy and natural resources management[4] and the EC's DG TAXUD database[5]. The

[4] http://www2.oecd.org/ecoinst/queries/

[5] European Commission -Taxes in Europe Database, ec.europa.eu/taxation_customs/tedb/

EPI-WATER efforts hence helped to improve and keep updated the existing knowledge base.

Second, and equally important, the ex-ante assessments drawing on a meticulous analysis of river basin-wide policy challenges and opportunities, pave the way for an improved regulatory impact assessment and serve as pilot studies for the assessment of programmes of measures (PoM) compelled by WFD. Anticipating the enhanced guidance of European Commission on economic matters and assessment of policy intervention (EC, 2012a), the team has produced (and tested in practice) policy guidelines (Delacamara et al., 2013; Zetland et al., 2013) that have been brought into the attention of the EU Water Directors through the *Common Implementation Strategy* (CIS). Targeted briefing events were conducted at the *Organisation for Economic Co-operation and Development* (OECD) and the *European Commission* (EC), and additional events are planned at the *Food and Agriculture Organization* of the United Nations (FAO) and the *European Environmental Agency* (EEA). Besides, the EPI-WATER team has analysed and demonstrated advantages of combining the complementary strengths of several EPIs in a policy mix addressing water scarcity and droughts (Gómez et al., 2013) and flood risk reduction (Mysiak et al., 2013a; Ungvári et al., 2013).

Third, the EPI-WATER project energised academic and science-policy debates on the methodological and practical aspects of EPIs, and their role in meeting European water policy goals. Throughout the life-span of the project, the team has organised several major conferences (Berlin, January 2012[6]; Alcalá de Henares-Madrid, February 2013[7], Venice, November 2013[8]), targeted workshops[9], summer school[10], and numerous other dissemination events[11].

On the downside, the research efforts towards producing regional recommendations or classifying areas in which a particular type of EPIs may be preferable used has not led to satisfactory results. The reasons for this are manifold: *Firstly*, whereas the types and magnitudes of current and future water-related risks (e.g. water quality impairments, water stress, flood risk) across European river basin districts are known to some extent; the (marginal) value of water, pollution abatement, and risk reduction costs are not adequately determined. *Secondly*, the institutional feasibility

[6] *Understanding the application* of Economic Policy Instruments in water management (Berlin, January 26-27, 2012), http://www.feem-project.net/epiwater/pages/events/120126/

[7] *Anticipating the performance* of Economic Policy Instruments in water management (Alcalá de Henares - Madrid, February 6-7, 2013); http://www.feem-project.net/epiwater/pages/events/130206/

[8] *Paving the way for a better application* of economic policy instruments for water resources mana-gement (Venice, November 28-29, 2013) http://www.feem-project.net/epiwater/pages/events/131128/

[9] Economic instruments for water management: *Responding to expectations and supporting environmental policy objectives* (Strasbourg, December 17-18, 2013; Pricing Water – towards an effective, efficient and socially fair pricing schemes and financing arrangements (Venice, June 8, 2012), and many others.

[10] Belpasso International Summer School on Environmental and Resource Economics: *Financing Disaster Risk Reduction and Climate Adaptation* (Belpasso, September 1-7, 2013), http://www.biss2013.it/

[11] See also http://www.feem-project.net/epiwater/pages/events_past.html

of specific EPIs depends from a host of supportive (enabling) conditions the sheer amplitude of which makes it impractical for systematic collection. *Thirdly*, the choice of a particular course of action or a combination of policy instruments is not determined by scientific and economic rationales alone. The analysis need to take into account processes by which policies are formulated and changed. Rather than being a mere alternatives to coercive regulatory instruments, the EPIs are entrenched in the institutional and regulatory frameworks, including but not limited to resource, property and liability regimes. Similarly, the choice of EPIs as a means of meeting water policy goals may not be entirely independent from the processes of setting that goals (Tietenberg, 2002).

3 EPI research agenda beyond the EPI-WATER project

3.1 Changing policy environment

Since the late 2009, when the EPI-WATER project had been designed, the EU policy *environment* underwent some important changes. These changes have extended considerably the scope (breadth and depth) of the EPI evaluation to which the EPI-WATER project was ill-suited to fully respond.

First, in March 2010, the *European Commission* (EC) disclosed the **Strategy 2020**, a decadal plan expected to put the EU on the pathway of '*smart, sustainable and inclusive economy delivering high levels of employment, productivity and social cohesion*' (EC, 2010b). The Strategy 2020, initiated not at least as a way out of the *unprecedented* (EC, 2009b) economic crises the EU faced since the summer 2007, embraces a clear commitment to *smart*, *green* and *inclusive* growth, based on knowledge and innovation; efficient resource use; high employment and cohesion, both social and territorial. The Strategy sets bold goals including the so-called 20/20/20[12] climate/energy targets and the 75 per cent employment target (population aged 20-64), while reiterating other commitments such as the target of investing 3 per cent of the EU's GDP in research and development. The Strategy comprises seven flagship initiatives including the *innovation union* and *resource-efficient Europe*. The latter was further explicated early in 2011 (EC, 2011a, 2011b) as a way to decouple resource use from economic development through technological innovation, improved management of natural resources (including water), and changes of consumption pattern. At the same time, the flagship initiative *resource efficient Europe* is expected to increase security of supply of main resources and help to tackle the impacts of climate change. With other words, the initiative reiterated the commitment to protect water resources throughout the European Union and beyond, while creating enabling conditions for *green(er)* growth. The initiative also emphasised the role of economic policy instruments (such as environmental related taxes) for the above goals, while using

[12] 20 per cent reduction of greenhouse gas emissions compared to 1990 levels, 20 per cent energy produced from renewable sources, and 20 per cent increase in energy efficiency.

the generated revenues for reducing the tax burden on labour. In doing so, the EC reaffirmed its earlier calls for a budgetary-neutral shift of the tax burden away from labour and capital to consumption, property and environment. The *environmental tax reform* (ETR) is expected to benefit job creation and economic growth. The ETR was outlined as early as in 1993 in the *White Paper on Growth, competitiveness, employment* (EC, 1993) and further reiterated in a number of occasions (EC, 2005a, 2005b), including the *Green paper on market-based instruments for environment and related policy purposes* (EC, 2007). The stated goal of the 2020 *resource efficiency roadmap* (EC, 2011b) includes '*a major shift*' away from labour to environmental taxation and '*a substantial increase*' of the share of public revenues from environmental taxes.

Second, the late 2000s economic and financial crisis revealed the high exposure of the EU to economic shocks exacerbated by fiscal and 'other macro-economic imbalances'. The EC responded by promoting a better coordination, surveillance and enforcement of the EU and Members States' economic and fiscal policies (EC, 2010c). The *European semester* (ES) is among the new instruments adopted in 2010 to this end. The ES stands for an improved *ex-ante* review and coordination of economic and budgetary policies along the agreed principles of the Strategy 2020 and the EU framework for coordination of national fiscal policies - the *Stability and Growth Pact* (SGP). Following the publication of the annual economic survey by the EC at the beginning of each year, the Member States (MS) submit reports displaying their current public financial situation (*Stability or Convergence Programmes* SCPs) and outlining measures they intend to apply to sustain growth and employment along the Europe 2020 strategy (*National Reform Programmes* NRPs). The *Commission* reviews both reports until June and offers country-specific recommendation and guidance. The *European Semester* is followed by *national* semester during which the MS translate the EU guidance into current-year public budget and policy making, and prepare the next year's reports. The first cycle of the ES was completed in 2011 (EC, 2011c). Whereas the ES is an opportunity to promote environmental tax reform, the reform of water policy has been rarely addressed. Withana et al. (2013) analysed the extent to which the *European Semester* stimulated changes in environmental policies and found *little* emphasis on other than energy and climate policies. The 2012 *Tax Reform report* (EC, 2012c) stresses the scope of an improved environmental taxation in about a third of the EU MSs. Taxes should play a role where the existing policies are not sufficient to ensure that the agreed environmental objectives are met. However, the taxes are also recognised as an instrument for fiscal consolidation. Hereafter the environmental taxes should be designed so as to provide appropriate incentives to reducing emissions and increase resource efficiency, through broadening the tax base and tax indexing (e.g. adjusting for inflation).

Third, in the late 2000s the EC intensified the efforts related to *better regulation*. A step-change of policy practice towards a *smart* regulation ('*getting legislation right*') was outlined in the 2010 Communication (EC, 2010d), building upon the principles of *whole policy cycle* analysis (including design, implementation, enforcement, evaluation and revision), *shared responsibility* (of EU and MS institutions), and making

policy efforts *accountable to those mostly affected*. The key tools in the new approach includes an *ex-post* evaluation of the legislation (*ex-ante* impact assessment was established in 2003; EC, 2005c) and a strategic assessment of the '*fitness for the purpose*' (fitness check, FC). Conducted for a set of pilot studies including water legislation (EC, 2012b) between 2010 and 2012, the FC addressed the regulatory burdens, gaps and overlaps, as well as inconsistencies and/or obsolete provision, while contributing to the assessment of the cumulative impact of a legislation. Based on the collected experiences, the EC has launched the *Regulatory Fitness and Performance Programme* (REFIT) focusing on simplifying existing legislation and '*reducing the regulatory cost for businesses and citizens without compromising public policy*' (EC, 2012d).

3.2 Future research agenda – towards a better informed policy analysis and decision making

Variety of economic policy instruments and their interplay

The EPI-WATER team analysed a vast array of economic policy instruments, but by far not all instruments that hold promise for better management of water resources and water-related risks. By choosing to concentrate on water tariffs and prices; resource, product and emission taxes; tradable environmental permits/entitlements; subsidies; cooperative agreements and payments for ecosystem services; the team attended to the essential water policy challenges in Europe. *Future research* should extend the sheer range of the instruments analysed, while paying attention to their synergies and interplay. From among the instruments not addressed in the project, or not to the degree needed, those which warrant greater attention include risk sharing and transfer schemes, green public procurement and concessions, public private partnerships, and land taxes/tradable development rights (TDR).

The 2013 EC *Green Paper* (GP) *on the Insurance of Natural and Man-made Disasters* (EC, 2013b) examined the scope for improving market conditions for insurers in the EU. Acknowledging the scarce market penetration rates and coverage, the GP questioned the EU and MS roles in conquering market barriers which limit the services provided by private sector. Likewise, the 2014-2020 Common Agriculture Policy (CAP) regulation promotes farm risk management though insurance schemes, mutual funds, and income stabilisation under the Rural Development Plan. This is in line with the EPI-WATER research that showed how a skilled combination of water pricing, agricultural insurance schemes and tradable water entitlements can improve water security (Gómez et al., 2013).

Though flood insurance has not been dealt with by the project team, it plays an important role in a policy mix designed to curb land consumption and soil sealing (through land taxes and TDR), encourage natural water retention and/or transient flood storage, and tackle residual risk (low-probability, high impact events) through risk sharing and transfer. Risk information disclosure affecting property prices may yield supplementary benefits.

Not only additional and complementary instruments warrant attention. Some of the instruments analysed in depth by the EPI-WATER team, such as tradable water entitlements and emission permits, merit further scrutiny through *controlled policy trials*. By confronting the theoretical aspects and practical experiences from overseas with policy reality in Europe, in a number of pilot river basins, policy trials would better inform the planned UK reform on water abstraction licences and the Scandinavian (Baltic Sea) schemes of water emission trading (see also Mysiak et al., 2013b).

Synergies and dissonance between water, land and energy resources

Water security, *energy* security, and *food* security are intimately connected, and inappropriate use of policy instruments, economic or regulatory ones, in one area may exacerbate the risks in the other areas. Several European and national projects have made complementary efforts recently in analysing the performance and comparative strengths of the EPIs, having similar scope but responding to different environmental concerns. Building upon their results, there is a case for a coordination action aimed at comparing the recent progress made and making possible a transfer of knowledge form different environmental policy fields including water, energy, land, and agriculture.

Many of the instruments analysed by the EPI-WATER team singled out agriculture, or agricultural land management, as having a large potential for sizeable water efficiency gains, pollution control, and flood damage reduction. These gains need to be wisely weighed against food security and prices; income and social protection of rural communities. With growing acquaintance with and emerging acceptance of the EPIs, the attention should be shifted to a better appreciation of both ancillary and harmful side-effects across policy domains.

Not only recent floods have demonstrated the ambivalent role of agriculture in altering surface water run-off. Ill-targeted agricultural subsidies, either not sufficient to steer intended behavioural change, or worse, rewarding soil management practices with detrimental impacts on flood risk, soil erosion, and pollution load should be identified and ended. On opposite side, farm income stabilisation instruments and payments for genuine ecosystem services should be targeted so as to reduce and halt land abandonment where this is associated with biodiversity losses and increased risk.

Similarly, the EPIs fostering development of renewable energy sources (RES) such as biofuels and hydroelectricity exercise additional pressure on water resources which have to be better understood. Arguably, biofuel policies have provided incentives for increased water abstraction, extending farming on marginal lands and occasionally withdrawing land from the existing nature conservation programmes. Much of the recent upward food price trend have been attributed to large-scale biofuel production. On opposite side, the EPI-WATER research has shown that incentives for RES can in principle be reconciled with good ecological status of water bodies.

Design choices and trade-off between multiple goals

The EPIs in the meaning used in the EU policy documents are designed to serve *multiple* goals, including (more) efficient use of resources, with implicit effect on innovation; re-allocation of resources to higher value uses; reduction of policy compliance costs; costs recovery and hence financial viability of water services provision; fiscal transformation; and shifting risk to entities best suited for coping with it. Attempts to satisfying multiple goals with single instrument often results in reduced efficiency gains. Not only, design features of EPIs are bowed so as to gain acceptance and respond to concerns of regulated entities or public resentment. To make EPIs politically palatable, policy makers often react by narrowing the tax base, introducing tax relief incentives, or allocating initially the environmental permits or entitlements free of charge. As a result, the actual outcomes of the EPIs differ from text-book theory. Yet, the multiple expectations and interests to which the design choices have to respond compromise the EPI outcomes, while trading off economic efficiency against applicability. Further research should shed light on the acceptance gains and efficiency losses of alternative EPIs designs, choices between revenue restitution and recycling, complementarity of policy goals, and policy processes that favour broader acceptance of EPIs.

Improving the economic and environmental knowledge base

Regulatory impact assessment for water resource and risk management require good, if not thorough, understanding of natural and social systems in which the economic instruments are to operate, as well as of the processes that shape those systems. Economic analysis hence build upon a pre-existing body of knowledge, the gaps in which pose limits, often unsurmountable, to policy assessment. The economic analysis underpinning the EPI assessment will benefit from advanced research in other disciplines on ecological and hydrological integrity; pollutant dispersion, transfer and natural removal; (altering) pattern of water availability and climate variability; to mention but a few areas.

The EPI-WATER assessment exercise has shown the uneven quality of knowledge readily available or accessible to demonstrate the environmental and social outcomes of the revisited EPIs. Frequently, the environmental performance was masked by temporal conditions such as droughts, or compound effects of other policies, or did not yet fully materialised at the time of assessment. Worse, the outcomes of the EPIs were neither analysed beforehand nor critically reviewed in hindsight. We have shown the counter-productive outcomes of EPIs that neglected some important environmental factors. For example the tradable water entitlement schemes the design of which neglected the return water flow (Young, 2011) lead to water over-allocation, subsequently corrected by costly bay-back schemes.

Sound economic analysis on its own necessitates an adequate understanding of how the regulated entities will or could respond to the incentives imbedded in the EPI. Depending from the instrument, this may entail ***elasticity of the response*** (e.g. price or income elasticity of residential water demand), which in turn may depend on

additional factors (such as age and income distribution); ***costs related to reduced*** use of water and water polluting substances, through changing practices and technologies; ***production value*** of water; or ***avoided damage*** of extreme climate and weather events. The latter is notoriously under-researched area not only in Europe. Besides, and echoing the calls made by others, proper accounting and valuing ecosystem services impaired by water emissions or excessive abstraction is indispensable for a sound economic and policy analysis.

Framing the assessment

Good policy analysis and decision making are informed, but not solely determined, by scientific and economic knowledge. Rather than arguing for the larger use of some particular EPIs, we argue for a thoughtful policy analysis capable to single out credible and viable solutions to the water management challenges faced. Cost benefit analysis (CBA) is an essential tool to inform public policy choices. A thoughtful policy assessment ought to examine all practical options and compare their performance. The EPI-WATER Assessment Framework (AF) embraced *process-oriented criteria* (such as institutional fit and policy feasibility) in addition to the economic, environmental and distributional outcomes. The AF shows the way but provides no definite recipes. Further research should promote techniques and methods that better estimate and reconcile the variety of views upon aspects that are relevant for choosing and adopting of EPIs.

The recent policy developments outlined in the section 3.1 compel additional criteria that we touched upon but not covered in depth in the EPI-WATER project. These include for instance the potential of EPIs to spur innovation, technology diffusion and spill-over, impact on employment and skill creation, and so on. Research and extended public dialog are also necessary on disputed themes beyond science but relevant for policy and decision making, for instance actuarial fairness and social justice/equity, solidarity, risk liability and accountability. The culture of evidence-based policy assessment and 'smart' regulation has yet to be endorsed and translated into practice. Research on best practices on regulatory impact assessment, promoted by OECD and the EC, and their actual implementation ought to be monitored critically reviewed regularly.

Regulatory and governance environment

The familiar split-up between *regulatory* (i.e. coercive and inflexible) and *economic* (i.e. incentive and flexible) policy instruments does not mean that EPIs work outside of a regulatory framework. In contrary, public regulation pervades the specification of EPIs. Due to the natural monopoly set-up of water supply and sanitation, price caps and adjustment, and the rate of return on invested capital are closely regulated. Liability and solvency of insurer is regulated by apposite rules. Tradable environmental permits operate within boundaries determined by environmental goals and trade rules which make them look closer to regulations than economic instruments. In addition, to live up to their expectation, the EPIs require regulatory discipline, monitoring and enforcement. EPIs are ingrained in a regulatory and

governance framework, and setting a goal is often not entirely independent of choosing how to meet it. The successful instances of EPIs show a familiar pattern of matching between the incentives offered and the regulatory framework. Further research should shed light on the variety of resource, property and liability regimes across Europe; the ways they evolved and persisted over time; as well as reform needed to meet the contemporary water policy challenges.

4 European water research funding

The contemporary water research and innovation in Europe is shaped to a large extent by three initiatives: the *Horizon 2020 - The Framework Programme for Research and Innovation*, the EU flagship in terms of basic and applied research funding; the *European Partnership for Innovation (EIP) on Water*; and the *Join Programming Initiative (JPI) on Water*.

4.1 Horizon 2020 - The Framework Programme for Research and Innovation (2014-2020)

In 2011, the European Commission proposed a single framework for European Union's Research and Innovation, the *Horizon 2020* (EC, 2011d). The new Framework is tied up to addressing societal challenges identified in the EU 2020 Strategy and contributing to the EU industrial leadership. To this purpose, the Framework pulls together the European Union's *Framework Programme for Research and Technical Developm*ent[13] with the *Competitiveness and Innovation Framework Programme* (CIP) (EP and EC, 2006) and the *European Institute of Innovation and Technology* EIT (EP and EC, 2008). The final budget of the Horizon 2020 agreed upon in 2013 amounts to 70.2 billion Euro (in 2011 prices), below the proposed 80 billion, but substantially higher than the budget of the previous 7th Framework Programme (FP7).

The Horizon 2020 consists of seven pillars: *Excellent Science* which embodies among other the European Research Council (ERC); *Industrial Leadership*; *Societal Challenges*; *Spreading Excellence and Widening Participation*; *Science with and for Society*; *European Institute of Innovation and Technology* (EIT); and *EURATOM*. Environmental and water related challenges are primarily covered in the sub-programme *Societal Challenges* (SC), although arguably transversal to the whole Horizon 2020. The Societal Challenges drives the focus on the issues of primary importance including SC1 *Health, demographic change and wellbeing*; SC2 *Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the bioeconomy*; SC3 *Secure, clean and efficient energy*; SC4 *Smart, green and integrated transport*; SC5 *Climate action, environment, resource efficiency and raw materials*; SC6 *Europe in a changing world -*

[13] Mandated by The Treaty on the Functioning of the European Union, Title XIX Research And Technological Development And Space, articles 179-190.

inclusive, innovative and reflective societies; and SC7 *Secure societies - protecting freedom and security of Europe and its citizens*.

Similar to the previous Framework Programmes (FPs)[14], water-related research is addressed in several sub-programme areas, namely SC2, SC5 and SC7.

The SC2 *Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the bioeconomy* (EC, 2013c) is composed by three calls addressing *food security*, *blue growth*, and *bioeconomy*. Food security is closely related to water resource use and conservation (SFS-8-2014/2015: *Resource-efficient eco-innovative food production*), curbing agricultural pollution (call SFS-2-2014/2015: *Sustainable crop production*), and soil protection (SFS-4-2014: *Soil quality and function*) Blue growth focusses on the protection and exploitation resources generated by oceans, seas and coasts. Bioeconomy addresses the priorities outlined in EC (2012e) and related to utilisation of biological resources (especially in rural areas), and boosting innovation in the bio-based industry.

The SC5 *Climate action, environment, resource efficiency and raw materials* sets to contribute to the resource (including water) efficiency, climate change resilient economy and society, the protection and sustainable management of natural resources and ecosystems, and a sustainable supply and use of raw materials (EC, 2013d). The three major topic areas include i) ***Waste***: *A Resource to Recycle, Reuse and Recover Raw Materials*; ii) ***Water Innovation***: *Boosting its value for Europe*; and iii) *Growing a Low Carbon, Resource Efficient Economy with a Sustainable Supply of Raw Materials*. The Water Innovation topic area offers numerous opportunities for a targeted research on EPIs. The call area WATER-1-2014/2015: *Bridging the gap: from innovative water solutions to market replication* establishes a link to the European Innovation Partnership (EIP) on Water (see section 4.2). The topic WATER-2-2014/2015: *Integrated approaches to water and climate change* is concerned with development of risk management strategies and adaptation options for extreme weather and other climate change-related threats, an area of a primary focus of the EPI-WATER project, and improving the scientific understanding of the land-water-energy-climate nexus. Other research priorities include resource efficient land use, agricultural productivity improvements, sustainable water management, and interactions with the existing regulatory frameworks and the potential barriers to implementation. The topic WATER-3-2014/2015: *Stepping up EU research and innovation cooperation in the water area* establishes a link to the Join Programming Initiative on Water (JPI Water) (see section 4.3). The topic WATER-4-2014/2015: *Harnessing EU water research and innovation results for industry, agriculture, policy*

[14] Under the FP5 (1998-2002), water research was mainly concentrated under the key action Sustainable management and quality of water; the FP6 (2002-2006) focussed more on better understanding of the implications of global change on water resources, while ensuring support to the WFD implementation under the sub-programme *Specific support for policies*. Several European Research Area Networks (ERA-Net) were established with specific focus on water related risks (e.g. CRUE-Net and IWRM-Net). The FP7 extended the support to the EU Water Policies implementation, disaster risk reduction and climate adaptation, while partially shifting the focus on eco-innovation and water resource efficiency (see also (EC, 2011e).

makers and citizens focusses among other on the innovative financial instruments boosting the effective use and market exploitation of water research results. Finally, the topic WATER-5-2014/2015: *Strengthening international R&I cooperation in the field of water* offers numerous opportunities for exploring transversal issues related to water supply and sanitation (WSS).

The SC7 *Secure societies* offers additional opportunities for the research on economic policy instruments (EPIs), especially the call related to *Disaster resilience and climate change* and protection of *critical infrastructures* (EC, 2013e). It focusses on developing new ways of coping with risk posed by extreme climate and weather events under changing climate (especially DRS-9-2014/2015: *Science and innovation for adaptation to climate change*; and DRS-10-2015: Natural Hazards: *Towards risk reduction science and innovation plans at national and European level*)

4.2 European Innovation Partnership on Water

The European Innovation Partnerships (EIPs), established under the Europe 2020 "Innovation Union" flagship initiative, are expected to close the gaps between the research and marketable exploitation, and speed up innovation in Europe. EIPs are "*means to pool expertise and resources on key political priorities by mobilising and linking up all relevant stakeholders across policies, sectors and borders*" (EC, 2012). Responding to the European Council's request, the European Commission laid out in 2012 the plan and priorities for the EIP on Water (*ibid*). The strategic objectives of EIP Water include i) provision of safe, available (*sic*) and affordable water for all, while ensuring sufficient water for the environment; ii) mastering a relative decoupling of the depletion of water resources from the level of economic activity in key EU sectors; and iii) (*contributing to*) maintaining and enhancing the good status of waters in all EU river basins – in terms of quality, quantity and use, and in the context of increasing pressures on water resources. The scope of the EIP on Water is to foster innovative solutions, in order to boost European competitiveness and to help achieving EU water policy goals quicker. The EIP Water operates within the context of the Water Framework Directive (WFD) and the Resource Efficiency Roadmap (EC, 2011b). The strategic programme is split into three *work packages*: urban water management, rural water management, and industrial water management (EC, 2012f).

Throughout 2012 and 2013, the EIP has become operational. The Strategic Implementation Plan (EIP Water, 2012) has identified five priority areas: i) *water reuse and recycling*; ii) *water and wastewater treatment*, including recovery of resources; iii) *water-energy nexus*; iv) *flood and drought risk management*; and v) *ecosystem services*; and, in addition, three cross-cutting priorities vi) *water governance*; vii) *decision support systems and monitoring*; and viii) *financing for innovation*.

The first call for Action Groups published early in 2013 led to selection of nine most promising and developed partnerships, including the Action Group SPADIS: *Smart Prices and Drought Insurance Schemes in Mediterranean Countries*, led by the EPI-WATER consortium member Carlos Mario Gómez from the University of Alcalá de

Henares and the Madrid Institute for Advanced Studies in Water. The second call closed in January 2014.

Some 40 million Euro has been mobilised in 2013 to support the activity of the EIP on Water, primarily from the 7th Framework Programme (FP7) for Research and Technical Development (RTD) through specific calls dedicated to the aims of the EIP Water. The funding of EIP on Water draws on the Horizon 2020 (see section 4.1) WATER-1-2014/2015: *Bridging the gap: from innovative water solutions to market replication*.

The priority areas of the EIP on Water offer multiple opportunities for development, testing and application of EPIs for exploiting alternative water supply sources and recovery of resources, water loss and pollution control, risk (stemming from extreme climate and weather) management and prevention, protection and management of ecosystem services; public-private partnership, and innovative water pricing.

4.3 Joint Programme Initiative on Water

Even before the recent consolidation of different research and innovation programmes under the Horizon 2020, the *European Framework Programme for Research and Technical Developmen*t (RTD) was the largest single research programme in the world. Yet the research expenditure of the individual European Union's Member States (MS), taken together, dwarfs the EU research spending. Consequently, whereas the EU RTD invested annually in water related research projects 130 million Euro on average, the annual investment made by MS has been estimated to 370 million Euro (EC, 2011e). To tackle the fragmentation of research opportunities and ineffectiveness of research spending in the EU, and building upon the positive outcomes of the ERA-Net schemes introduced under the FP6, the coordination of national and regional programmes is fostered though the *Joint Programming Initiatives* (JPIs).

The JPIs create a coordinated pool of national research efforts in order to make better use of Europe's precious public R&D resources and to tackle common European challenges more effectively[15].

The process driven by the European Commission (EC, 2008) fosters voluntary partnership among the Member States in terms of common vision and strategic research areas, implemented through joint competitive call for proposals that encourage building of international consortia. As one out of ten JPIs, JPI *Water Challenges for a Changing World* (JPI Water) was endorsed by the Council of the European Union and the European Commission in 2011. The Water JPI addresses five research areas: i) closing the water cycle gap; ii) developing safe water systems for the citizens; iii) maintaining ecosystem sustainability; iv) implementing a water-wise bio-based economy; and v) reinforcing competitiveness of the water industry in

[15] See also http://ec.europa.eu/research/era/what-joint-programming_en.html

Europe. Each challenge is further specified in terms of priority research topics (JPI Water, 2011).

The JPI Water involves up-to-date 19 participating and 5 observing countries. The member countries account for 88 per cent of the estimated 370 million Euro worth water research and innovation budget. The first call of the JPI Water has been published in November 2013 and focusses on the emerging water contaminants – anthropogenic pollutants and pathogens.

To some extent, the JPI Water research priorities overlap those of Horizon 2020 and EIP Water, especially in terms of efficient water use, managing of extreme event risks, and market-oriented solutions for the water industry. The research on economic policy instruments is transversal to most topics but without a specific focus on the instruments as such, a part of water incentive pricing.

6 References

2030 Water Resource Group. (2009). Charting Our Water Future Economic frameworks to inform decision-making.

Ancev, T. (2011). Salinity offset in Australia. Report of the EPI-WATER project. Retrieved from www.epi-water.eu

Bakker, K. (2012). Water Security: Research Challenges and Opportunities. Science, 337(6097), 914–915. doi:10.1126/science.1226337

Barredo, J. I. (2009). Normalised flood losses in Europe: 1970–2006. Natural Hazards and Earth System Sciences, (9), 97–104.

Bogaert, S., Vandenbroucke, D., Dworak, T., Berglund, M., Interwies, E., Görlitz, E., … Álvaro, M. H. (2012). The role of water pricing and water allocation in agriculture in delivering sustainable water use in Europe – final report. Project number 11589. Arcadis, Brussels.

Branth Pedersen, A., Ørsted Nielsen, H., & Skou Andersen, M. (2011). The Danish Pesticide Tax. Report of the EPI-WATER project. Retrieved from www.epi-water.eu

Bräuninger, M., Butzengeiger-Geyer, S., Dlugolecki, A., Hochrainer, S., Köhler, M., Linnerooth-Bayer, J., … Schulze, S. (2011). Application of economic instruments for adaptation to climate change Final report. perspectives GmbH, Hamburg, Germany.

CEPS. (2012). Which economic model for a water-efficient Europe? Report of a CEPS Task Force. Centre for European Policy Studies, Brussels.

Ciscar, J.-C., Iglesias, A., Feyen, L., Szabo, L., Van Regemorter, D., Amelung, B., … Soria, A. (2011). Physical and economic consequences of climate change in Europe. Proceedings Of The National Academy Of Sciences Of The United States Of America, 108(7), 2678–2683. Retrieved from <Go to ISI>://000287377000015

Defrance, P. (2011). Financial compensation for environmental services: the case of Evian Natural Mineral Water. Report of the EPI-WATER project. Retrieved from www.epi-water.eu

Defrance, P., Raveau, A., Amen, J. F., Rossi, A., Garzón Delvaux, P. A., Strosser, P., … Branth Pedersen, A. (2013). Ecosystem services and conservation in the Seine-Normandie River Basin (France) Part A - PES scheme and nitrate tax in the Bassée-Voulzie area. Report of the EPI-WATER project. Retrieved from www.epi-water.eu

Delacamara, G., Dworak, T., Gomez, C. M., Lago, M., Maziotis, A., Rouillard, J., … Vollaro, M. (2013). Guidance on the design and development of Economic Policy Instruments in European water policy. Report of the EPI-WATER project. Retrieved from www.epi-water.eu

Delvaux, P. A. G., Mattheiß, V., Mysiak, J., Maziotis, A., & Lago, M. (2013). Premium for ecologically friendly hydropower – exploration of its prospects in France. Report of the EPI-WATER project. Retrieved from www.epi-water.eu

Dinar, A. (2011). Water Budget Rate Structure: Experiences from Urban Utilities in California. Report of the EPI-WATER project. Retrieved from www.epi-water.eu

Donoso Harris, G. (2011). The Chilean Water Allocation Mechanism, established in its Water Code of 1981. Report of the EPI-WATER project. Retrieved from www.epi-water.eu

Dworak, T. (2011). Green Hydropower in Switzerland. Report of the EPI-WATER project. Retrieved from www.epi-water.eu

EC. (1987). Council resolution of the Council of the European Communities and of the representatives of the governments of the Member States, meeting within the Council

of 19 October 1987 on the continuation and implementation of a European Community policy and actio.
EC. (1993). Growth, competitiveness, employement. The challenges and ways forward into the 21st century. White Paper. COM(93)700.
EC. (2005a). Commission staff working document on the links between employment policies and environment policies SEC(2005) 1530.
EC. (2005b). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions "European values in the globalised world" Contribution of the Commission to the October Meeting of Heads.
EC. (2005c). Communication to the Spring European Council - Working together for growth and jobs - A new start for the Lisbon Strategy Communication from President Barroso in agreement with Vice-President Verheugen. COM(2005) 24 final.
EC. (2006). Communication from the Commission halting the loss of biodiversity by 2010 — and beyond: Sustaining ecosystem services for human well–being. COM(2006) 216 final.
EC. (2007). Green paper on market-based instruments for environment and related policy purposes COM(2007) 140 final.
EC. (2008). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - Towards joint programming in research: Working together to tackle common challenges more effectively. .
EC. (2009a). Economic Crisis in Europe: Causes, Consequences and Responses. European Economy 7|2009. European Commission, Directorate-General for Economic and Financial Affairs.
EC. (2009b). Working programme 2010 Cooperation Theme 6 Environment including climate change. EC C(2009) 5893 of 29 July 2009. European Commission.
EC. (2010a). Ccommunication from the Commission: EUROPE 2020 A strategy for smart, sustainable and inclusive growth. COM(2010) 2020 final.
EC. (2010b). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Reinforcing economic policy coordination. COM(2010) 250 final.
EC. (2010c). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Smart Regulation in the European Union. COM(2010) 543 final.
EC. (2010d). Report from the Commission to the Council and the European Parliament the 2010 assessment of implementing the EU biodiversity action plan, COM(2010) 548 final.
EC. (2011a). Commission staff working paper - Research joint programming initiative on water: rationale and state of play at European level. Accompanying the document Commission recommendations on the research joint programming initiative 'Water Challenges for a Chang.
EC. (2011b). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions "Roadmap to a resource efficient Europe" COM(2011) 571 final.
EC. (2011c). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: A resource-efficient Europe – Flagship initiative under the Europe 2020 Strategy. COM(2011) 21.

EC. (2011d). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Concluding the first European semester of economic policy coordination: Guidance for national policies .

EC. (2011e). Proposal for a Regulation of the European Parliament and of the Council establishing Horizon 2020 - The Framework Programme for Research and Innovation (2014-2020) COM(2011) 809 final.

EC. (2012a). A Blueprint to Safeguard Europe's Water Resources. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. COM(2012) 673 final.

EC. (2012b). Commission staff working document - The Fitness Check of EU Freshwater Policy. SWD(2012) 393 final.

EC. (2012c). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - EU Regulatory Fitness. COM(2012) 746 final.

EC. (2012d). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - Innovating for Sustainable Growth: A Bioeconomy for Europe Strategy for "Innovating for sustainable gr.

EC. (2012e). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the European Innovation Partnership on Water. COM(2012) 216 final.

EC. (2012f). Tax reforms in EU Member States: Tax policy challenges for economic growth and fiscal sustainability. Working paper n.34 - 2012, Directorate General for Taxation and Customs Union Directorate General for Economic and Financial Affairs.

EC. (2013a). Green Paper on the insurance of natural and man-made disasters. COM(2013) 213 final.

EC. (2013b). Horizon 2020 Work programme 2014 – 2015 9. Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy. European Commission Decision C (2013)8631 of 10 December 2013.

EC. (2013c). Horizon 2020 Work Programme 2014 – 2015: 12. Climate action, environment, resource efficiency and raw materials. European Commission Decision C (2013)8631 of 10 December 2013.

EC. (2013d). Horizon 2020 Work Programme 2014 – 2015: 14. Secure societies – Protecting freedom and security of Europe and its citizens. European Commission Decision C (2013)8631 of 10 December 2013.

EC. (2013e). Report from the Commission to the Council and the European Parliament on the implementation of Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources based on Member State reports.

EEA. (2006). Urban sprawl in Europe - The ignored challenge. Copenhagen, Denmark: European Environmental Agency, Report No 10/2006.

EEA. (2010). EU 2010 biodiversity baseline. European Environmental Agency (EEA) Technical report No 12/2010.

EEA. (2011). Mapping the impacts of natural hazards and technological accidents in Europe - An overview of the last decade. EEA Technical Report No 13/2010, http://www.eea.europa.eu/publications/mapping-the-impacts-of-natural. (T. report N. 13/2010 European Environment Agency, Ed.). Retrieved from http://www.eea.europa.eu/publications/mapping-the-impacts-of-natural

EEA. (2012a). European waters — current status and future challenges. European Environmental Agency, EEA Report No 9/2012.
EEA. (2012b). Towards efficient use of water resources in Europe. (E. E. A. Report No 1/2012 Copenhagen, Ed.).
EEA. (2013). Assessment of cost recovery through water pricing. European Environmental Agency (EEA) Technical report No 16/2013.
EIP Water. (2012). Strategic Implementation Plan. European Innovation Partnership Water.
EP, & EC. (2006). Decision No 1639/2006/EC of the European Parliament and of the Council of 24 October 2006 establishing a Competitiveness and Innovation Framework Programme (2007 to 2013). Official Journal of the European Union, (L 310, 9.11.2006), 15–40.
EP, & EC. (2008). Regulation (EC) No 294/2008 of the European Parliament and of the Council of 11 March 2008 establishing the European Institute of Innovation and Technology. Official Journal of the European Union, (L97, 9.4.2008), 1–12.
Feyen, L., Dankers, R., Bodis, K., Salamon, P., & Barredo, J. I. (2012). Fluvial flood risk in Europe in present and future climates. Climatic Change, 112(1), 47–62. Retrieved from <Go to ISI>://000302327600004
Gómez, C. M., Delacámara, G., Pérez, C. D., Ibáñez, E., & Solanes, M. (2011). Water transfers in the Tagus River Basin (Spain). Report of the EPI-WATER project. Retrieved from www.epi-water.eu
Gómez, C. M., Delacámara, G., Pérez, C. D., & Rodrígue, M. (2011). Lower Ebro (Spain): Voluntary agreement for river regime restoration services. Report of the EPI-WATER project. Retrieved from www.epi-water.eu
Gómez, C. M., Delacámara, G., Pérez-Blanco, C. D., Ibáñez, E., & Rodríguez, M. (2013). Droughts and water scarcity- Tagus (Central Spain & Portugal) and Segura (SE Spain) interconnected river basins. Deliverable, Report of the EPI-WATER project.
Gupta, S., Tirpak, D. A., Burger, N., Gupta, J., Höhne, N., Boncheva, A. I., … Sari, A. (2007). Policies, Instruments and Co-operative Arrangements. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. .
Hernández-Sancho, F., Molinos-Senante, M., & Sala-Garrido, R. (2011). Increase in the pollution charge at Serpis River Basin. Report of the EPI-WATER project. Retrieved from www.epi-water.eu
Hernández-Sancho, F. Molinos-Senante, M., & Sala-Garrido, R. (2011a). Negotiation and monetary incentives to promote the use of reclaimed water at Tordera River Basin. Report of the EPI-WATER project. Retrieved from www.epi-water.eu
Hernández-Sancho, F. Molinos-Senante, M., & Sala-Garrido, R. (2011b). Voluntary intersectoral water transfer at Llobregat River Basin. Report of the EPI-WATER project. Retrieved from www.epi-water.eu
Holzinger, K., Knill, C., & Schäfer, A. (2006). Rhetoric or Reality? "New Governance" in EU Environmental Policy. European Law Journal, 12(3), 403–420.
Howe, C. W. (2011). The Efficient Water Market of the Northern Colorado Water Conservancy District: Colorado, USA. Report of the EPI-WATER project. Retrieved from www.epi-water.eu
IPCC. (2012). Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.

JPI Water. (2011). Water Challenges for a Changing World. Water JPI, Water challenges for a changing world. Retrieved from http://www.waterjpi.eu/images/documents/Vision_Document.pdf

Kan, I., & Kislev, Y. (2011). Urban Water Price Setting under Central Administration. Report of the EPI-WATER project. Retrieved from www.epi-water.eu

Kieser, M., & McCarthy, J. L. (2011). Miami River Watershed Water Quality Credit Trading Program. Report of the EPI-WATER project. Retrieved from epi-water.eu

Kossida, M., Makropoulos, C., Tekidou, A., Kakava, A., Mimikou, M., Gómez, C. M., … Viaggi, D. (2013). Macroeconomic perspective on water quality and quantity issues of relevance to the System of Environmental-Economic Accounting for Water (SEEAW) - PART B – Water Quantity (Pinios River Basin, Greece). Report of the EPI-WATER project. Retrieved from www.epi-water.eu

Kossida, M., & Tekidou, A. (2011). Subsidies for Drinking Water Conservation in Cyprus. Report of the EPI-WATER project. Retrieved from www.epi-water.eu

Kousky, C. (2011). New York City Watershed Agricultural Program. Report of the EPI-WATER project. Retrieved from www.epi-water.eu

Mattheiß, V. (2011). Subsidies for ecologically friendly hydro-power plants through favourable electricity remuneration in Germany. Report of the EPI-WATER project. Retrieved from www.epi-water.eu

Møller, F., Hasler, B., Zandersen, M., Andersen, M. S., Kossida, M., Mimikou, M., & Mysiak, J. (2013). Special Report on the Environmental Accounts. Report of the EPI-WATER project. Retrieved from www.epi-water.eu

Möller-Gulland, J., & Lago, M. (2011). Water Abstraction Charges and Compensation Payments in Baden-Württemberg (Germany). Report of the EPI-WATER project. Retrieved from www.epi-water.eu

Möller-Gulland, J., McGlade, K., & Lago, M. (2011). Effluent Tax in Germany. Report of the EPI-WATER project. Retrieved from www.epi-water.eu

Mysiak, J. (2013). Research agenda for the design and implementation of economic policy instruments. Report of the EPI-WATER project. Retrieved from www.epi-water.eu

Mysiak, J., Amadio, M., Santato, S., Carrera, L., & Maziotis, A. (2013). Economic policy instruments for flood risk reduction. Repoort of the EPI-WATER project. Retrieved from www.epi-water.eu

Mysiak, J., Farinosi, F., Carrera, L., Testella, F., Breil, M., & Massaruto, A. (2011a). Green energy certificates and compliance market. Report of the EPI-WATER project. Retrieved from www.epi-water.eu

Mysiak, J., Farinosi, F., Carrera, L., Testella, F., Breil, M., & Massaruto, A. (2011b). Water tariff system in Italy and tariff structure in the Region Emilia Romagna (RER). Report of the EPI-WATER project. Retrieved from www.epi-water.eu

Mysiak, J., Vollaro, M., Gómez, C. M., Andersen, M. S., Defrance, P., Delvaux, P. A. G., … Viavattene, C. (2013). EPI-WATER Synthesis report. Report of the EPI-WATER project. Retrieved from www.epi-water.eu

OECD. (2005). Environmentally Harmful Subsidies. Challenges for reform. Organisation for Economic Co-operation and Development.

OECD. (2013). Water Security for Better Lives (Report). Paris (France): Organisation for Economic Co-operation and Development.

Rademaekers, K., van der Laan, J., Smith, M., van Breugel, C., & Pollitt, H. (n.d.). The role of market-based instruments in achieving a resource efficient economy. DG ENV framework contract: ENV.G.1/FRA/2006/0073. Ecorys, Cambridge Econometrics and Cowi.

Rákosi, J., Ungvári, G., Mezősi, A., Kelemen, L., & Kaderják, P. (2011). Water load fee, Hungary. Report of the EPI-WATER project. Retrieved from www.epi-water.eu

Sardonini, L., Viaggi, D., & Raggi, M. (2011). Water tariffs in agriculture – Emilia-Romagna case study. Report of the EPI-WATER project. Retrieved from www.epi-water.eu

Schuerhoff, M., Weikard, H. P., & Zetland, D. (2011). Groundwater taxes in the Netherlands. Report of the EPI-WATER project. Retrieved from www.epi-water.eu

Schuerhoff, M., Weikard, H. P., & Zetland, D. (2013). The life and death of the Dutch groundwater tax. Water Policy, 15(6), 1064–1077.

Skou Andersen, M., Ørsted Nielsen, H., Branth Pedersen, A., Thodsen, H., Pizzol, M., Fonnesbech Wulff, A., … Molinas Senante, M. (2013). Macroeconomic perspective on water quality and quantity issues of relevance to the System of Environmental-Economic Accounting for Water (SEEAW) PART A – Water Quality (Odense River Basin, Denmark). Report of the EPI-WATER project. Retrieved from www.epi-water.eu

Strosser, P., Dworak, T., Delvaux, P. G. A., Berglund, M., Schmidt, G., Mysiak, J., … Ashton, V. (2012). Gap Analysis of the Water Scarcity and Droughts Policy in the EU. European Commisison Directorate General Environment, Final report Tender ENV.D.1/SER/2010/0049.

Tietenberg, T. (2002). The Tradable Permits Approach to Protecting the Commons: What Have We Learned? Nota di lavoro 36.2002 Fondazione Eni Enrico Mattei.

Ungvári, G., Kaderják, P., Mezősi, A., & Kiss, A. (2011). Water Resource Fee - Hungary. Report of the EPI-WATER project. Retrieved from www.epi-water.eu

Ungvári, G., Kis, A., Kaderják, P., Keszthelyi, A., Mezősi, A., Kerekes, L., … Vollaro, M. (2013). Floods and Water Logging in the Tisza River Basin (Hungary). Report of the EPI-WATER project. Retrieved from www.epi-water.eu

Viavattene, C., Pardoe, J., McCarthy, S., & Green, C. (2011). Cooperative agreements between water supply companies and farmers in Dorset. Report of the EPI-WATER project. Retrieved from www.epi-water.eu

WEF. (2014). Global Risks 2014 Ninth Edition. Geneva, Switzerland: World Economic Forum.

Weikard, H. P., & Zetland, D. (2013). A critical analysis of the EPI Water Assessment Framework for evaluating economic policy instruments designed to improve sustainable water management. Report of the EPI-WATER project. Retrieved from www.epi-water.eu

Withana, S., Kretschmer, B., & Farmer, A. (2013). Environmental policy in the European Semester: Assessing progress to date. , A report for the Greens/EFA Group of the European Parliament, Final report, Institute for European Environmental Policy (IEEP), London/Brussels.

Withana, S., ten Brink, P., Franckx, L., Hirschnitz-Garbers, M. M. I., Oosterhuis, F., & Porsch, L. (2012). Study supporting the phasing out of environmentally harmful subsidies. A report by the Institute for European Environmental Policy (IEEP), Institute for Environmental Studies - Vrije Universiteit (IVM), Ecologic Institute and Vision on Technology (VITO) f. Brussels.

Yang, X. (2011). Case Study of China. Report of the EPI-WATER project. Retrieved from www.epi-water.eu

Yates, A. J. (2011). Nitrogen Permit Trading in North Carolina's Neuse River. Report of the EPI-WATER project. Retrieved from www.epi-water.eu

Young, M. (2011). The role of the Unbundling water rights in Australia's Southern Connected Murray Darling Basin. Report of the EPI-WATER project. Retrieved from www.epi-water.eu

Zetland, D., Dworak, T., Lago, M., Maziotis, A., & Viavattene, C. (2013). An orientation to the assessment framework for evaluating economic policy instruments for managing water. EPI-WATER Policy Paper. Retrieved from www.epi-water.eu

Zetland, D., & Weikard, H. P. (2011). Payment by the drop: The move to water metering in England and Wales. Report of the EPI-WATER project. Retrieved from www.epi-water.eu

Zetland, D., Weikard, H. P., Delacámara, G., Dworak, T., Gómez Gómez, C. M., Görlach, B., … Breil, M. (2011). Overall Assessment Framework. Report of the EPI-WATER project. Retrieved from www.epi-water.eu

Zetland, D., Weikard, H. P., Delacámara, G., Dworak, T., Gómez Gómez, C. M., Görlach, B., … Breil, M. (2012). Review of the Assessment Framework and Toolbox. Report of the EPI-WATER project. Retrieved from www.epi-water.eu