WHICH ECONOMIC MODEL FOR A WATER-EFFICIENT EUROPE?

REPORT OF A CEPS TASK FORCE

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CEPS TASK FORCE REPORT

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This report is based on discussions in the CEPS Task Force on "Which economic model for a water-efficient Europe?" The Task Force met three times over a concentrated period in March and April 2012. Participants included senior executives from a broad range of stakeholders, including business and industry, business associations, academic experts and NGOs.

The members of the Task Force engaged in extensive debates over the course of several meetings and submitted comments on earlier drafts of this report. Its contents reflects the general tone and direction of the discussion but does not necessarily represent a full common position agreed by all members of the Task Force, nor do they necessarily represent the views of the institutions to which the members belong. A list of members and invited guests and speakers appears in Annex 2.

This Final Report benefited from many other contributions from the Task Force members and invited guests and speakers.

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FOREWORD

The continuous availability of fresh water in sufficient quantity and quality is one of the world's most important challenges. Population growth, urbanisation and climate change are important factors of water stress, and must be dealt with on a multinational basis.

While Europe already has highly ambitious legislation in place, it is necessary to review our policies from time to time. With the "Blueprint to Safeguard Europe's Waters", the European Commission presents a thorough analysis of the status quo and provides policy-makers with a broad basis for discussion.

The Blueprint is another step towards a successful European water policy. In the future, it will be necessary to focus, first of all, on the implementation of existing legislation. Furthermore, we need to gather more data and also take regional differences into account when it comes to devising specific water policies.

This CEPS Task Force Report has involved a broad range of stakeholders, subjecting their views to analysis and review. Thus, this report is a major contribution to the debate on the most appropriate measures to safeguard Europe's water resources in a balanced and economically efficient way. I am confident that it will offer more and better opportunities to Europe's water industry.

Richard Seeber
Member of the European Parliament
President of the EP Water Group

EXECUTIVE SUMMARY

In adopting the Water Framework Directive (WFD) in 2000, the European Union took a crucial step towards an integrated approach to water on the basis of river basin management. Since then, very significant progress has been made. By seeking completion of the current policy framework, the forthcoming EU "Blueprint to Safeguard Europe's Waters" (henceforth the 'Blueprint') will attempt to provide guidance on the instruments needed to reach the full potential of the Directive. In addition, it will promote the integration of the WFD with other policies addressing scarce resources and their use, including the implications of adaptation to climate change. The Blueprint finally will focus on water availability and resource sustainability, as pressures on resource availability across many EU member states are increasing. Tensions between the availability of water resources and increases in water demand are growing rapidly, not only endangering minimum flows for ecosystems, but also rapidly exacerbating competition between uses.

The EU agenda on water even goes beyond the WFD and the Blueprint. Water is a central element of the 'Europe 2020 Strategy', notably of the Resource Efficiency Roadmap but also of the EU climate change mitigation and adaptation policy. A 'water-efficient' Europe will offer enhanced and new growth potential for the EU while strengthening its competitiveness.

This CEPS report concentrates on how to improve water efficiency, notably in public supply, households, agriculture, energy and manufacturing as well as across sectors. Acknowledging that 'water efficiency' is complex as a concept and even more so in practice, it will develop 'politically feasible next steps' to improve water efficiency in those cases in which – recognising the coupling between water use and other environmental, economic and societal dimensions – it may be appropriate to seek improved water-use efficiency. This report presents a number of key findings and recommendations in terms of economic policy instruments towards a sustainable management of EU water resources, and points at possible consequences of future developments depending on the economic models chosen.

The Key Messages for each of the following four chapters are highlighted each time in a text box at the beginning of each chapter.

Key Messages

<u>Part I. The EU Water Policy Framework</u>

Water challenges in the EU

1. With the adoption of the WFD, the EU has taken a very important step towards water efficiency. Yet challenges remain. One relates to the lack of data and information, such as on water flows in and out of river basins, or data on water stress. Another challenge concerns ageing infrastructure, coupled with a lack of finance, which has led to under-investment in infrastructure. A third challenge consists of unsustainable water-use practices and over-exploitation of water resources. Cases of water stress are increasing, and lead to competition for scarce resources between different uses, as well as to water pollution and the degradation of water ecosystems. The effects of climate change will add new uncertainty to water planning as well as further pressures on water resources and ecosystems.

Water productivity

2. In cases where water is scarce and because of the probable impact of climate change on the variability of water availability, it is important to make the best use of existing water, in economic, social and environmental terms. Improving water productivity means obtaining the highest possible net social value from a given amount of water. What is counted under this net social value has to be clarified (i.e. only GDP or added value, some indication of rural development or employment, environmental benefits, etc.). Improved productivity might be obtained through the reduction of losses in every sector, through technological improvements, but also through more profound changes within a specific sector (redesigning a production process, shifting to other business models or other types of production) or through re-allocation of water between uses (which

already happens in scarcity situations). Informed and transparent discussion is a precondition for a correct assessment of the different options available to improve the productivity of water resources (within or among sectors), including evaluations of the social, environmental and economic productivity of water uses under the different options. In anticipation of possible scarcities, it will be crucial to ensure the flexibility of reallocation of water between uses, unless efficient water markets can be operated. The flexibility of water allocation rules, if supported by rigorous evaluation of net social values of different allocation options, is likely to enhance resource sustainability and viable socioeconomic development at the same time.

Financing the water sector through water pricing

3. Cost recovery through water pricing[1] is a tool to obtain the necessary funds to run the public water supply system and cover the investments needs. Appropriate cost recovery mechanisms are essential to ensure the financial viability of water management. The WFD does not provide details on the fundamental requirements for cost recovery (e.g. there is no agreement within the EU on the costs to be covered, and there is also some disagreement between the European Commission and a number of member states about which kind of water use qualifies as a water service). For pragmatic reasons, a logical starting point to decide which costs should be included consists of first addressing operational and management costs as well as full capital costs. Progressively, resource and environmental costs could also be added. All decisions will require sound cost-recovery assessments, in order to allow an informed discussion to be held on the distribution of the cost of future investments amongst different users. This includes the need to consider social tariffs to avoid

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[1] Water pricing can have two functions. The first is *cost recovery*, aimed at paying for the costs of management, maintenance and renewal of public water supply networks. The second function is to influence the behaviour of users to induce a more *water-efficient use of the resource*. The design of the pricing system plays a particularly important role in areas under water stress, in particular in areas with persistent or recurrent drought.

excluding vulnerable parts of the population from access to water and sanitation services, as well as the necessity to consider, as possible legitimate sources of funding, the financial transfers from for instance the local, national or European general budgets, and not only from water users (see the 3Ts of the OECD; see paragraph 5), to acknowledge the public good character of some water-related services.

4. Pricing can also be a key to promoting a sustainable use of water. Giving a price to water resources confers on them a value and influences the way in which they are used. Water prices have an effect on the allocation of water across users and/or sectors, and can serve as an incentive to change users' behaviour. Prices, and – if appropriate – water trading schemes and markets can promote measures to increase water efficiency and a correct allocation between sectors.[2] However, decisions on prices and by extension on water allocation, require a detailed knowledge of hydrological conditions, e.g. by water accounting. But knowledge alone is not sufficient to ensure efficient pricing decisions; price determination and allocation of water across sectors is fraught with difficulties and subject to strong political pressures.

EU financial assistance

5. Full-cost recovery of investments in public infrastructure through prices may prove to be socially untenable or even economically not viable, in particular in poorer regions of the EU. In these cases, EU public financial instruments will be required to complement pricing and regulation approaches to improve water efficiency. The EU can play a pivotal role in poorer regions for the development of water infrastructure, not only for water supply, but also for water treatment plants in towns where they are still underdeveloped. The Cohesion and Structural Funds already allocate considerable sums to this end. For agriculture, direct payments and rural development plans can be an important mechanism. Additional funding for water infrastructure could be introduced in the form of loans channelled through intermediary national banks and backed up by the European

[2] Provided it is based on a rigorous hydrological assessment, i.e. water accounting.

Investment Bank (EIB). Other tools could include a European Water Efficiency Fund comparable to the European Energy Efficiency Fund, possibly combined with water efficiency targets, such as exist for example in the Common Agricultural Policy.

Water trading schemes and water markets

6. Water trading schemes and markets can operate at different levels, from simple ones between two users, e.g. between farmers and cities, to highly complex ones, involving trade amongst all users. Theoretically, water markets and water trading are efficient and effective in allocating scarce water resources to the most productive uses. However, water trading can become a complex instrument, burdened by heavy transaction costs. It often does not address political issues such as equity concerns, socially problematic trade-offs (e.g. with food security) and environmental considerations. If implemented, the design of such schemes deserves careful consideration and their operation needs to be closely monitored.

Payments for ecosystem services

7. The good functioning of a water ecosystem might necessitate specific actions by some stakeholders, but benefit a broader set of water users. The distribution of such costs and benefits among water users and other stakeholders can take the form of financial transfers between them. If cost assessment methodologies could incorporate a calculation of these implicit transfers, they could clarify in which circumstances payments for ecosystem services (PES) are useful, and contribute to transparency in the policy process. PES can be used to compensate for the direct costs or loss in economic benefits incurred by water resources protection. PES can be made, for example, in cases such as the preservation of flood plains by the landowner or the management of wetlands.

   To date, however, there is no agreement on the concept, let alone a commonly agreed definition. Some argue that PES can also include payments for pollution avoidance, when pollution is linked to the provision of a public good. In this case, the payments would help polluters to invest in water protection measures, especially when they lack the financial means to do so themselves. In a strict sense, however, these are not ecosystem payments, but pollution avoidance payments. Finally, payment schemes such as agreements to ensure certain volume flows have been advocated in order to manage water scarcity issues.

Part II. Sector-Specific Policies

Efforts to improve water efficiency will affect a number of sectors.

Public water supply network

1. Leakage from public distribution networks[3] – accounting for some 20% of water supplies – remains a significant issue throughout the EU, although to varying degrees across the member states. Leakage constitutes a waste both of water and energy/carbon. Effective measures to address leakage have included in the past explicit leakage targets and goals, benchmarking, low operating pressure systems, sharing of best practices as well as continuous investments and inspections. The use of cost-benefit analysis, including also the long-term sustainability and viability of water supply systems, can identify the 'efficient' level of leakage, i.e. design-efficient policies. One of the most well-known analytical tools is the SELL (Sustainable Efficient Level of Leakage) used in the UK.

End-use efficiency in households

2. Using water more efficiently requires changes in users' behaviour. Such changes can be facilitated by raising awareness and disseminating information, notably on simple actions and techniques to reduce water use, such as:
    - Education campaigns to raise users' awareness about the environmental impacts of water stress;
    - Water-labelling schemes for appliances;
    - Water efficiency standards for fittings, fixtures and appliances to accelerate market penetration of efficient products; and
    - Training for plumbers and fitters.

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[3] Public networks typically supply households, services, public buildings and small businesses and sometimes industry. In many cases, however, industry has different water abstraction rights.

Although not a panacea, pricing of water services is essential to change users' behaviour. Evidence suggests that users alter their water consumption patterns in response to water charges, especially if based on variable pricing, although elasticity of demand is low. Variable pricing can in principle be a valuable tool to express current or expected water scarcity. Metering, which enables users to monitor their water consumption, is necessary for pricing to have an impact on users' behaviour.

Agriculture

3. Agriculture in the EU is responsible for some 24% of water abstracted, although abstraction can reach 80% in southern Europe, mainly as a result of irrigation. In many member states water use in agriculture still lacks effective metering and pricing, making it difficult to implement the concept of water productivity and the objective of increasing water efficiency. Due to the complex relationship between water and agricultural production, reducing water use does not necessarily follow the same logic as other sectors. Reducing water per unit of output may affect the characteristics of the products (e.g. smaller fruits).

Also the fact that the value of crops is linked to their weight – and thus water content – makes decreases in irrigation a sensitive issue. The most profitable produce for the farmer often does not correspond to the point of maximum water productivity. Hence, reducing water use in agriculture is linked both to advanced farming techniques and the possibilities to change characteristics of produce or even markets. Technically, numerous solutions to reduce water use in the agricultural sector exist, mainly through modern irrigation systems, but they require widespread training programmes and special support for low-income farms. Economically, it would make sense to prepare for situations in which water scarcity would require changes in the type of products produced by irrigation because of probable restrictions in water allocation to agriculture. Such situations need to be prepared for in advance, in order not to reach difficult situations of radical reconversion.

Energy

4. The energy sector accounts for the largest amount of water withdrawal in the EU (approximately 45% of total water abstracted), primarily used for cooling purposes. Most of this water is not consumed. More modern 'cooling-tower' or 'recirculation' systems require less abstraction from rivers or groundwater reserves, in particular due to water reuse. This also reduces the impact on thermally-sensitive aquatic ecosystems. However, they consume an important share of this water. Expanding the use of recirculation is possible. There is also potential for a greater use of alternative water sources for energy-production purposes, particularly as cooling (and boiler-feed) water, which does not typically need to be high quality. In the case of hydropower, abstraction of water for the purpose of power generation does not necessarily consume or change the quality of the water. Nevertheless, dams and reservoirs may lead to indirect consumption resulting from increased evaporation (mainly relevant under warm climatic conditions), to hydrological alterations and to negative impacts on surrounding ecosystems. They may also entail resource costs, because of storage at particular moments of the year (i.e. in summer) when another user might make an economic use of the water flow. On the other hand, hydropower can offer environmental and economic benefits such as flood protection, ground-water regulation, irrigation, shipping and riverbed stabilisation or even as an enabler for variable renewable power supply. In some countries, such potential adverse effects by hydropower are addressed by regulation. Such regulation, however, is seldom based on socio-economic cost-benefit analysis of the full range of water services provided by hydropower.

Manufacturing industry

5. Water is an important input in industry, and in manufacturing industry in particular, as many industrial processes are highly dependent on water. Within the EU, industry abstracts some 10% of water[4] directly from the resources, without being supplied by a

[4] Industry commonly pays for water self-abstraction either by means of volumetric pricing or based on a flat or variable rate, e.g. calculated on the area of industrial

public sector water supply network. Water use in industry is relatively price inelastic and with few exceptions, it is seldom a major cost of the production process. Water prices remains important, nevertheless, as they will determine the level of investment in new and more efficient water technologies. Low or non-existent prices discourage investments in water efficiency and savings as they increase the payback period. Given the expected increase in competition for water between sectors (especially in water-scarce regions), industry is starting to adapt to the allocation priorities set up by governments, and to increase water productivity and efficiency to meet them. For example, spurred by EU environmental liability legislation, industry has developed a voluntary environmental management system (EMS - ISO 14000), of which water is an important element.

Recommendations

Although this report alludes to numerous practical ideas to improve water efficiency throughout the text, we list below 13 key practical recommendations in line with the strategic priorities of this report.

1) In light of the importance of cost-recovery assessments for water pricing and investment, the EU should set a deadline for agreement on the main methodological questions, for example on which cost categories to include in cost-recovery analysis and in what way, including not only financial costs but also environmental and resource costs, whenever feasible. This would then constitute a strong basis for the design of cost-recovery mechanisms, such as pricing policies and other transfers (for water services, but also for access to the resources). A well-designed policy package may encourage water users to invest in water efficiency in all sectors, while ensuring access for the basic needs of the weakest members of society.
2) The EU should base cost-recovery analysis on high-quality hydrological data, so as to match prices and charges to the actual value of the resource. This means that the EU will need to invest in

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real estate (Bogaert, 2012). OECD (2012) experience shows that the prices rarely reflect water scarcity and are generally rather low.

improving the knowledge base by further developing the Water Information System for Europe (WISE).

3) Direct payments in agriculture, particularly if they include the recently proposed payments under green contracts, should also require the inclusion of water efficiency targets and metering obligations in regions under water stress due to drought.

4) The EU should seriously consider the establishment of a European Water Efficiency Fund, comparable to the one on energy efficiency.

5) Rigorous evaluations of the water productivity of different allocation options are important ingredients for water resources management. They could in the long run trigger more innovative options for water-demand management. It is important to systematically explore the variety of options at hand to ensure the adoption of a balanced solution.

6) The EU and the member states should support further analysis on the present water allocation and pricing mechanisms. Information on 'who pays for what' would be highly valuable in the process of policy formation, as it would allow making more informed political choices concerning (financial) transfers between different water users and the various sectors. Transparency on the use of public money and cross-subsidies between users is essential to the formation of basic rules and to assessing who benefits and who loses under the status quo. Volumetric metering and more generally data collection and processing are important means to properly identify water users.

7) In light of some key positive experiences of water markets/trading schemes, the EU could further explore this option in specific regions where a strong signal needs to be given to users on the value of water resources. Careful *ex-ante* evaluations will have to be undertaken, to ensure that potentially negative social and environmental impacts are mitigated and that possible transaction costs are weighed against the benefits of such schemes.

8) In the context of resource efficiency and green growth potentials of the "Europe 2020 strategy", the meaning of the concept of water productivity in practice should be defined, i.e. what does it mean to obtain the highest possible net social value from a given amount of water.

9) The European Commission should consider developing an "EU 2050 Water Roadmap", comparable to those on a low-carbon economy, transport and energy.

10) An immediate priority for the EU is to reduce leakage to economically efficient levels so as to avoid wasting water as well as excessive costs. Existing models for identifying an Economic Level of Leakage (ELL) such as the UK SELL (Sustainable Efficient Level of Leakage) should be developed further at member state and EU levels, for example under the auspices of the European Environment Agency.

11) A uniform EU labelling system for water efficiency, following the example of the EU energy efficiency labels for domestic appliances, could have a positive impact on consumer choices.

12) The EU should develop effective strategies to improve water efficiency in agriculture, with the objective to boost water productivity and enable the sector to effectively compete with other uses when water is scarce, as well as anticipate risks of radical changes for the business model of supply chains and production systems. Such strategies must take into account the complex relationship between water and agricultural production, such as unintended incentives that can lead to increase the irrigated land surface.

13) The EU should focus on advanced farming techniques and explore the possibilities for EU farmers to gradually enter into markets better aligned with EU water productivity objectives.

1. INTRODUCTION

This chapter provides a short overview of the present challenges in the area of water policy in the European Union.

Key messages

- The member states are not on track to achieve the objectives of the Water Framework Directive by 2015 due to a *lack of appropriate, coherent and effective instruments* in some member states.
- The life cycle of water needs to be better understood, in order to obtain reliable data at river-basin level.
- Investment methods in water management need to be improved, mainly through appropriate cost-recovery analysis methodologies, to clarify financial transfers, and also cost recovery tools, i.e. prices for users and charges to polluters.
- Better strategies are needed at the sectoral level.

The adoption of the Water Framework Directive (WFD) in 2000 was a crucial step towards an integrated approach to water on the basis of river-basin management. Since then, very significant progress has been made in improving the quality and availability of water. Despite the progress, a number of shortcomings exist and the EU is not on track to achieve the WFD objectives set for 2015. The insufficient progress towards the objectives is primarily related to the *lack of appropriate, coherent and effective instruments* in (some) member states. The WFD does not specify which instruments should be used towards reaching the objectives. Member states can implement different measures and have done so. However, the approaches have in certain cases failed to set a path ensuring the achievements of these objectives, while strong divergences in interpretation have also led to a lack of policy coherence across the EU.

The forthcoming EU "Blueprint to Safeguard Europe's Waters" (hereafter the 'Blueprint') is meant to complete the current policy framework. It will not review the WFD objectives, which are generally considered appropriate. Instead it seeks to complement them by providing guidance on the instruments needed to implement the Directive.

Reinforcing the implementation of the WFD is also seen as important for resource sustainability. The objective of achieving *good ecological status*[5] of water bodies in the WFD (implicitly) includes resource sustainability. The Blueprint will reinforce this focus, in order to address rapidly growing tensions between water availability and an increasing water demand. These tensions not only endanger minimum flows within ecosystems, but may also lead to conflicts between users over the (re-)allocation of resources. Finally, the Blueprint will also promote the integration of the WFD with other policies as well as support adaptation to climate change.

The EU 'water sustainability' agenda goes even further: water is already a major element of the 'Europe 2020 Strategy', notably of the Resource Efficiency Roadmap, but also of the EU climate change mitigation and adaptation policy. A 'water-efficient' Europe can be seen as one more element in the 'green-growth'[6] agenda for a sustainable competitive Europe.

Key areas for water policy are outlined below.

a) Understanding the water life cycle

Managing water resources in a sustainable manner will require an understanding of both the water life cycle (notably the drivers and causes of water stress) and the policies that can reverse existing trends. This will require among other things addressing the lack of data and information, e.g. data on water flows in and out of water basins or data on water stress and the drivers causing it, as well as data on infrastructure.

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[5] Art. 4 of the WFD.

[6] See for exampe the contributions to the Forum Green Growth, *Intereconomics*, Vol. 3, No. 47, May/June 2012 (http://www.ceps.eu/content/intereconomics-vol-47-no-3-mayjune-2012).

b) Investments

For many years, the water sector has suffered from a lack of investment in infrastructure and water protection, at least in some member states. This underinvestment has led to water overuse and pollution, as well as to the degradation of water ecosystems. The effects of climate change will most likely add further pressure on water resources and ecosystems, thereby requiring an even higher rate of investment in many parts of Europe, compared to the past. An important cause of recent underinvestment has been the discrepancy between the finances required to achieve the WFD objectives and the mechanisms set up to raise the necessary funds, for example through pricing water services. As a result, many member states are examining the role of economic and financial instruments for water management.

c) Targeted sector-specific policies

While EU framework legislation will be able to increase water efficiency, additional sector-specific policies can address water efficiency in a more targeted way. Chapter 4 presents an analysis of specific policies that can improve water-efficiency in different sectors, notably in the public water supply and in the agriculture, industry, energy and household sectors.

The report is structured as follows: Chapter 2 discusses what economic and financial instruments are required to increase water use efficiency and achieve sustainability. Chapter 3 looks in more detail at sector-specific solutions. Chapter 4 presents a set of recommendations on the way forward.

2. ECONOMIC AND FINANCIAL INSTRUMENTS TOWARDS INCREASING WATER EFFICIENCY

This chapter concentrates on an economic framework, including economic and financial instruments, that can encourage a more efficient use of water, and thus a more sustainable water-resource management in Europe.

Key messages

- A main weakness in Europe's water management is the lack of an adequate financial structure to run an efficient water management policy. This has led to widespread under-investment.
- There is a need for an appropriate cost-recovery system based first on a systematic cost-recovery analysis to clarify financial transfers, and then on user prices and polluter charges reflecting closely the real costs of water management and the value of the resource.
- The EU has an important role to play to financially support poorer regions in the development of necessary infrastructures.
- The Common Agricultural Policy should focus its actions more in line with the objectives of the Water Framework Directive and reinforce measures to increase water efficiency in the sector.
- In cases of recurrent drought, or year-round water scarcity, member states could consider introducing water-trading mechanisms where appropriate, in order to improve water allocation and to determine prices that better reflect the value of the resource.

Water resources in the EU are under stress in a number of regions, both in terms of quantitative overuse and in terms of poor quality due to pollution. This has triggered interest in the role that economic (e.g. economic evaluation, pricing, water trading) and financial instruments (e.g. subsidies) can play in aligning them to the specific needs of WFD implementation.

This chapter will discuss various instruments that are able to give clear policy and price signals to water users, so that the behaviour of users reflects the value of the resource. The first and most basic economic instrument is volumetric pricing, as a means to recover the costs of running the water network and to affect user behaviour. However, where there is water scarcity, financial cost recovery will not be enough, as water supply constraints are not reflected in that price; ideally the price should incorporate the value of water as a resource to avoid its over-exploitation. However, determining the 'scarcity' value of water is complex. In some cases, water markets or trading are discussed. Pricing alone will moreover not necessarily bring about the most resource-efficient or socially-optimal outcome. Other financial and policy instruments are needed to complement it. In addition to pricing, this chapter discusses the implementation of the 'polluter-pays' principle and the potential use of assistance for water protection practices in the Common Agricultural Policy (CAP).

2.1 Cost recovery

Benefits of cost recovery

Cost recovery (i.e. the costs associated with the provision of water services are recovered through the revenues) can be achieved through the prices that consumers pay to the provider of the water service as well as via any tax, charge or levy *related* to the provision of the water service (Unnerstall, 2007).[7]

[7] This may include polluter charges if the pollution has an impact on the costs associated with the provision of the water service. It excludes, however, cost recovery from 'unrelated' sources such as general taxation.

According to the WFD (Art. 9), water pricing[8] policies that take the polluter-pays principle into account may provide incentives for a more efficient use of water,[9] depending on the price elasticity of consumers and polluters. The higher the cost-recovery rate, the more the necessary investment costs are provisioned and guaranteed. If not, the shortfall needs to be filled by public budgets, which are however increasingly under stress in a large number of member states.

Prospective cost recovery assessments are normally based on cost-benefit analyses. They have the advantage of allowing policy-makers or regulators to determine whether investments in new infrastructure or technologies are less costly than alternative options, such as demand management. On the other hand, this will require further progress in estimating the true costs of water use, especially with a view to environmental and resource costs.

Cost components

As the WFD does not define the cost components – apart from the generic statement that environmental and resource costs should be included – the definitions of cost components are based on (non-legally binding) definitions provided by the economic working groups of the Common Implementation Strategy for the Water Framework Directive (WATECO and DG ECO):[10]

1. Financial (also called: full-supply) costs associated with providing water services, namely:
    - Operating and maintenance costs (e.g. for labour, energy, chemicals)
    - Capital costs including the cost of servicing debt
    - Administrative costs (e.g. regulatory costs associated with water abstraction licensing system)

[8] 'Water pricing' covers all aspects relevant to the final price that customers have to pay including levies and taxes that are imposed on the consumption of water services and water uses" (Unnerstall, 2007).

[9] The explicit aim of Art. 9 (WFD) is "that water-pricing policies provide adequate incentives for users to use water resources efficiently".

[10] The classification draws upon ECO1 (2004) and ECO2 (2004).

2. Environmental costs reflecting the damage to the water environment, inter alia:
    - Reduction in the ecological quality of aquatic ecosystems
    - Salinisation and degradation of productive soils
3. Resource costs, opportunity costs associated with using a scarce resource (water used for one purpose may no longer be available for a more beneficial use), thereby reflecting the scarcity value of the resource.[11]

Estimating costs

Estimating financial costs is relatively straightforward. Yet, differences in accounting rules, especially with regard to depreciation, make cross-country comparisons difficult. Cross-border comparisons however are essential because many river basins and the River Basin Management Plans (RBMPs) are trans-boundary. In order to understand the financial costs linked to the RBMPs, it is important to collect and aggregate data at the river basin level, and not – as it is done today – at the level of water-service providers only.[12]

Quantifying E&R (environmental and resource) costs is even more difficult. For example, the assessment of resource costs requires analysing possible alternative water uses (in both the present time and future) to be able to make an informed judgement of the allocation efficiency.[13] Not surprisingly, most member states provide limited information on primary estimations of E&R costs in the RBMPs.

Cost allocation

Water pricing is not only about the price that water service customers have to pay; it also concerns other water uses. The reason is that the customers of water-service providers are not responsible for all costs associated with their water use. Part of the water treatment costs result, for example, from

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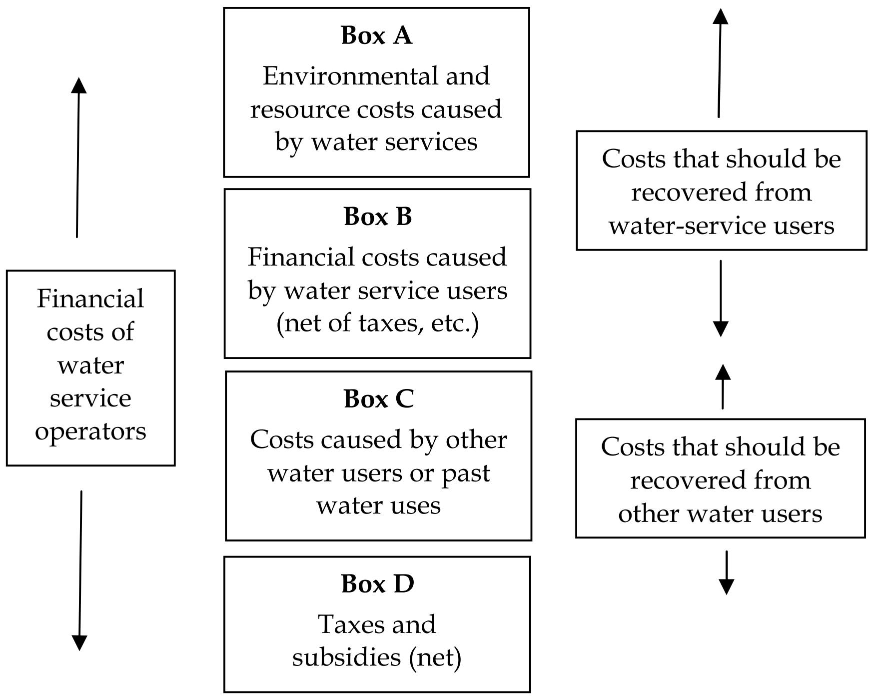
[11] This is related to the issue of allocation efficiency also discussed in section 2.3. The issue of opportunity costs is, generally speaking, more salient in water-scarce regions.

[12] Water-services providers may also serve water users in different river basins.

[13] For a more detailed discussion, see Howarth (2009).

agricultural or industrial water pollution. To avoid imposing an unfair burden on water-service customers, it is therefore necessary to properly allocate these costs as illustrated in Figure 2.1. Accordingly, Art. 9 of the WFD requests "an adequate contribution of the different water uses, disaggregated into at least industry, households and agriculture, ... taking account of the polluter pays principle". But, of course, cost-recovery assessments do not have to lead to full cost recovery in practice (see below).

Figure 2.1 Schematic representation of the principles used to assess cost recovery



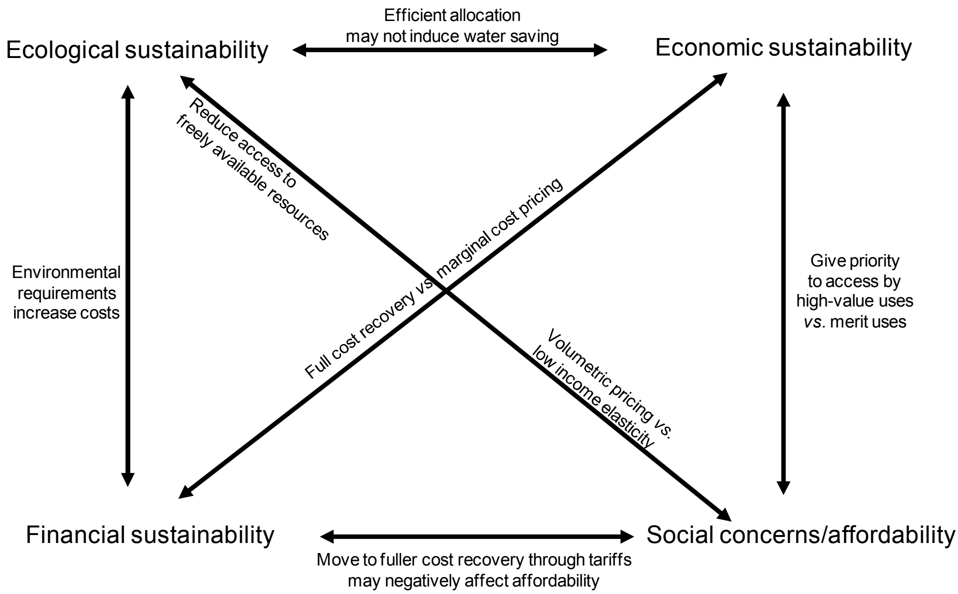
Note: Diagram not to scale!

Source: EUREAU (2004).

Limits of cost recovery pricing

Water-related infrastructures and services are important public goods. Because of this dimension, there is a case to (partially) rely on public finance. The OECD (2009b) has conceptualised this in its 3-T concept: tariffs, taxes and transfers, meaning that cost recovery pricing may on occasion have to be complemented by other instruments. For example, in the case of very high treatment costs due to historical contamination or diffuse pollution, there is a rationale for socialising additional costs to avoid unduly penalising water users. In addition, especially in rural regions where the basic infrastructure is still missing, subsidies may be needed. Art. 9 of the WFD explicitly allows for this as "Member States may ... have regard to the social, environmental and economic effects of the recovery as well as the geographic and climatic conditions of the region or regions affected". The complex interplay between the different policy objectives is illustrated in Figure 2.2 below.

Figure 2.2 Policy objectives and trade-offs that affect pricing levels and structures



Source: OECD (2010), based on presentation by A. Massaruto (2007), "Abstraction Charges: How can the Theory Guide Us?", made at the OECD Expert Meeting on Sustainable Financing for Affordable Water Services: From Theory to Practice, November 2007.

Implementation challenges

In a survey carried out in 2010, 69% of respondents declared that the implementation of the Art. 9 requirements on water pricing and cost recovery were among the three most urgent issues to be addressed. In particular, there is some disagreement on what basis the cost-recovery principle should be applied. Germany, for example, argues that cost recovery should apply only to the supply of drinking water and the disposal and treatment of wastewater. The European Commission, however, considers that other activities such as hydro-power have to be included in the definition of water services. An infringement proceeding against Germany is currently pending before the Court of Justice of the European Union (CJEU). The Commission is investigating similar cases in Austria, Belgium (Flanders region), Denmark, Finland, Hungary, the Netherlands and Sweden. Ireland has accepted the Commission's interpretation and will change its legislation accordingly (European Commission, 2012).

Diverging methodologies in the first RBMP cycle (Howarth, 2009) mean that at the moment costs are not transparent and/or comparable across countries, regions and river basins. In addition, subsidies/cross-subsidies are not dealt with in a consistent way.[14] It is thus not always clear who currently contributes to cost recovery, and which costs are recovered. While households are accounted for quite well, the (critical) issue of agriculture is only considered to a limited extent as "in more than one-third of the Member States, farmers do not pay for their water abstractions" (Arcadis et al., 2012). In some cases water use is not even measured, for example, unmonitored self-abstraction still exists.

Information on 'who pays for what', however, will be required for efficient and better informed policy-making. This information is also pertinent in making decisions concerning (financial) transfers between different water users and the various sectors.

Thus transparency on the use of public money and cross-subsidies between users is important in order to create basic rules for assessing who benefits and who loses under the status quo. Volumetric metering, and more generally data collection and processing are important means to

[14] According to the general thrust of discussion among the Task Force members.

properly identify water users. Both "a transparent policy dialogue and a sound analytical base" have been identified as key requirement for strategic financial planning (OECD, 2009a).

Cost recovery cannot ignore equity considerations. For example, access to water for consumption, health and sanitation is a recognised human right.[15]

Improving cost recovery in three steps

On the basis of the analysis above, we suggest improving cost recovery mechanisms in three steps:

1) In order to improve the consistency of methodologies, one way forward could be to intensify the methodological discussions among water economists that have for example been started by the WATECO Working Group.[16] Ideally, this would lead to a single methodology, while allowing sufficient flexibility for local, regional, national or basin-based circumstances. The authoritativeness of the analysis could be strengthened over time by independent *ex-post* analysis, as has taken place in the US. For example, a starting point could be the European Commission-sponsored EPI Water project.[17]
2) It would also be sensible to initially focus on establishing cost recovery mechanisms for financial costs. This would include the recovery of investments in infrastructure, operation and maintenance, administrative costs, etc. As public budgets are under stress in virtually all member states, making sure that the financial costs of providing the water service are borne by those responsible for it

[15] A recent UNECE & WHO (2012) report gives a number of best-practice examples of well-designed social tariff structures.

[16] The WATECO (for WATer and ECOnomics) Working Group was set up to support the implementation of the economic elements of the Water Framework Directive. The members of WATECO are economists, technical experts as well as other interested stakeholders from EU member states.

[17] The EPI-WATER Project aims to assess the effectiveness and the efficiency of economic policy instruments in achieving water policy goals. It is funded by the European Commission under the 7th Framework Programme and coordinated by the Fondazione Eni Enrico Mattei, Milan, Italy.

would be an important insurance to guarantee that adequate funds are available for maintaining and possibly increasing the quality of water supply.

3) In a third step, however, progress towards more comprehensive cost recovery, meaning properly estimating E&R (environmental and resource) costs, would be helpful for a more sustainable water policy. This is because the effectiveness of water pricing as an economic policy instrument crucially depends upon the information on which water pricing policies are designed. In other words, aligning cost recovery mechanisms with the underlying ecological reality requires more and better information on the environmental and resource costs of water use.

Long-term objectives

From a longer-term perspective, turning to an ecosystem service approach could be an interesting option. This could then also be translated into a 'payments for ecosystem services' (PES)[18] approach as a possible means to compensate some water users (e.g. agriculture) for the positive externalities they generate.[19]

So far, however, no agreement has been reached on the concept, let alone a commonly agreed definition. Some restrict the notion to private agreements between private actors leading to real financial transfers, as a substitute for public intervention. Some restrict the notion to situations where ecosystems do provide benefits. Some include the costs of reducing water pollution from users. Others argue that when pollution is linked to the provision of a public good, there is a case to be made for payments to help polluters to invest in water protection measures, especially when they lack the financial means to do so themselves. In a strict sense, these are not ecosystem payments, but pollution-avoidance payments. Finally, payment schemes, such as agreements to ensure certain volume flows, have been advocated in order to manage water-scarcity issues.

[18] For an overview, see Kelsey et al. (2008).

[19] The degradation or the scarcity of water resources leads to (environmental) costs that are borne by some stakeholders who are often not the water users. The good functioning of a water ecosystem might also necessitate specific actions by some stakeholders, but benefit a broader set of water users.

A comprehensive ecosystem-based reform, however, is a rather long-term prospect and would probably only be politically feasible in the event of a severe water crisis in Europe. Progress towards better estimating environmental and resource costs is an essential interim objective that has to be met. The estimation of E&R costs could be introduced in cost assessment methodologies, in order to clarify in which circumstances payments for ecosystem services are justifiable, and to contribute to transparency in the policy process. However, some PPP (polluter-pay principle) and PES schemes can already be introduced, for example to motivate farmers to introduce metering and other water-efficiency practices, or to reduce discharges.

2.2 Financial instruments

As mentioned above, water-related infrastructure and services have an important public-good dimension. Accordingly, it may be reasonable to (partially) rely on public money to finance them. Costs may be too high for the person or body having to implement the investments, or the individual return on investment may be too low compared to the social benefits. For this reason, the European Union has already introduced a number of support policies in the Common Agricultural Policy (CAP) and in the Cohesion Policy.

2.2.1 EU instruments for agriculture

Improving the environmental sustainability of the agricultural sector is a central objective of the CAP. The first and second pillars of the CAP already include a number of environmental measures. Pillar One (direct payments) imposes environmental conditionalities on farmers, which need to be fulfilled in order to benefit from the payments. Many of the conditionalities are related to sister directives to the water framework Directive, such as the pesticides Directive 209/128/EC. However, there is little connection yet between the policy and the WFD. The European Commission wants to reinforce the link between the direct payments and Water Framework Directive in the proposals for the CAP in the post 2013 period (European Commission, 2011a).

The reform proposals for the CAP for the next Multiannual Financial Framework (MFF) takes into account the obligation imposed by the WFD according to which the river basin management plans (RBMPs) need to be implemented at farm level by 2013 (Art. 11.7). The Commission furthermore stresses the need to incorporate the WFD objectives into the cross-compliance rules of the direct payments. Water efficiency should be a key element in the conditionalities for EU support in dry regions, with clearly defined obligations according to the conditions in the different regions, all being incorporated in the management and control systems of the member states.

The proposal on direct payments stipulates that these should be divided into two payments. The first consists of a basic compulsory component worth 70% of the direct payments and requires following the Good Agricultural and Environmental Condition (GAEC) practices. The second is a voluntary component worth 30% of the payments under green contracts with higher requirements (European Commission, 2011b). The green payments scheme, if introduced, could require specific water-efficiency obligations, for example through more onerous efficiency objectives and/or mandatory introduction of water metering devices.

In addition, the rural development policy of the second pillar of the CAP (Regulation (EC) No 1698/2005) already plays an important role in financing environmental measures at farm level. It is used in particular to implement actions in farms to comply with the nitrates Directive 91/676/EEC. Many actions can already be financed that aim at enhancing water efficiency in farms, through investments in necessary infrastructure or training programmes. The Regulation also can be used to finance water infrastructures in rural areas.

The proposals for a reform of the rural development Regulation (European Commission, 2011c) require – as is the case for the direct payments – that the policy supports the integration of the river basin management plans at farm level. Priority is given to water efficiency and water management. The proposal supports the development of a panoply of possible technologies in the water sector, e.g. water transport, irrigation systems, water treatment and reuse systems, etc., but unfortunately, does not seem to introduce water efficiency standards as a prerequisite to apply for funding in regions with water scarcity.

Water-efficiency investments are often revenue-generating due to the resulting lower water use costs.[20] This means that there is scope to develop

[20] Assuming that the water is appropriately priced.

specific loan schemes for farms, conceivably in the form of loans supported by the European Investment Bank (EIB) or European Investment Fund (EIF), channelled through local banks. However, low-income farms may need additional support.

The rural development policy also plays a key role in farmers' training, either through direct assistance to farms by financing extension services, or through vocational training programmes. The policy also supports the start-up of young farmers and their training.

2.2.2 *Support for water-efficiency investments under regional and cohesion funds*

There is a long history of support for water infrastructure through the Regional and Cohesion Funds. Some €8 billion have been allocated over the period 2007-13 to finance leakage control, the improvement of connections and the development of infrastructure.[21] Of this, €2 billion were allocated to wastewater treatment through the Cohesion (EEA, 2009b).

The next MFF will most likely reinforce the role of these funds. Their use will depend strongly on the regional plans developed by national or regional authorities.

The Structural Funds can finance the upgrading of water infrastructure, for supply and wastewater, in poorer regions of the EU. In addition it can finance training programmes, the exchange of best practices and information campaigns if a member state wished to do so (Table 2.1). While water infrastructure investments have been a key element of expenditure in the Cohesion and Structural Funds, there was no particular focus on water efficiency. For the next MFF the EU could issue specific guidance on increasing the focus on water efficiency.

River basin management is a cross-border issue, as 80% of river basin catchments are international. It is therefore important that the EU's Territorial Cooperation funding addresses water.

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[21] For more details on these data, see the website of DG Environment (http://ec.europa.eu/environment/water/quantity/instruments.htm).

Table 2.1 Potential EU funding assistance to WFD objectives

	Structural Funds		Cohesion Fund	Rural Development Fund
	ERDF	ESF		
Strengthening of River Basin Authorities (RBAs)	■	■		
Technical capacity-building for RBAs	■	■		
Setting up a stakeholder network and managing the participatory processes by RBAs		■		
Support and capacity-building of stakeholders/interested parties by RBAs	■	■		
Communication/information material and publications for participatory processes managed by RBAs				
Scientific studies, inventories, mapping	■	■		
Awareness-raising campaigns		■		
Monitoring systems and risk analyses	■			
Pilot demonstrations				
Flood risk management	■			
Vegetation restoration				■
Erosion control	■			
Water-saving solutions for agriculture				■
Water-saving solutions for industry	■			
Water-saving solutions for end-users	■			
Pollution control				■
Adapting existing water infrastructures	■		■	
New infrastructure for the management of water resources	■		■	
Improvement of water networks	■		■	
Wetlands restoration	■			■
Equipment acquisition	■			
Training for farmers				■

Source: Adapted and expanded from European Commission (2006).

2.3 Determining efficient water prices and allocation

Under scarce water conditions, price levels and/or public water allocation will determine the total consumption of water.[22] Determining the right price and allocation to ensure sustainability are complex and politically highly sensitive tasks. Historically, public water allocation to sectors often failed to be based on objective criteria and solid data (EEA, 2012). Even with good data and sound economic analyses, governments find it challenging to make decisions on water allocation and prices by decree, because of the impossibility to account for the innumerable individual decisions in an economy. Water allocation by the government is furthermore prone to be biased due to the lobbying of interest groups.

Market mechanisms could thus contribute to a more sustainable resource allocation. If the value of the scarce resource is reflected in prices determined by an efficient market mechanism, the demand will reflect the actual water availability. However markets vary in complexity, from simple markets trading excess water from one river basin to another or from one group of users to another, to fully-fledged markets where water is traded across all users. The decision of which system to use will depend on the institutions involved and the needs in the water sector. Wrongly designed markets can lead to worse outcomes, for example by introducing in the market water that would not have been used otherwise, ultimately exacerbating scarcity (see for example the case of the Tagus and the Segura basins markets in the EPI Water report, 2012, p. 4).

Evaluations are necessary in a policy debate on pricing water resources or on allocation, as they enable systematic exploration and discussion on a wide range of options as alternatives to keeping the *status quo*. Transparency is considered a key requirement for a policy debate in the opinion by the European Economic and Social Committee (EESC, 2012). Even with complex economic studies, it is difficult determining efficient water pricing and allocation.

Another weakness of markets is that they often exclude the economically weakest citizens or neglect public goods and ecological needs. Public policies can address such market failures. For example,

[22] Assuming there is no uncontrolled abstraction.

market operators can be required via public service obligations to set aside water to preserve the ecosystem water lifecycle.

To date, there are only a few water trading markets in Europe and they are generally limited to trade between river basins and/or agricultural irrigation organisations, i.e. public or private large entities trading with each other to address specific needs. They have been introduced on an *ad hoc* basis in times of drought.

2.3.1 Water trading between sectors and river basins

When water is scarce, most of the time it is allocated between sectors by the government. Such decisions are generally based on historical-use levels, identified needs, political and/or economic considerations. This type of allocation usually does not provide incentives to change practices and increase efficiency. If trade is possible, sectors can trade water with other sectors where the user value or the value of output per unit of water is higher. The combination of the price of water and the possibility to trade creates incentives to increase efficiency.

This means that in arid regions, where water is scarce and is allocated to different sectors through quotas, water-trading schemes can bring 'win-win' situations in particular for farmers, provided that consumption (including trade) stays within sustainable limits, avoiding for example over-exploitation of aquifers.

The EPI Water project presents a successful case of intersectoral water trading in the region of Llobregat near Barcelona (EPI Water, 2012b). Farmers have agreed through a voluntary system to reduce the use of freshwater for irrigation in exchange for recycled 'brown' water, thereby releasing more freshwater for other uses. The system is self-financing. The cost of regenerating the water is paid by domestic users, in application of the polluter-pays principle, and the cost of distributing the regenerated water is paid by farmers since they profit from its use. The greater availability of freshwater reduced the need to curtail irrigation in drought seasons, thus increasing farm production and farm incomes. The implementation of the system included water-saving awareness programmes for households. The net effect has been positive for all the stakeholders involved, as well as for the Llobregat aquifer itself, whose condition has improved. The total net profit from the operation has been estimated at €16 million a year.

If not well designed, however, a trading mechanism may backfire. This is the case, for example, of water trading between Madrid and farmers in the Henares river basin, who sold water they were in fact not intending to use, thus increasing the abstraction of water from the aquifer (EPI Water, 2012a, p. iv).

Trading in Europe has remained limited due to a lack of infrastructure, water rights allocation systems that are not yet compatible, and loss of interest on the part of the authorities once the water emergency is over. The present financial crisis is also slowing down the necessary investments in infrastructure and the setting up of the supporting institutions. The variability of hydrological conditions adds to the complexity of setting up water markets, as water prices fluctuate and create an uncertain environment for water rights holders.

2.3.2 *Fully-fledged water markets: Examples and experiences*

Permanent and well-established water markets between different users and regions are rare. One of the most prominent cases can be found in Australia – the Murray-Darling Basin water trading market. It is based on an initial allocation of entitlements to water, linked to a trading mechanism and a solid legal framework on water rights allocation and dispute settlement. The market price of water is determined by demand and supply, underpinned by very precise hydrological data. It also includes stringent allocation of water to ecological needs. Water rights are bought and sold in an exchange, involving for example brokers, water accounts and online trading tools. The system has been developed to such an extent that it includes water entitlement mortgages.

Permits trading has created immediate efficiency incentives, such as the introduction of metering devices for those wanting to trade. However, in both Australia and Spain, pressures on ecosystems have increased, due to problems with over-allocation of water rights (Arcadis et al., 2012). Water resource allocation in Australia "disproportionately favours water diversions that, typically, decline by a lesser amount than inflows in dry periods" (CSIRO, 2008, p. 43), with negative environmental impacts.

While a leading example of water-market efficiency, introducing such trading mechanisms is well beyond the capacity of many countries and requires highly specialised, accountable and independent agencies to manage them. Setting up complex trading mechanisms can be fraught with transaction costs, partly due to regulations in areas other than water use. In

Australia, the set-up of the trading mechanism met with difficulties and barriers caused by unexpected transaction costs, which can have a multitude of origins, such as policy implications, legal requirements, information requirements, complex monitoring, setting up new entities, etc. Even cultural barriers can cause considerable difficulties.[23] This can explain why water markets tend to appear only after all other options have been exhausted.

Another water trading system can be found in Chile. The water resource management code of 1981 allowed the development of water markets and permits. These are managed by a specialised water authority, which is supported by precise water rights legislation determining who holds water rights and how they may be traded. However, the insensitivity of the mechanism to social concerns of water access led to a significant reform in 2005. It introduced environmental requirements, as well as mechanisms to avoid speculation and the accumulation of market power of some traders. The Chilean example is seen in general as a success, but it suffers from a number of limitations: variable quality of the water markets from one region to another, depending on available infrastructure; high transaction costs due to local traditions and lack of administrative and human capacity; considerable technological barriers and costs; a sometimes inefficient judicial system in the field of water management conflicts; and finally a largely missing waste-water treatment capacity.

2.3.3 Lessons learned from water markets

Water trading markets are case-specific, but generally depend on the following:

- Decision on the kind and complexity of the trading mechanism have to be based on precise hydrological data and a cost-benefit analysis, as the infrastructure and transaction costs are considerable. Complex trading mechanisms are not recommended unless the scarcity of water is severe and the value of water as a resource is high.[24]

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[23] The many transaction costs encountered in Australia are documented by Martin et al. (2008), who give a comprehensive picture of the challenges involved.

[24] Convery (2012) observes that "frequently, the costs of technological modification are so large relative to the benefits of trading that the transactions do not take place".

- The market price of water resulting from trading systems should incorporate levies to cover all costs incurred by the water management bodies or subcontracted entities (whichever is the most cost-effective): data gathering and research, infrastructure, maintenance and repair, staff and management costs, legal and audit services, etc. Prices must not only reflect costs, but also the hydrological conditions of the water bodies to ensure demand does not outstrip a sustainable supply level. In addition, vulnerable sections of society need to be protected, for example through differentiated pricing.
- A solid legal framework needs to underpin the market, and the roles and responsibilities of the different actors need to be codified by law. Property rights to water and land need to be fully documented, and have legal legitimacy (Convery, 2012). Conflict resolution needs to be effective at all levels, from intra-sectoral disputes to inter-sectoral ones (e.g. between hydropower and irrigation interests), in a cost-effective and technically-informed manner, with a minimum of judicial and bureaucratic delays.
- Water is a fundamental public good, and markets need to be regulated in such as way as to ensure social equity and environmental protection. To provide legitimacy to the process, water needs to be allocated equitably to the actual water users.
- Last but not least, all stakeholders must be fully trained and educated, including marginalised sections of the population.

3. SECTOR-SPECIFIC POLICIES TO IMPROVE WATER EFFICIENCY AND WATER PRODUCTIVITY

This chapter focuses on sector-specific strategies to improve efficiency in the water supply network, the energy sector, households, industry and agriculture.

Key messages

- Water pricing is an essential element in water efficiency and productivity investment decisions in selected sectors.
- The public supply network can reduce leakage significantly, but to do so efficiently it should use appropriate cost-benefit analysis tools, such as the Sustainable Economic Level of Leakage (SELL) methodology.
- A combination of actions can be introduced to reduce water consumption from the household sector: consumption-related water pricing, compulsory metering, regulation on fittings, labelling of appliances and information campaigns.
- The relationship between water and production is particularly complex in agriculture, thereby requiring a step-by-step approach. Increased efficiency does not necessarily imply water conservation, and radical changes in agricultural production systems might occur in the near future due to the increase of water resources variability. There are a number of possible solutions to increase water productivity, but they require specialised knowledge and training. The CAP as well as the Structural and Cohesion Funds will have to play an important role in meeting this requirement.

- The energy sector is the largest user of abstracted water, but a large part is used for cooling and is subsequently returned. A number of actions can considerably reduce the environmental impact of water use. Water savings in other sectors indirectly reduce energy demand (e.g. less water heating) and thus energy supply needs.
- Given the expected competition for water between sectors, the manufacturing industry will need to adapt to potential allocation priorities by governments. Environmental Management Systems (EMS), to date voluntary, have proven to be a good tool to improve water efficiency. Water pricing remains important also for industry as it is a driver for investment in water-efficient technologies, despite the fact that water generally is a small cost factor, and therefore water is relatively price inelastic.

The economic instruments discussed in chapter 2, however, are not always sufficient or suitable. Additional sector-specific policies dealing with market failures or other barriers are necessary complements. In principle, suitable alternatives can be implemented. This chapter presents efficient and effective policies in a number of important sectors: public water supply, households, agriculture, energy and industry.

This chapter discusses how water use efficiency can be increased by:

i) minimising water supply network losses, for example due to leakage,

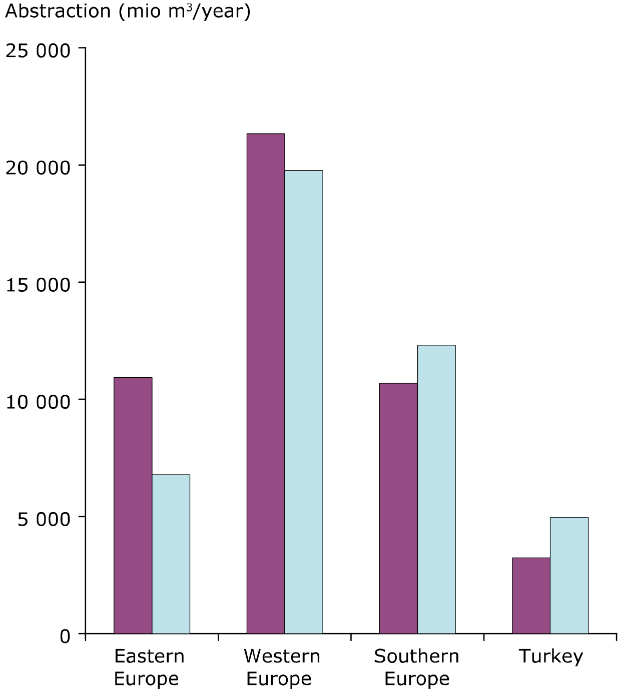
ii) the adoption of the best available practices and technologies to reduce water consumption and

iii) minimising water use by maximising water productivity, i.e. the amount of output per unit of water input, sometimes linked to radical changes in production systems and outputs.

3.1 Improving the efficiency of the public supply network

In the EU, 21% of water is provided by public water supply networks (EEA, 2009b) going to households, public buildings and small businesses. Industry is in some cases also supplied by public water networks, but only to a limited extent as it has different water abstraction rights. Figure 3.1 illustrates the quantities of water abstracted for public water supply (in million m^3/year) in the early 1990s and the period 2001 to 2005.

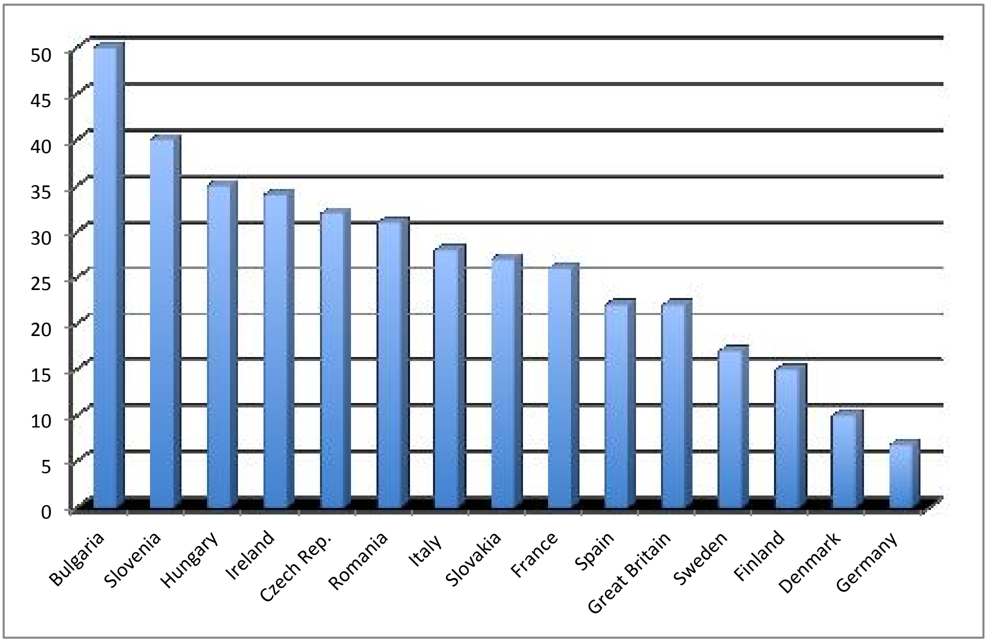
Figure 3.1 Water abstraction for public water supply (million m3/year) in the early 1990s and the period 2001-05



Source: EEA Core Set Indicator CSI 18, based on data from Eurostat data table: Annual water abstraction by source and by sector.

While efficiency on the demand side is important in order to reduce water use, more efficiency can be achieved by improving public supply networks in Europe. Years of under-investment have led to many networks being highly inefficient. Water leakage is substantial. In the EU, water loss due to leakage from public distribution networks prior to reaching domestic premises is considerable. This constitutes a major waste in terms of water, energy and unnecessary repair costs. Leakage varies significantly across member states, ranging from 6 to 50%. Figure 3.2 illustrates the estimated leakage in public water supply networks due to failing infrastructures for selected European countries.

Figure 3.2 Losses in the public drinking water network in selected EU member states



Note: Extractions for operational purposes and fire control are rated as losses in England and Wales, France and Germany.

Sources: Data from the presentation by Timme Dossing, "Efficient water distribution solutions, key to safeguarding Europe's water", second meeting of the Task Force, 27 March 2012. Compiled from VEWA 2006 Survey (Italy, France); Federal Statistical Office 2004 (Germany).

According to reports by EU member states, leakage reduction programmes are being carried out in a number of countries and are delivering benefits. Between 2007 and 2011, 14 EU member states (Austria, Belgium, Bulgaria, Cyprus, Spain, France, Ireland, Italy, Malta, Portugal, Romania, Sweden, Slovakia and the UK) report that they have taken measures to reduce leakage from public distribution networks, while The Netherlands reports that leakage in its supply network for drinking water is less than 5% (European Commission, 2011d).

There are many factors that influence leakage, including age and maintenance levels of the system, the total length of mains, the number of connections, the local topography and resulting hydraulic and pressure characteristics, the soil and climatic conditions, as well as the manner in which water is valued by society (EUREAU, 2011).

Experience from different member states has shown that effective measures exist to tackle leakage. They include explicit leakage targets and goals, benchmarking, sharing of best practices as well as continuous investment and inspections, the installation of low operating pressure systems and more generally, the increase of public awareness on water conservation issues. Other measures that have been implemented include indicative targets on water and energy loss reduction in distribution systems, an obligation for distributors to gradually and significantly reduce water and energy loss, certification schemes or audits and measurements by third parties.

Box 1. Example of a successful leakage reduction strategy

The Romanian city of Ploesti (230,000 inhabitants) offers a good example of a successful leak reduction strategy. One of the supply centres (Ploesti Nord Gageni) has managed to reduce water losses from 50% to 30% over the last 10 years by installing new pumps, replacing pipes and reducing water pressure at night. A further reduction of water loss of almost 7% has been realised by using demand-driven distribution. In addition, the pumps reacting to demand more accurately resulted in substantial energy savings (7%).

The following results were obtained: First, through lowering pressure at night time, leakage was reduced by 2.5% and energy use by 3%. Subsequently, with the introduction of demand-driven distribution, which substituted the existing constant pressure system, leakage was further reduced by 6.6% (146,000 m^3/year) and energy savings increased by 7.4% (48,000 kWh/year).

Source: Grundfos (2011).

Not only leakage, but also the policies to reduce it, generates costs. There is always a point at which the cost of repairing the leakage is higher than the cost of saving water or developing additional supplies elsewhere. This is why leakage control policies increasingly are based on cost-benefit analysis to establish the economic level of leakage (ELL). This does little, however, to ensure sustainability. Whether leakage undermines sustainability depends on accounting methodologies, e.g. whether factors such as the level of water scarcity, the impact on the environment or even consumer views are included. It is fair to say that existing practices often insufficiently – or not all – reflect the long-term sustainability of the water environment, including environmental (e.g. less water abstraction due to leakage reduction) and social considerations (e.g. traffic disruptions due to repairs and maintenance), but also financial considerations if long-term investment needs are not accounted for.

Ofwat and the Environment Agency are reviewing the methodology to value the externalities and incorporating them into a SELL (Sustainable Economic Level of Leakage) calculation (Ofwat, 2008; Defra, 2011). Between 1994 and 2010, the use of SELL reduced leakage in the UK by 36%, enough to provide public water supply for 12 million people (Defra, 2011). SELL not only addresses leakage control, but includes preventive measures, such as optimal water flow and pressure in the mains. SELL or similar concepts allow authorities not only to optimise the management of the infrastructure, but also energy consumption and maintenance costs.

3.2 Water efficiency in households

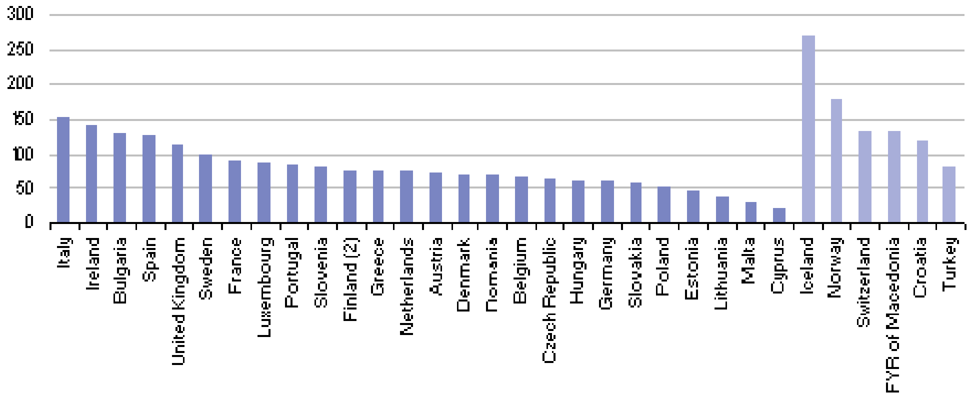
The main demand for water from the public supply network comes from households, accounting for 60–80% of the demand across Europe. Some 60% of this is used for personal hygiene and toilet flushing. The EEA (2009b) estimates that national average per capita of freshwater abstraction for public water supply ranges between 50 and 150 m^3 per capita annually in the EU (see Figure 3.3), reflecting the net effect of a number of drivers listed below.

Population and household size: The total population of the EU-27 countries has increased from just above 400 million in 1960 to above 502 million in January 2011 (Eurostat, 2011), and will continue to rise. During this period, the size of households, in terms of the number of occupants, has steadily decreased, resulting in a greater number of smaller households. Smaller households, however, use a greater amount of water proportionally than do larger families, as water use tends to be more closely linked to the household (e.g. laundry, gardening) than to the number of individuals composing it. Household consumption is also linked to individual behaviour, whereby younger people tend to use more water than their older counterparts (e.g. longer baths and showers, more frequent use of the washing machine). Awareness campaigns and education can change these habits to some extent as long as consumption is linked to individual behaviour.

Tourism: Tourism considerably increases water use during peak season, especially in water-stressed southern European countries, not only for food, drinks and personal hygiene, but also for leisure activities (e.g. swimming pools, golf courses). Tourists tend to use much more water than they do at home.[25] In the Mediterranean region, with a higher concentration in France, Italy and Spain, tourism has risen by more than 300% between 1970 and 2002, and it is estimated that it will continue increasing at a rate of 2.0 to 2.5% per annum (UNEP, 2005).

Income: "As GDP increases, the proportion of households connected to public supply networks increases. Higher household income is also linked to greater water use and increased capacity of water appliances (e.g. showers, toilets, water heaters, dishwashers, washing machines, sprinklers and swimming pools)" (EEA, 2009b, p. 29). Continued economic growth is likely to result in a further increase of domestic water consumption.

Figure 3.3 Total freshwater abstraction for public water supply, 2009 [1] *(m^3 per inhabitant)*



Note: These figures do not indicate actual consumption, as they do not take leakage into account.

[1] Spain, Italy, the Netherlands, Austria, Portugal, United Kingdom and Turkey, 2008; Germany, Ireland, Greece, France, Slovakia, Sweden and Norway, 2007; Switzerland, 2006; Finland and Iceland, 2005; Latvia not available.

[2] Estimate.

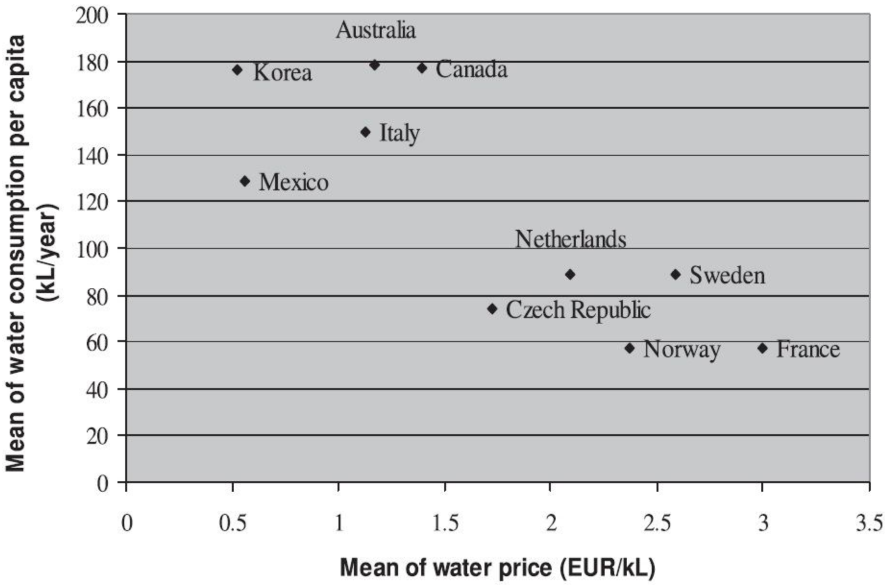
Source: Eurostat (online data code: env_watq2).

[25] The OECD (2000) reports that per capita water use by tourists in deluxe hotels in Greece averages 450 litres per day compared to the 100 to 200 litres per person per day across Europe (EEA, 2009b, p. 29).

Based on proposals by the EEA (2009b, 2012) and Walker (2009), there are a number of actions at EU and member state level that can increase the efficiency of water use by households including the full array of government policy such as metering, pricing, demand management, technological change, regulation, labelling, subsidies for water reuse systems and information. The EEA (2009) has reported gains due to "recent innovations that have improved the efficiency of water appliances have been important drivers for reducing water use, promoting water savings without requiring a change in consumer behaviour" (p. 30).

The role of pricing: Pricing is also a fundamental requirement for increasing water efficiency in households. If water has no real cost for consumers, there is thus no incentive to change behaviour and invest in water-efficient appliances. It has been observed that wherever pricing is low or non-existent for households (for example, in Ireland), water abstraction per capita is very high, as illustrated in Figure 3.3 above. Figure 3.4 by Grafton et al. (2011) shows the relationship between prices and water consumption for selected OECD countries.

Figure 3.4 Relationship between water prices and consumption per capita



Source: Grafton et al. (2011).

The structure and level of pricing are essential elements because they create incentives to invest in metering, water efficient appliances and water collection and reuse systems, not only for households but also for industry (see section 3.5).[26]

The role of metering: Pricing only makes sense if water consumption is metered. All consumers including households should be able to link their consumption to the price they pay for water, in the absence of which most of the benefits of pricing will be lost.

The role of demand-driven technological change: Technological change in appliances can be driven by consumer demand, and this in turn is driven by the cost of water. The demand for more efficient household appliances can also be promoted by increasing public awareness of the costs of not adopting the most efficient technologies.[27]

Other technologies can be installed at the level of water discharge (grey water) for water reuse. All household water other than toilet water is fit to be reused, for example for flushing or for watering gardens. Collecting rainwater is also an effective source of non-potable water fit for a number of uses, and needs to be promoted (EEA, 2009b). Wherever the costs of installation are too onerous for consumers to invest, incentives through price cuts or subsidies can be considered.

The role of labelling: According to Walker (2009), awareness of water consumption by appliances is limited or even non-existent, and information is often difficult to convey or to obtain. Information, when provided, is presented under differing labelling schemes, which are oriented towards marketing the products rather than informing the buyer. A uniform EU labelling system for water efficiency, following the example of the EU energy efficiency labels for domestic appliances, could be a potential solution (Walker, 2009).

Regulation: Whenever the user and the owner of the fixtures and appliances are not the same, the incentive for the owner is to install the

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[26] For a discussion on pricing options, see Walker (2009).

[27] The appliances are not only electronic devices such as washing machines, but include items such as toilet flushes. Flushing alone already accounts for 20-30% of the water consumed in a household. A number of simple technologies exist to reduce water use, such as dual flush toilets. For showers as well, simple technologies can lead to a large reduction of water used.

cheapest products, because the cost of water is covered by the user. This split incentive – equally existing in energy efficiency – can be addressed by regulation that bans the sale and installation of inefficient water fittings, fixtures and appliances.

Information: Information on all options and possible behavioural changes can work under certain circumstances. This includes information campaigns explaining the possibilities and the underlying environmental reasons.

3.3 Increasing water productivity in agriculture

In the EU, agriculture is responsible for approximately 24% of water abstracted (EEA, 2009b). This can reach as high as 80% in southern Europe, mainly as a result of irrigation. The quantities of water abstracted are expected to increase due to the progressive introduction of irrigation also in northern European countries. There is mounting pressure to increase water and land productivity in agriculture due to the combined effects of rising demand for food as a result of population growth, and of production of biomass for fuels. This will require an increase in both yield and crop intensity (number of harvests per year on the same hectare of land). As a result, progress in water productivity through the expansion of efficient irrigation systems will increasingly come into focus (see also EEA, 2012), before more thorough changes in crop choices might have to be made.

In areas where water is scarce, in the medium to the long term, agriculture will increasingly face competition for water, and governments will need to decide to which sector they will allocate scarce water resources. To be able to compete with other sectors, agriculture will face additional pressure to increase water productivity, measured for example by unit of GDP per added value, employment, local tax income or other indicators.

3.3.1 The role of water pricing and farm practices in increasing water productivity in the crop sector

Agriculture still offers significant potential for water efficiency improvements in Europe, largely because of subsidised water and free abstraction rights, including a lack of effective pricing and metering. However, the relationship between water, crops and agricultural markets is too complex to be tackled with a single set of measures, such as metering and pricing. A single volumetric price will not ensure optimum water productivity,[28] as the relationship between water and output varies for each agricultural product. The level of highest water productivity in many cases does not correspond to the highest profitability for the farmers.

There are many available technical and management solutions to improve water productivity in agriculture. They include: i) better infrastructure planning and management at the river basin level, ii) technological innovations in irrigated agriculture (e.g. surface irrigation, sprinkler irrigation, drip irrigation), iii) deficit irrigation technologies, iv) reducing runoff, percolation and evaporation, v) water re-use and vi) changes in cropping patterns, or in crops and commodities produced. However, the introduction of such practices needs extensive information and training, combined with adapted financial assistance. The introduction of inappropriate technologies and the incorrect management of irrigation systems can considerably reduce the benefits and cause considerable financial losses to farmers. Increased efficiency does not necessarily result in overall water savings. Evidence suggests that how the resource is used may turn out to increase (rather than decrease) the rate of water consumption – an effect known as 'Jevons paradox' (Polimeni et al., 2008). Spain offers an interesting European example[29] of this paradox in which efficiency programmes promoted the extension of irrigated areas (Arcadis et al., 2012).

3.3.2 Reducing the impact of agricultural practices on water quality

While the main use of water in agriculture is for crop irrigation, water pollution from agriculture also deserves attention. Pollution from crop production arises through the use of inputs such as the use of nitrates and pesticides. But another important source of pollution comes from the effluents from livestock production. Livestock effluents can cause immense damage to groundwater, rivers and the sea, mostly in the form of

[28] Increasing water productivity is defined in this specific paragraph as increasing the level of output per unit of water used, whereas it is generally in this report extended to the net social value per unit of water used.

[29] Examples of this effect can also be found in the US (Ward & Pulido-Velazquez, 2008).

eutrophication.[30] Wastewater treatment is an important component in water policy in general and for agriculture in particular. There are interesting technical options for wastewater and notably sludge treatment, for example biogas obtained through anaerobic digestion, which generates residues that are safe as fertilisers and facilitates the treatment and reuse of water. Incentives to improve sludge treatment in agriculture can be enhanced through a combination of enforcing standards, pricing, subsidies and information and training.

3.3.3 Public assistance to improve farming practices

A change in agricultural farming practices will also require complementary policies directed at improving the entrepreneurial skills of farmers, helping to improve productivity and efficiency. These could include a package of measures including one or more of the following initiatives:

- Innovation, in terms of technological development, focusing mainly on low-cost or highly effective actions, that take advantage of existing infrastructure and equipment at farm, irrigation district and basin level;
- Knowledge-based development, i.e. accelerated efforts towards training and support of farmers in order to strengthen entrepreneurship;
- Facilitating the return of or attracting young skilled people to the agricultural sector; and
- Enhancing the economic framework to allow farmers to become profitable without overuse of natural resources or excessive subsidies.

The Common Agricultural Policy and its rural development component would be the main tool to support the changes in farming practices. It should be adapted to take into account the need to modernise farms in line with a water-efficient agriculture. This has been highlighted in section 3.2 on financial instruments to improve water efficiency.

[30] A process in which bodies of water receive excess nutrients, especially phosphates and nitrates, that stimulate excessive plant growth.

3.4 Energy sector

In 2009, energy production accounted for 44% of total water abstraction (EEA, 2009b),[31] primarily serving as cooling water for thermal power generation (EEA, 2009b). A large part of this water is returned to the source after use; this is considered non-consumptive use.[32] However, both cooling water use and even hydropower are responsible for some water consumption, mainly due to evaporation. In addition, fuel production of oil, gas, coal and biomass is associated with significant water use.

Cooling water use in thermal power generation

Cooling systems may evaporate water directly at the plant or cause indirect evaporation in the receiving water body by increasing the water temperature, which, together with the ecosystem impact of a temperature increase, is also called 'thermal pollution' (Kohli & Frenken, 2011). The extent to which cooling is associated with water consumption depends on the cooling system. As described below, there are three main types of cooling systems in use: once-through systems, tower-cooled (wet recirculating) systems and air-cooled (dry recirculating) systems. The choice of an appropriate system depends on location, for example cooling water availability. In addition, the choice is affected by a weighting of advantages and disadvantages to the water environment, the other environment and society at large. Estimates for the water consumption associated with most forms of thermal power plants are available from the Electric Power Research Institute (2002). Whatever the choice of technology, it is based on BAT (best available technology) principles as part of the permitting process.

i) *Once-through system*. Generally this system returns the abstracted water at higher temperature, immediately after use. This requires a large volume of abstracted water per unit of electricity produced,

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[31] Followed by agriculture (25%), public water supply (21%), and industry (11%), according to EEA (2009b).

[32] Thus, there is a distinction to be made between water withdrawal (i.e. the water taken from a source) and water consumption (i.e. the amount of water that is not returned to that source after use).

although only about 1% of the amount abstracted is actually consumed (Electric Power Research Institute, 2002).

ii) *Wet recirculating systems*. This requires less abstracted water although it consumes more water than a once-through cooled system serving the same thermal load. Following the cooling process, a recirculation system removes heat from the cooling water through contact with air in a cooling tower, a process that results in a consumptive loss of water via evaporation. The remaining water can then be re-circulated and re-used for cooling purposes. This process, however, causes higher energy consumption and reduced thermodynamic cycle efficiency, which may create an environmental impact and incurs extra costs.

    Wet tower-cooled systems discharge a fraction of the recirculating flow in order to manage the chemistry of the cooling water circuit. This (small) discharge is normally at elevated temperatures compared to the receiving waters. Such systems do therefore have a residual impact on the environment. This is dealt with in the plant permitting process to ensure that it meets EU requirements, e.g. avoids unacceptably high residual impacts and ensures the availability of sufficient local water resources.

iii) *Air-cooled (dry recirculating) systems*. By not discharging heated water, this method avoids inflicting potentially adverse impacts on thermally-sensitive aquatic ecosystems.

Hydropower generation

Hydropower production intervenes in the natural water flow, thereby temporarily affecting local availability of water downstream. Hydropower consumes water only indirectly when reservoirs lead to increased evaporation (depending on the climatic conditions).

Generally, the same water can be used for several purposes, one after the other (multi-purpose use). On the one hand, this can lead to trade-offs between hydropower and other consumers if water stored during the summer is released for downstream users, thereby lowering the benefits of the power utility in the winter when this water could have been used to respond to peaks in energy demand – depending however on circumstances such as the location of reservoirs, storage of reservoirs and water requirements downstream (JRC-IET, 2011). Hydropower generation can, by contrast, also offer benefits for flood protection, ground water regulation, irrigation, shipping, riverbed stabilisation or even as an enabler for variable renewable power supply.

To date, various trade-offs have been dealt with by regulation to address environmental impacts. Water pricing has been identified as less effective to achieve such objectives (see e.g. Umweltbundesamt, 2011, p. 292; Gawel, 2011). The costs and benefits of the full range of water services provided by hydropower can be revealed by a thorough socio-economic cost-benefit analysis, which is best undertaken on a case-by-case basis because hydropower is a site-specific technology. Detailed data based on life-cycle analysis are publicly available for power plants, for example, in the form of Environmental Product Declarations (EPDs) in the context of certification of environmental management.

Other forms of power generation

The operation and maintenance of solar PV (photovoltaic) systems and windmills requires only limited water use for cleaning purposes (Ecologic, 2007).[33] This is different for biofuels (see the previous section on agriculture).

Interplay between water and energy savings

Since energy production is associated with water consumption, saving energy could also lead to less water consumption in the energy sector. Conversely, as water use is often related to energy consumption (e.g. hot water), reducing water use in households may also decrease water consumption in the energy sector.

3.5 Industry

Water is an important input in industry, and manufacturing industry in particular, as many industrial processes are highly water-dependent. Within the EU, some 11% of water is abstracted by industry (EEA, 2009b). Different manufacturing sectors account for different proportions of total

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[33] For concentrated solar power plants, by contrast, water use may be significant – especially as they are often installed in desert(-like) areas – unless dry cooling systems are used (see thermal power generation).

industrial water use in Europe. Production processes also vary in their use of water.

Water use in industry is relatively price-inelastic, as it is not, in most cases, a key cost of the production process. Irrespective of this fact, water prices matter as the cost of water is a key determinant of investment decisions, i.e. low or non-existent prices will discourage investments in water savings. In addition, with water becoming an increasingly scarce resource, the industry sector is aware of the risks of having to compete for water resources with agriculture and households (see WBCSD, 2012). Due to increasing regulation, water scarcity, costs, as well as image branding, many industries are motivated to improve resource efficiency, including water use. As manufacturing *per se* is technology-intensive and innovation-driven, automation and standardisation will continue to remain a driver for continuous optimisation of the use of resources, including water.

The implementation of best practices to manage natural resources is codified in the Environmental Management System (EMS) that companies worldwide have voluntarily adopted to attain the internationally recognised ISO 14000 standards. While the EMS is a voluntary code, it is largely compulsory in the EU for most industries due to the Environmental Liability Directive (ELD) 2004/35/EC,[34] which set legal environmental obligations for companies. This has made the EMS the environmental standards compliance instrument of choice for most companies in the EU. In general, the EMS identifies objectives and processes to reduce waste and resource use, including water. Reinforcing the importance of water efficiency in the EMS standards to achieve the ISO 14000 certification could be an effective tool to increase water efficiency in the EU and abroad.

[34] Directive 2004/35/EC of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage.

Box 2. The EMS impact on water use: Case study of Toyota Motor Manufacturing France

While the Environmental Management System (EMS) takes into account all inputs, water is an especially important focus at the industrial site. To improve water efficiency, Toyota Motor Manufacturing France (TMMF) applies the waste hierarchy pyramid: avoid, reduce, re-use, recycle, treat and dispose. Examples include:

a) Avoid the use of drinking water in industrial processes. Differentiate between water sources, drinking and non-drinking water, whenever the option is offered by water supply companies.

b) Substitute water for non-drinking water applications with rainwater. By collecting rainwater, the plant reduced purchased water use by 36%.

c) Use water-saving equipment.

d) Reuse water between processes through a cascading system.

e) Recycle water: 40% of treated discharge water is recycled back into the production process.

TMMF has reduced its use of raw water by 67% from 2.3m^3/vehicle in 2002 to 0.78m^3/vehicle in 2011. Through consolidated efforts, the plant managed to reach zero purchased water consumption for 14 weeks in 2011. In the future, the plant aims to expand rainwater storage to eliminate the need for purchased water altogether.

The cost of using rainwater and recycling treated discharge water is approximately 87% cheaper than purchasing tap water. The cost of recycling treated industrial water from the city network is about 63% cheaper (this includes manpower, energy, chemicals and consumables).

Source: Rahim & Hope (2012).

4. THE WAY FORWARD

With the Water Framework Directive, the EU has put in place a comprehensive framework drawing on an integrated approach to water on the basis of river basin management. While considerable progress has been achieved in WFD implementation, it is likely that a number of EU regions will fail to meet the objectives for 2015. **Three priorities** emerge: The first is to close the gap between data and information on the hydrological situation and water stress by water accounting, which is a prerequisite for the design of sustainable policies. The second is to reverse the chronic underinvestment in infrastructure. The third is to counteract unsustainable water use practices and the over-exploitation of water resources. Both challenges are dealt with in the forthcoming Blueprint.

4.1 Three priorities

Priority 1

Devising appropriate water policy with effective river basin management plans (RBMPs) requires detailed knowledge of hydrological conditions, e.g. by water accounting, but also of the relevant opportunity costs. To meet this requirement necessitates a strong involvement of economic analysts in the policy process on water resource allocation.

Priority 2

Reversing under-investment requires the setting up of a sustainable cost recovery mechanism through pricing and other transfer mechanisms.

- Pricing is one of the essential elements for sustainable water use, which has not been used appropriately. Prices can reveal the value of water for different uses, can function as an allocation mechanism – at least to a certain extent – where water is scarce, and can create incentives to change behaviour.

- Water pricing is also important to cover the operations and investment costs of public water suppliers. Whilst there is no EU-wide agreement on cost categories to include in the calculations, it seems logical to include operational and management costs as well as full capital costs to the largest extent possible. Progressively, the EU should put into motion a process to include resource and environmental costs, for example, through polluter pays charges and payments for ecosystem services (PES). However, developing a comprehensive policy can only become meaningful after appropriate operational and capital cost recovery assessment methodologies are fully functional.
- Cost recovery assessments can include resource management costs that are not exclusively linked to the water supply network. The assessments can estimate implicit transfers between users, such as costs and benefits associated with pollution and water management practices, which today are not factored in (such as using taxes or payments for ecosystem services). Such assessments are useful to clarify who benefits and who loses from the present system of water management, even in situations where full cost recovery is not sought: it is essential as a sound basis to foster transparent debate in the policy process about what constitutes a fair distribution of transfers among water users.
- There are some regions where full-cost recovery of investments in public infrastructure through pricing policies may be socially and economically untenable. For these regions, the EU has a pivotal role in funding the development of water infrastructure, e.g. for supply and treatment, or for environmental management (e.g. flood prevention infrastructure). The existing key instruments are i) the Structural and Cohesion Funds, ii) direct payments and rural development plans to increase water efficiency in agriculture and iii) loans channelled through intermediary national banks and possibly backed by the EIB or EIF.
- It is difficult to set the correct price, in particular when water is scarce and prices need to reflect the value of the water resource in addition to cost recovery for the water network. In these cases water markets and water trading schemes may be used. There are examples where

these have proven to work. However, their complexity and the need to address politically sensitive issues such as equity, makes them less likely as a standard policy solution.

Priority 3

As noted above, a third priority is quickly emerging, i.e. addressing unsustainable water use practices and the over-exploitation of water resources. In cases of water scarcity and in regions where water scarcity is expected to worsen in the medium to long-run, it will become increasingly urgent to focus on the best possible use of existing water, in economic, social and environmental terms. Governments will be facing difficult questions such as whether to allocate to agriculture or tourism. In the context of the "Europe 2020" strategy on economic growth, resource efficiency and the notion of green growth, improving water productivity will mean obtaining the highest possible net social value from a given amount of water. What is counted under this net social value (GDP, added value, employment, environmental benefits, etc.) will need to be clarified. More work is needed, for example, on the relative merits of the different options for improving productivity of the resources (within or among sectors), by producing evaluations of the social, environmental and economic productivity of water uses.

4.2 Recommendations

This report has identified a number of concrete measures to improve water efficiency in the key sectors: public supply, households, agriculture, energy and manufacturing as well as across sectors.

In line with the strategic priorities identified above as the way forward, we propose the following 13 practical recommendations:

1) In light of the importance that cost recovery has for water pricing and investment, the EU should set a deadline for agreement on the main methodological questions, for example on pricing and on which cost categories to include in cost recovery and in what way, with the aim of including not only financial costs but also environmental and resource costs, whenever feasible. This would then constitute a strong basis for the design of cost recovery mechanisms, such as pricing policies and other transfers (for water services, but also for access to the resources). A well-designed policy package may encourage water

users to invest in water efficiency in all sectors, while ensuring access for the basic needs of the weakest members of society.

2) The EU should base the cost recovery system on good quality hydrological data, so as to match prices and charges to the costs of maintaining a sustainable water management system and to the actual value of water as a resource. This means that the EU will need to invest in improving the knowledge base by further developing the Water Information System for Europe (WISE).

3) Direct payments in agriculture, particularly if they include payments under the proposed new green contracts, should also require the inclusion of water efficiency targets, and metering obligations in regions subject to droughts.

4) The EU should seriously consider the establishment of a European Water Efficiency Fund, comparable to the one on energy efficiency.

5) Rigorous evaluations of the water productivity of different allocation options are important ingredients for water resources management. They could in the long run trigger more innovative options for water demand management. It is important to systematically explore the variety of options at hand to ensure the adoption of a balanced solution.

6) The EU and the member states should support further analysis on the present water allocation and pricing mechanism. Information on 'who pays for what' would be highly valuable in the process of policy formation as it would allow making more informed political choices concerning (financial) transfers between different water users and the various sectors. Transparency on the use of public money and cross-subsidies between users is essential for the creation of basic rules and to assess who benefits and who loses under the status quo. Volumetric metering and, more generally, data collection and processing are important means to properly identify water users and to acknowledge the public good character of some water-related services.

7) In light of some key positive experiences of water markets/trading schemes, the EU could further explore this option in specific regions where a strong signal needs to be given to users on the value of water resources. Careful *ex-ante* evaluations will have to be undertaken, to ensure that potentially negative social and environmental impacts are

mitigated and that possible transaction costs are weighed against the benefits of such schemes.

8) In the context of resource efficiency and green growth potentials of the "Europe 2020" strategy, the meaning of the concept of water productivity in practice should be defined, i.e. what does it mean to obtain the highest possible net social value from a given amount of water.

9) The European Commission should consider developing a "EU 2050 Water Roadmap", comparable to the ones already developed on carbon, transport and energy.

10) An immediate priority for the EU is to reduce leakage to economically efficient levels so as to avoid waste of water as well as excessive costs. Existing models for identifying an Economic Level of Leakage (ELL) such as the UK SELL (Sustainable Efficient Level of Leakage) should be developed further at member state and EU level, for example under the auspices of the European Environment Agency.

11) A uniform EU labelling system for water efficiency, following the example of the EU energy efficiency labels for domestic appliances, could have a positive impact on consumer choices.

12) The EU should develop effective strategies to improve water efficiency in agriculture, with the objective to boost water productivity and enable the sector to effectively compete with other uses when water is scarce, as well as anticipate risks of radical changes for the business model of supply chains and production systems. Such strategies must take into account the complex relationship between water and agricultural production, such as unintended incentives that can lead to increase the irrigated land surface.

13) The EU should focus on advanced farming techniques and explore the possibilities for EU farmers to gradually enter into markets that are better aligned with EU water productivity objectives.

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ANNEX 1. GLOSSARY OF ABBREVIATIONS

CAP	Common Agricultural Policy
BAT	Best Available Technology
EEA	European Environment Agency
EIB	European Investment Bank
EIF	European Investment Fund
ELD	Environmental Liability Directive
ELL	Economic Level of Leakage
EMS	Environmental Management System
EPD	Environmental Product Declaration
EPI	Environmental Performance Index
E&R	Environmental and Resource
GAEC	Good Agricultural and Environmental Condition
MFF	Multiannual Financial Framework
PES	Payments for Ecosystem Services
PPP	Polluter-Pays Principle
RBA	River Basin Authority
RBMP	River Basin Management Plan
SELL	Sustainable Economic Level of Leakage
UNECE	United Nations Economic Commission for Europe
WATECO	Water and Economics Working Group of the Water Framework Directive
WHO	World Health Organization
WISE	Water Information System for Europe
WFD	Water Framework Directive

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