

# Recovery of full cost and pricing of water in the Water Framework Directive

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## Abstract

The Water Framework Directive (EC 2000/60) introduces the fundamental idea that water is a social and at the same time, an economic good. This concept imposes the implementation of measures for the recovery of water services costs. An integrated management of water resources with specific environmental objectives needs economic principles, tools, methods and measures, which will aim also at economic and social targets. The recovery of costs of water services is a central target of the Directive and the necessary steps for its implementation are outlined. Water services and uses are defined and the methods and tools available for the estimation of supply, environmental and resource costs are presented. The main issues related to the design and implementation of water pricing policies that set appropriate incentives to all users for reducing consumption are analysed. Finally, the potential impacts for the implementation of Directive in Greece are outlined.

## 1 Introduction

Water is a social good, irreplaceable for survival, human health and economic growth with important cultural or even religious value. Availability of high quality fresh water improves the individuals' welfare and benefits society as a whole. In this sense, water is not just a social but also a common good and access in clean water is a basic right of all. Social goods in some cases have also the characteristics of private goods. More water for someone may mean less water for others, which share the same water resources (1).

Increasing needs for water services in the 80's, led to the formulation of the "*Dublin Principles of Water*". From the 4 principles adopted with the Dublin declaration, the most controversial and confusing was the one that "*water has an economic value in all its competing uses and should be recognised as an economic good*" (International Conference on Water and Environment, Dublin 1992). In fair interpretation, this statement does not mean that water is a commercial good but simply that it has a different value in competitive uses. Management of water as an economic good means that water will be allocated to competitive uses in such way so that the clean social benefit is maximised. These arguments led to the opinion that "*integrated water resources management is based on the perception of water as an integral part of the ecosystem, a natural resource, and a social and economic good*" (Environment and Growth, Rio 1992) (2).

Directive 2000/60 builds on these principles and constitutes a bold and forward-looking instrument for the future management of water and aquatic ecosystems throughout Europe being the EU's first '*sustainable development*' Directive (3). It expresses a basic change, which has already taken place in the 90's, in the priorities of water resources management. It takes into account the value of water for the environment, human health and consumption in productive sectors and establishes a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater with the specific goals to (4):

- Prevent further deterioration and protect and enhance the status of aquatic ecosystems and, with regard to their water needs, terrestrial ecosystems and wetlands directly depending on the aquatic ecosystems
- Promotes sustainable water use based on a long-term protection of available water resources
- Aims at enhanced protection and improvement of the aquatic environment, inter alia, through specific measures for the progressive reduction of discharges, emissions and losses of priority

substances and the cessation or phasing-out of discharges, emissions and losses of the priority hazardous substances

- Ensures the progressive reduction of pollution of groundwater and prevents its further pollution
- Contributes to mitigating the effects of floods and droughts.

The innovation of the Water Framework Directive (WFD) is that, for the first time in the EU environmental policy, a legal text proposes economic principles and measures as basic instruments for the achievement of specific environmental objectives. In this way, the Directive creates a unique opportunity and challenge, for the combination of applied research and water resources policy development. For the coherent and harmonious implementation of the WFD, EU Member States developed the *Common Strategy for Supporting the Implementation of Directive 2000/60*. In this context the WATECO working group has been established to analyse the economic elements of the Directive. WATECO has recently organised a Workshop in Lille, France and published a preliminary non-obligatory guidance document for the implementation of the Directive.

Section 2 presents the economic elements of the Directive and focuses on the assessment of the level of water services cost recovery. In section 3, the general guidelines for the design of water pricing mechanism are discussed. Section 4 presents the potential impacts of the Directive implementation in Greece.

## 2 Economic analysis and environmental objectives

The most important economic concept that WFD introduces, is the creation of common framework for water resources management based on the recovery of the full water services cost. The main references of the Directive in economic elements and parameters are outlined in Table 1.

**Table 1. Economic elements of the Water Framework Directive (6)**

Reference	Summary
Article 4 Environmental Objectives	Justification is required for the definition of heavily modified water bodies for reasons of technical feasibility or disproportionate costs <ul style="list-style-type: none"> <li>• Less stringent time schedule is justified if completing the improvements within the timescale would be disproportionately expensive</li> <li>• Less stringent environmental objectives for specific water bodies could be justified if they are so affected by human activity or their natural condition is such that the achievement of these objectives would be infeasible or disproportionately expensive</li> </ul>
Article 5 and Annex III Characteristics of the river basin district	Each Member State shall ensure that for each river basin district falling within its territory an economic analysis of water use is undertaken. Technical specifications are set out in Annex III: The economic analysis shall contain enough information in sufficient detail in order to <ul style="list-style-type: none"> <li>• Make the relevant calculations necessary for taking into account the principle of recovery of the costs of water services</li> <li>• Make judgements about the most cost-effective combination of measures to be included in the programme under Article 11</li> </ul>
Article 9 Recovery of costs of water services	Member States shall take account of the principle of cost recovery of water services, including environmental and resource costs, in accordance with the economic analysis and the polluter pays principle. Member states ensure by 2010 <ul style="list-style-type: none"> <li>• That water-pricing policies provide adequate incentives for users to use water resources efficiently</li> <li>• Adequate contribution of the different water uses, disaggregated, at least, into industry, households and agriculture, to the recovery of the costs of water services, based on the economic analysis</li> </ul>
Article 11 and Annex VI Programme of measures	Each Member State shall ensure the establishment for each river basin district of a programme of measures, taking account of the results of the analyses required under Article 5, in order to achieve the objectives established under Article 4. <ul style="list-style-type: none"> <li>• “Basic” measures are the minimum requirements to be complied with</li> <li>• “Supplementary” measures are designed and implemented in addition to the basic measures, with the aim of achieving the environmental objectives</li> </ul>

Policies and measures are designed and implemented in the level of river basins taking into account the particular conditions in each region and the environmental objectives that should be achieved. The successful choice of suitable measures and their effective implementation presuppose the participation of responsible institutions and consumers in the processes of decision-making (5, 6).

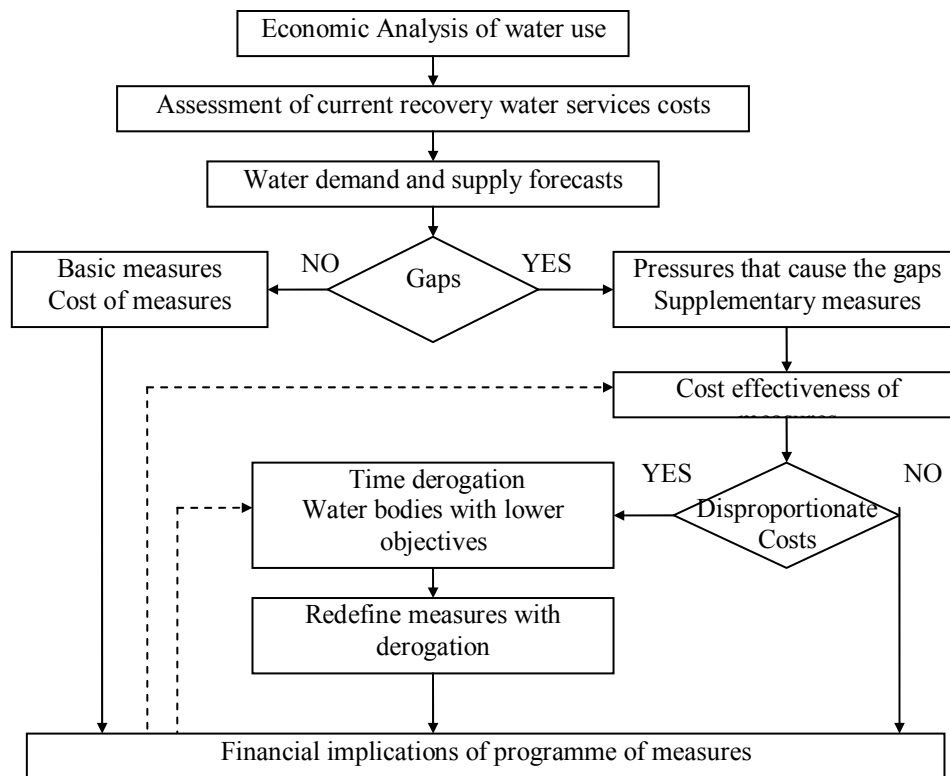
Table 2 presents the timeframe for the implementation of the Directive and the basic steps on the achievement of environmental objectives. Analysis of water resources management problems using economic tools and practices constitutes the basic condition for the identification of the environmental objectives that have to be achieved and the economic consequences of the appropriate measures. The successful selection of the measures requires a cost effectiveness analysis that may lead to the formulation of less stringent objectives or timeframes for specific water bodies. The use of water services pricing presupposes the evaluation of potential impacts in each productive sector and each water use. The program of measures and the water services pricing policies are revised every 6 years aiming to maintain the good status of water bodies.

**Table 2. Timescale for the implementation of the Directive**

<i>Year</i>	<i>Task to be completed</i>
2004	Economic analysis of water uses and assessment of current level of cost recovery
2006	Assessment of gaps from the environmental objectives and cost of measures to reduce those gaps
2007	Assessment of effects of gaps and costs on cost recovery
2008	Selection of measures and assessment of costs, cost effectiveness analysis of measures and presentation of the river basins management plans
2009	Programme of measures and its cost, river basin management plans should be published
2010	Water pricing policies and appropriate contribution of water uses have to be in place
2012	Implementation of the measures has to begin
2013	Reassessment of effects of measures
2015	Achievement of good quality of inland waters could be achieved

Figure 1 presents the procedure for the implementation of the economic analysis as it is proposed by the WATECO working group. This process includes three steps:

- The first step involves the assessment of the current level of full cost recovery based on the economic analysis of water uses and long term forecasts of water supply and demand in the river basin district. The analysis aims at the development of the Baseline Scenario of the evolution of basic parameters affecting water demand and supply and necessary investments.
- In the second step, the Baseline Scenario is used for the assessment of the anticipated impacts on the quality of water bodies. Potential gaps in relation to the environmental objectives are identified. If there are not any gaps it is considered that the basic measures determined in Article 11 are adequate for the achievement of the environmental objectives and their cost is estimated. If there are gaps, supplementary measures are designed based on the identification and assessment of the pressures that cause these gaps.
- The last step of economic analysis is completed with the assessment of the economic impacts from the application of program of measures. In case where gaps from the objectives of Directive have been identified, the determination of suitable additional measures is required. Initially, appropriate measures to reduce these gaps are determined and their cost effectiveness is evaluated. If the total cost of measures is disproportionate, then time or target derogation can be justified and the cost of required measures to achieve the less stringent objectives is estimated.



**Figure 1. Procedure for the implementation of the economic analysis of the Directive (6)**

One of the most ambitious objectives of Directive, that influence immediately all the productive sectors and all the uses, is the proposal for recovery of the full cost of water services. In the first stage of implementation, Member States have to assess the level in which the full cost of water services is recovered in each river basin. In the next stage they are obliged to use appropriate pricing policies towards the full recovery of water services cost and the extend to which *polluter pays principle* is assessed through the next steps:

- Determination of water service providers, users and polluters
- Assessment of the full water cost
- Identification of the cost recovery mechanism and cost allocation to the users
- Estimation of the level of cost recovery

## 2.1 Identification of water services, users and polluters

The Directive distinguishes water services from water uses determining the services as the activities between the natural water resources and the end uses. Water services are all alteration on the basic characteristics of naturally available water or water that is rejected after each use. According to the WATECO guidelines, the characteristics that are altered by water services include:

- The spatial distribution of water resources (irrigation networks, water supply and sewage networks)
- The time distribution of water resources (dams and storage tanks)
- The height of water (dams and hydroelectric installations)
- The chemical contamination of water (filtration of water for water supply, desalination of seawater or brackish water for water supply and industrial use, treatment of wastewater)
- The thermal pollution (cooling of water used in power plants)

Water uses includes all water services together with any other activity having a significant impact on the status of water. This definition covers most of human activities as agriculture, households, industry, navigation, flood-protection and production of energy.

The most crucial step, in the assessment of the water services cost recovery, is the determination of the service providers, users and polluters. The spatial analysis, the type of entities involved and the type and extent of environmental impacts from the provided services are the main factors that have to be analysed.

The geographic level of the economic analysis can be defined on the basis of several criteria such as the water basin boundaries, the regions in which different water service companies operate or finally, the market is covered.

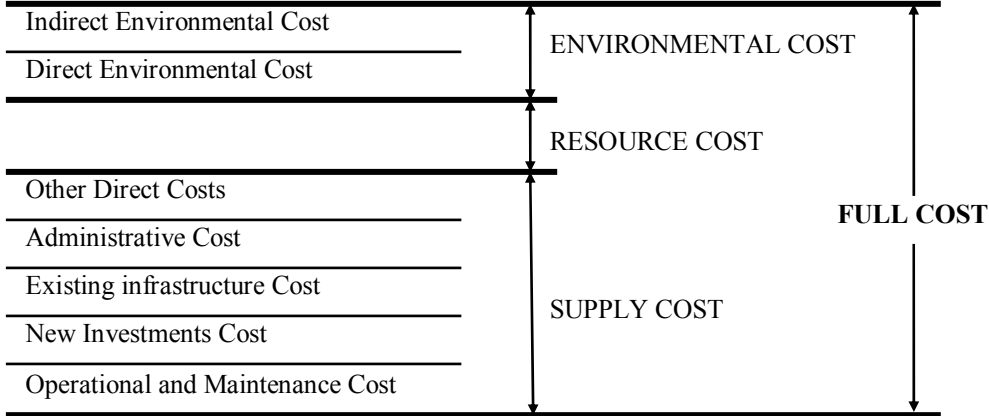
In many cases, the distinction between service providers and service users is very difficult because part of services is provided by the users (eg privately-owned drillings for irrigation, wastewater treatment for industries). The main difficulty is the evaluation of the level of costs already covered by the users and the additional cost that should be covered.

The application of the “polluting pays principle” in cases of important diffuse pollution is very difficult. Additional cost for water services due to diffuse pollution cannot be allocated to the polluters but in most cases it is distributed among the users of the services.

**2.2 Assessment of the full cost of water services**

Article 9.1 of the Directive refers to the recovery of the full cost of water services and clarifies the cost components that should be included in the full costs. Figure 2 presents the components of full water cost that include:

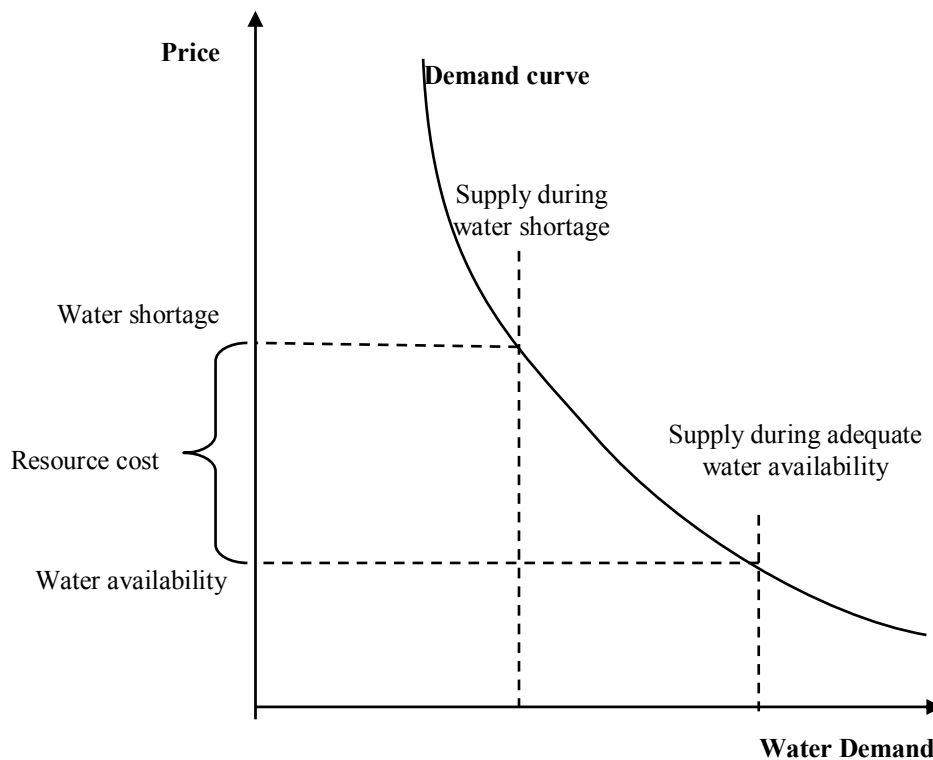
- The supply cost that includes the costs of investments, operation and maintenance, labour, administrative costs and other direct economic costs.
- The resource cost that represents the loss of profit because of the restriction of available water resources.
- The environmental cost that represents the cost from the damage on the environment and aquatic ecosystems caused by the water uses and services.



**Figure 2. Components of the full water services cost (6, 7)**

The estimation of supply cost is rather easier but requires the choice of suitable values for all the parameters as investments lifetime, discount rates, value of existing infrastructure and depreciation methods. General taxes and subsidies are not included, while the environmental taxes are included in the environmental cost since they constitute part of this cost.

An assessment of the resource cost is based on the estimation of the water price before and after the reduction of water resources. Figure 3 outlines the estimation procedure. The demand curve should be available as well as the availability of water resources.



**Figure 3. Estimation of the water resource cost (6)**

When the water demand for all the uses is covered adequately, the resource cost is zero. The resource cost increases considerably when water shortages occur for certain water uses. The resource cost for a specific use could be assessed on the basis of the foregone economic benefits from competitive water uses (7).

The environmental cost can be assessed using several methods such as:

- *Market methods.* These methods use price fluctuations of products and services in existing markets. The fluctuations that depend on changes of environmental parameters provide a measure of the environmental costs. Market data are required for the use of these methods that are not always available.
- *Methods based on costs.* Estimate the cost for preservation of an environmental good which represents a measure of the environmental value of this good. Although environmental costs are underestimated these methods provide a good starting point. Costs of measures already taken should not be included (they are included in the economic supply costs)
- *Preference methods.* These include methods such as hedonic pricing, recreational demand models, averting behavioral models that are based on the estimation of the value of specific activities as a measure of the environmental costs and benefits. These methods are complicated and time demanding and apply to specific problems.
- *Willingness to pay methods.* Assessment of the willingness to pay for the preservation of an environmental good by using questionnaires.

### 2.3 Allocation of cost to the users

The mechanism of water cost recovery is determined by the structure of system of prices, charges, taxes and subsidies that each water user pays. The WFD implies that users of water services should pay prices proportional to the cost that they cause. The economic analysis of water uses provides the essential information for the estimation of the full cost of water services. Consequently, the allocation of the full water cost in the users and polluters should be based on the quantity of services that they used and the cost that is caused from each user.

One of the characteristics of the water sector has always been the dependence on significant government funding either through grants for the development of the necessary infrastructure or price subsidies to the consumers. In general, these grants and subsidies reduce substantially the participation of the service users on the recovery of water costs.

Article 9.1 of the directive determines that an “adequate contribution of the different water uses” should be achieved through the water pricing policies. This requirement suggests that grants, subsidies and general taxes should not be taken into account in the estimation of water services costs and the design of the cost recovery mechanism. Moreover, it suggests that efforts should be made to expand the level of user contribution on the recovery of water services costs.

### 3 Water pricing and environmental objectives

The Directive recognizes that water pricing constitutes an important instrument for the achievement of environmental objectives and sets the objectives and the priorities of water pricing policies in Article 9.1 (“Member States shall ensure by 2010 that water-pricing policies provide adequate incentives for users to use water resources efficiently and thereby contribute to the environmental objectives of this Directive ...”).

The water pricing policies contribute in the achievement of the Directive’s objectives when the reduction of consumption and pollution has as a result the important reduction of cost for each user. For this reason, the prices should be proportional with the consumption of water and the pollution that is caused by the use. In this frame, rational prices of water that contribute in the achievement of objectives of Directive can be described, through the following equation (6):

$$P = F + a \cdot Q + b \cdot Y$$

P=Total price

F= Constant component (related to the fixed costs)

a= Charge per unit of water used (covers variable costs such as pumping, operating and maintenance costs)

Q= Total quantity of water used

b= charge per unit of pollution emitted to the environment (covers environmental costs)

Y= Quantity of pollution caused

Depending on the specific objectives that should be achieved, the parameters that determine the final price of water they can have different values.

- Time differentiation of prices is imposed when higher prices are necessary in periods with low water resources availability so that the water consumption will be reduced. The time differentiation of prices is achieved with different charges per unit of water consumed (a) on a seasonal or hourly base, depending on the particular conditions.
- Differentiation of prices depending on the level of consumption constitutes an effective incentive for the reduction of consumption from large consumers. For consumption up to a specific level, the values of factors (a) and (b) are usually very low while for the next consumption blocks these values increase substantially.

- In general, the constant charge (F) should not be very high compared to the consumption and pollution charges because it would act as a disincentive for the reduction of consumption.

When designing water pricing policies the specific characteristics for different users should be taken into account. The potential for water consumption reduction is limited in cases where the water cost is small concerning the total cost of production (for industrial use or agriculture) or the income of consumers (domestic use) and in cases where technical solutions for the reduction of demand are not available. The elasticity of demand on water prices constitutes a basic measure of the effect that prices have on water demand and varies temporally as well as between different levels of consumption.

#### **4 Application of Directive in Greece**

The application of the WFD in Greece constitutes a challenge since the existing water management practices are considerably different from the principles and objectives suggested. Greece is characterised by high differentiation in the availability of water resources between different river basins and low availability of water resources in the most developed regions. Irrigation water demand (more than 80% of total consumption) in combination with substantial tourism growth pose high seasonal fluctuations on the demand. Water infrastructure has been developed with important government subsidies while extensive needs for further development in most of the river basins still exist.

Water pricing for domestic and industrial use is characterized by prices and charges designed for the recovery of operational, maintenance and administrative costs as well as a small part of the investment costs. The environmental and resource cost are recovered in a very small level mainly through funding of the wastewater treatment facilities in the industrial sector. The pricing system in agriculture allows for a limited recovery of operational costs while the rest of the cost components are not taken into account.

In this framework, water pricing policies can involve important increases of prices and consequently they might have important implications in the sectors where they will be applied:

- In agriculture there is a significant elasticity of water demand on prices. Consequently, increase of water prices would lead to irrigation practices with less water losses. However, the adoption of those practices might require significant investments from the farmers. Another approach might be the substitution of the cultures with less water intensive ones. In cases of cultures where there is not any elasticity of demand, small increase of prices of water, will have important effects on the prices of products, the competitiveness and the income of farmers.
- In the industry, further reduction of demand could be achieved, since the prices of water are very low concerning the economic profit from its use. Nevertheless the price increases should be substantial in order to have a measurable effect. It should be stressed that the industrial sector already covers part of the environmental cost through funding and operation of wastewater treatment plants. Stricter environmental objectives will increase considerably the environmental cost with important implications in the competitiveness of enterprises.
- In the households sector, prices are very low in most regions and the demand for water services is continuously increasing. The demand elasticity has not been analyzed extensively in all regions but it is considered that important potential of demand reduction exists.

#### **5 Conclusions**

The Water Framework Directive creates a new and dynamic model of water resources management in the level of river basins aiming at the protection and enhancement of the status of aquatic ecosystems. At the same time, the implementation of the Directive is a challenge that Member States have to face in very stringent timeframe. The incorporation of the Directive in the Member States national legislation requires a realistic evaluation of the current institutional capacity and the setting up of new structures aiming to an effective implementation. Moreover, it creates extensive requirements for research and development of the necessary principles, methodologies and tools for the achievement of the Directive's environmental objectives.



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