European Commission

Potential for stimulating sustainable growth in the water industry sector in the EU and the marine sector - input to the European Semester

Water Industry Final REPORT

Framework Contract ENV.F1./FRA/2010/0044

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Accronyms

DWD: Drinking Water Directive

ERC Environmental and Resource Costs

ERDF: European Regional Development Fund

ESF: European Solidarity Fund

FD: Floods Directive

MS: Members State

UWWTD: Urban Waste Water Treatment Directive

WFD: Water Framework Directive

WSS: Water Supply and Sanitation

Chapter 1. Introduction

One of the EU answers to the current economic crisis was the annual launch of the EU Semester process that aims to stabilize the European economy and prepare it to meet future challenges through increased coordination. The European Semester provides the EU with a policy framework within which national economic policies and national budgets are to be designed for the year. Through this process and following the publication of the Annual Growth Survey which the Commission sets out the key economic policy priorities for the year to come for each Member States (MS). Following a review of the report, EU leaders agree on a common direction for fiscal and structural policies as well as financial sector issues.

Box 1– Key historical directives related to the water industry

The **Drinking Water Directive (DWD)** 98/83/EC aims to make sure that drinking water everywhere in the EU is wholesome and clean. The directive sets standards for the most common substances (so-called parameters) that can be found in drinking water. According to the directive, Member States are obliged to regularly monitor drinking water quality and to provide consumers with adequate and up-to-date information on their drinking water quality.

The **Urban Waste Water Treatment Directive (UWWTD)** 91/271/EEC has the objective to protect the environment from the adverse effects of urban waste water discharges and discharges from certain industrial sectors and concerns the collection, treatment and discharge such waste water. Targets:

•The collection and treatment of waste water in all agglomerations of >2000 population equivalents (p.e.);

•Secondary treatment of all discharges from agglomerations of > 2000 p.e., and more advanced treatment for agglomerations >10 000 population equivalents in designated sensitive areas and their catchments.

In this context, the Commission services identified a need for underpinning material providing insight on the macro-economic impact of water and marine policies, together with recommendations on how such policies can best contribute to the Europe 2020 objectives of a smart, sustainable and inclusive growth. DG Environment thus launched two parallel studies aimed at exploring the links between water policy, economic growth and job creation, and namely:

- “Potential for Growth and Job Creation through the Protection of Water Resources”, aiming to assess the likely impact of the protection of water resources, and in particular of the implementation of the WFD and Flood Directive, on growth and job creation, also identifying those MS which are likely to be most impacted.
- “Potential for stimulating sustainable growth in the water industry sector in the EU and the marine sector - input to the European Semester”, whose objective is to provide an assessment on the potential to foster sustainable growth through the full compliance of the Water Industry-related (Box 1) and Marine Directives.

Interim outcomes and recommendations were already used as an input to the European Semester. This report presents the final results of the project. A report summarizing the main outcomes of both projects is also available.

Outline of the report

This report presents the outcomes of the study in the following manner:

- The objectives and methodology of the project (Chapter 2) to gather an updated picture of the water industry and its macroeconomics implication in the EU;
- The outlook at the water industry in the EU by taking stock of its structure and macroeconomic dimension (Chapter 3);
- The level of implementation of the DWD and UWWDT directives and potential full implementation macroeconomic effects at EU level trough a modelling exercise (Chapter 4)
- The review of financing and available instruments to incite compliance (Chapter 5)
- The conclusion and recommendations of the study (Chapter 6)

Chapter 2. Objectives and methodology of the study

The study is a stock-taking exercise on the size and sustainable growth potential of the water industry operators[1]. The objective of this project was to provide an assessment on the potential to foster sustainable growth through the full compliance of the Water Industry-related and Marine Directives[2]. The outcomes of this assessment provided information in water for the European Semester.

The specific contribution of the assessment to the Semester exercise for water industry is a mid-term development of more systematic methodologies and background analysis for water industry. The assessment addressed the following specific objectives:

- Carry out a stock-taking exercise on the size and sustainable growth potential of the water industry operators as well as the construction industry active in the water industry sector;
- Prepare an analysis of the potential benefits for the economy of full implementation of the existing legislation, and the availability or lack of economic instruments that could incite compliant implementation;
- Provide recommendations on how to best achieve sustainable growth through full ("smart") implementation of the EU environment legislation.

The assessment is presented for all EU28 Member States (MS) in order to provide information on the potential economic impacts of full compliance with the Urban Waste Water Treatment and the Drinking Water Directives for each MS. This approach was completed by an EU-wide assessment that accounts for the functioning of the EU internal market and economy[3].

Methodology

The existing and potential macroeconomic links of the water industry to the economy from two different perspectives: an MS level assessment approach (Tasks 1, 2, 4) and an EU-wide analytical approach (Tasks 3 and 4). These two approaches are complementary and their outcomes are linked in this report.

Figure 1 summarises the different Parts and Tasks along with their inter-relationships which are developed below.

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[1] The construction industry active in the water industry sector is considered indirectly through the macro-economic effects of the water sector over the economy as a whole. No specific information is available on the construction sector dedicated to water industry.

[2] The Marine part of the project is developed in a separate report.

[3] This assessment was also carried out in close interaction with the parallel study titled "*Potential for Growth and Job Creation through the Protection of Water Resources, with a Special Focus on the Further Implementation of the Water Framework Directive and Floods Directive*" proposed under Framework Contract ENV.D.1/FRA/2012/0014.

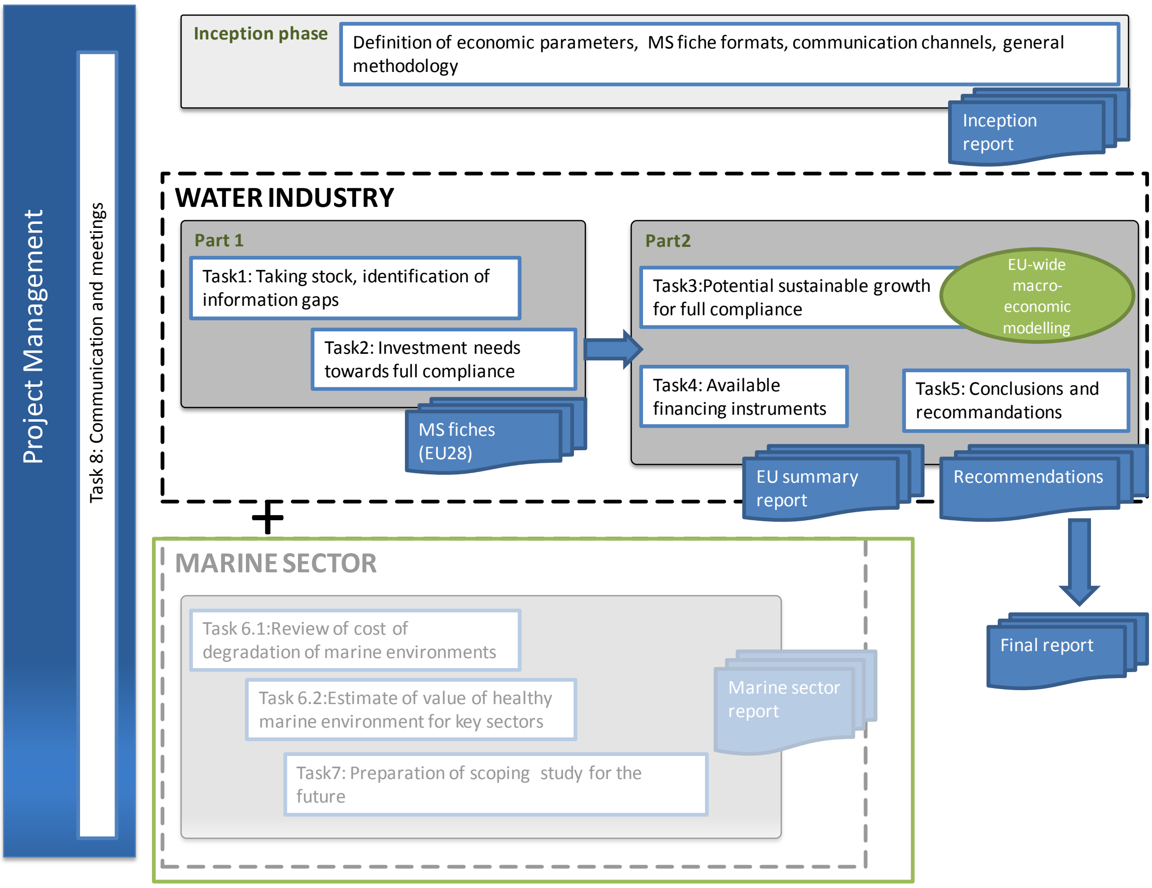

Figure 1. The overall methodology of the study

(Please note that the study on the marine sector is being addressed in a parallel report, so its flow is not described here).

The MS-level assessment approach

The MS-level assessment approach consists of taking the way countries are implementing or proposing to implement EU water legislation and then to assess its economic impact over a set of economic aspects such as growth, employment, fiscal balances, innovation, etc. This approach builds on using standard macroeconomic assessments at a Member state or EU-wide level. Although the approach could be applied to past water policy (i.e. how has previous water policy and in particular the first RBMPs contributed to smart growth), the current WFD implementation and ambitions of the first RBMPs favour looking ahead on what could be expected from achieving the objectives of EU water policy (WFD, Floods Directive, sustainable quantitative management of water resources, etc.). For the purpose of this study, all EU28 MS were reviewed.

For each MS, based on a data collection template, two deliverables were produced:

- A **MS country fiche**, presenting a narrative with the key features and issues concerning the relationships of the water industry and policy with economic growth in the country. Each fiche includes the following headings: (i[4]) the country's economy at a glance; (ii) water management in a nutshell developing on the industry structure and its condition along with more general water management issues; (iii) water as an economic asset focusing on the macroeconomic weight of the water industry; (iv) water policy, and particularly on the implication on economic growth of compliance with the water Directives ; and (v) water efficiency: opportunities and challenges for green growth. The complete MS fiches are collected in Annex I, along with their respective annexes;

- An **MS recommendation** sheet, which provides a basic synthesis of the elements presented in the fiches and, based on such findings, proposes key recommendations for promoting economic growth and job creation through water policy and EU Directive compliance in the country. Key MS recommendations are summarized later in this report, whereas the complete MS recommendations are collected in Annex II.

The production of the deliverable followed the process described in Figure 2, below:

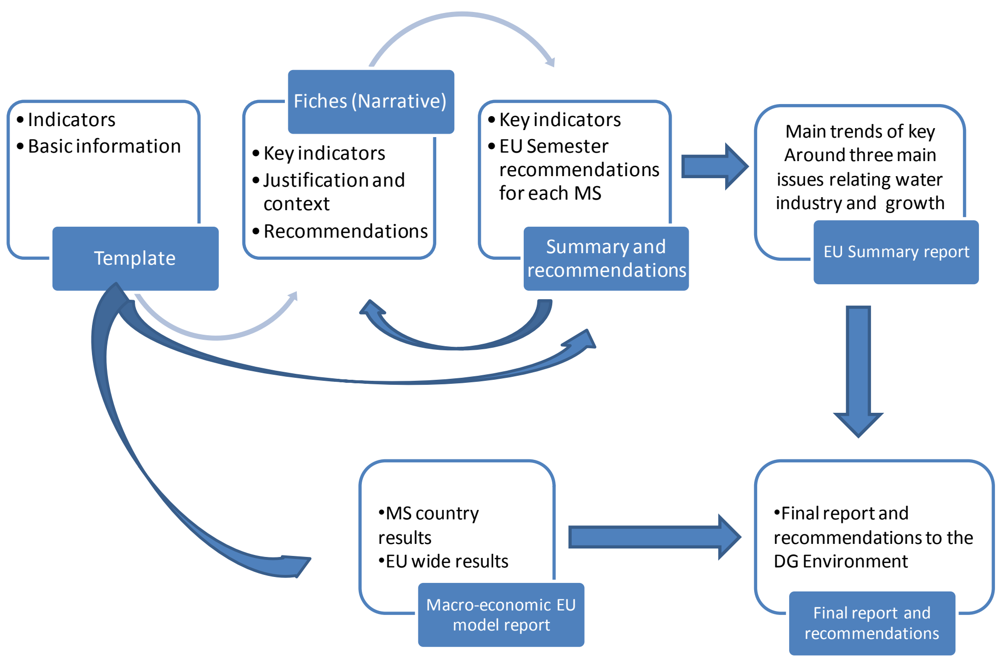

Figure 2. Sequence of deliverables.

The EU-wide analytical approach

The EU-wide analytical approach involves the discussion of how investment in water industry and water policy could be improved in order to enhance its contribution to (smart) growth. At the EU level, the Cambridge Econometrics macro-economic E3ME model assesses can translate relevant water policies (i.e. WWTD, DWD compliance) into an increase in investment in the water industry and, more broadly water sector (i.e. WFD, FD), financed by an increase in water prices, taxes and European funding. The model can then provide outputs in terms of the impact on sectoral employment,

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[4] Both the MS country fiche and the MS recommendations were developed in coordination with the study on 'Potential for Growth and Job creation through the Protection of Water Resources' for its 12 selected MS, which focused on the implication of the WFD and the FD.

output and prices. There is also scope to model an increase, over time, in the efficiency of the water sector.

Clearly, this EU-wide assessment will not address all the dimensions and investments of EU policy. However, it will provide a coherent basis for comparing MS and for understanding the robustness of the results of individual MS assessments. This is expected to significantly enhance the value added of the assessments performed in this study.

The E3ME model

This paragraph summarizes the main characteristics of the E3ME, for a detailed description please refer to annex III.

E3ME is a computer-based model of Europe's economies, energy systems, and the environment (hence the three Es); more recently it has been expanded to also include physical material demands. E3ME was originally developed through the European Commission's research framework programmes and is now widely used in Europe for policy assessment, forecasting and research purposes. Figure 3 provides an overview of the model structure.

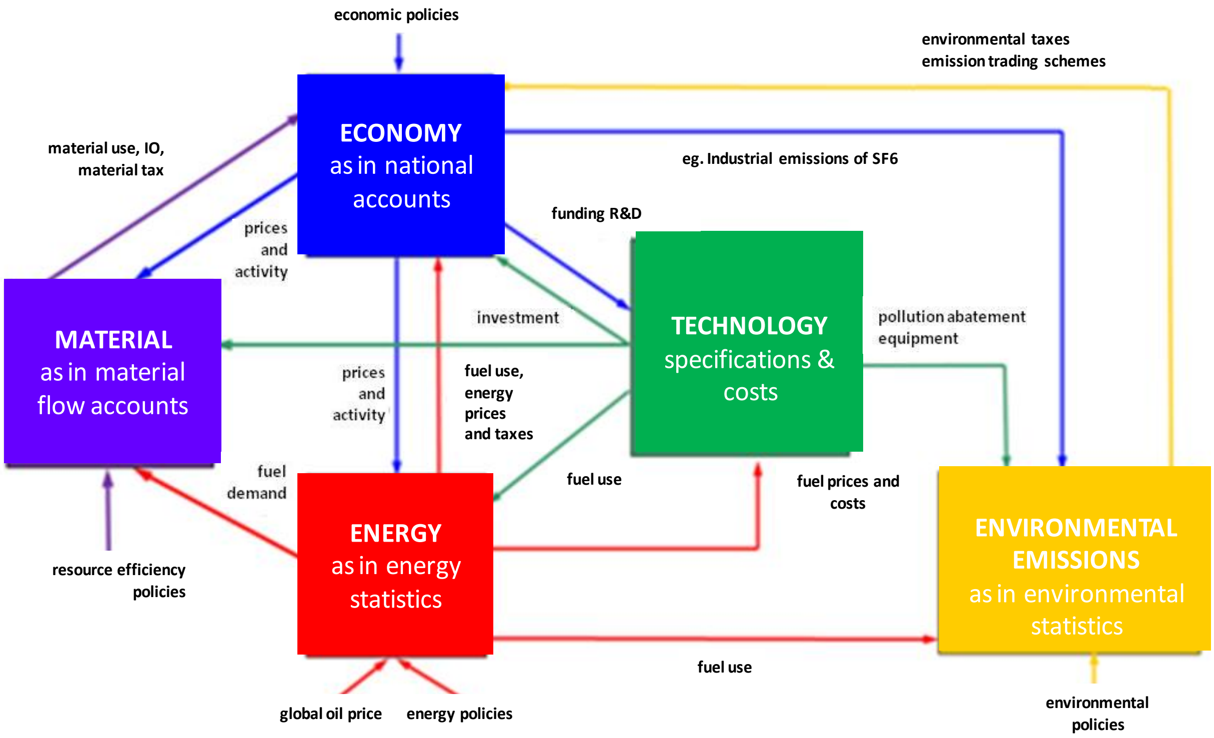


Figure 3. Overview of the E3ME Model.

The economic structure of E3ME is based on the system of national accounts, as defined by ESA95 (European Commission, 1996), with further linkages to energy demand and environmental emissions. The economic model includes a full set of macroeconomic feedbacks at the sectoral level that capture supply chain impacts and multiplier effects. In total the model comprises 33 sets of econometrically estimated equations, covering the individual components of GDP (consumption, investment, and international trade), prices, the labour market, energy demand, and materials demand. Each equation set is disaggregated by country and by sector.

The main dimensions of the version of the model used for this analysis are:

- 33 countries (EU28 Member States, Norway, Switzerland and three candidate countries)
- 69 economic sectors (2-digit NACE rev2 level), including a disaggregation of the energy sectors and 38 service sectors
- 43 categories of household expenditure
- 21 different users of 12 fuel types
- 14 types of air-borne emissions including the six greenhouse gases monitored under the Kyoto protocol
- 13 types of household, including income quintiles and specific socio-economic groups

Water industry is represented in the model purely as an economic sector defined at the NACE Rev. 2, two digit level as E36 Water collection, treatment and supply. While equations for the demand for water in terms of its physical flows exist as part of the model's materials module, these are not currently operational due to the quality and coverage of the available historical time series of water prices and water consumption (in physical volumes). This will be developed further in future.

Due to the data limitations we are not able to directly estimate a price elasticity for water and instead assume a value taken from the applied econometric literature. While there is a relatively extensive literature on the estimation of household water demand, estimates of non-household water demand are less common. Furthermore, few studies have been carried out which estimate a price elasticity of demand for water, disaggregated by user-type, using European data (European Commission, 2000b). Of those studies which do, NERA (2007) estimate a price elasticity of -0.24 for non-household water demand using UK data and Reynaud (2003) estimates the price elasticity for industrial water demand in France of -0.29. European Commission (200b) cites estimates of the industrial price elasticity derived from US data ranging between -0.11 and -0.44 (although these estimates are now quite dated, having been made in 1991).

On the basis of this limited evidence, for the purpose of this modelling experience we have assumed industrial price elasticity -0.25. This implies that a 1% increase in unit water prices will result in a reduction in industrial demand for water of around 0.25%.

E3ME is similar in many ways to a Computable General Equilibrium (CGE) model and produces a similar set of outputs. However, E3ME does not impose the assumptions about the nature of the economy that are typically incorporated in CGE models. Instead E3ME follows a more empirical approach, with behavioural parameters estimated using historical data sets rather than imposed or calibrated to conform to neoclassical economic theory. This means the model's empirical validity does not depend on the validity of the assumptions common to CGE models, such as perfect competition or rational expectations, but it does mean that the model's validity depends on the quality of the data that are used to estimate the parameters.

The econometric specification also allows for an assessment of short-term impacts, which is important when considering the period up to 2020.

The key characteristics of E3ME for this exercise are thus:

- its coverage of the EU at Member State level
- its full representation of the national accounting system
- its econometric specification, allowing for analysis of both short and long-term impacts

Chapter 3. Water industry and economic growth: taking stock

Water industry: its structure

The water industry is structured in different ways throughout the EU. The importance of the structure of the industry for this report lies in the consequences on efficiency and the diversification of funding[5] it can bring to a sector which is characterised by natural monopoly and faced with increased public budget restrictions. However the diversity of systems and the lack of truly systematic indicators[6] prevent a meaningful comparison of performance or ways to predict it (Boscheck, 2013).

By structure we focus here on the spectrum of **ownership** and **organisational options** that provide both water supply and sanitation services. **Ownership** tends to be divided as follows:

- Public (State or mainly municipal level);
- Public-public partnership (i.e. Municipal and State, among various municipalities, etc.) ;
- Public-private partnership (PPPs-different models);
- Private.

In turn and following previous reviews[7], Moreau-Le Golvan and Bréant (2007) highlight the four dominant types of **organisational arrangements** which include:

- Direct public management (Public ownership and direct management by administration);
- Delegated public management (Public ownership and management delegated to separate public enterprise);
- Delegated private management (Public ownership and private management);
- Direct private management (Private ownership and management).

As pointed out by Hoffjan and Müller (2012) municipalities (or *direct public management*) were traditionally the owners and managers of both systems in most EU countries. In many Member States this model is in transition towards alternative structures (van Dijk and Schouten, 2004). Today private companies play an increasing role in how the services are delivered and can reach full ownership and management, at the end of the spectrum.

However, recent high profile returns from delegated systems to direct public management or "re-municipalisation" (i.e. Paris (France[8]), Berlin (Germany) or Pecs (Hungary – Hall and Lobina, 2012) are examples that the transition is not unidirectional or that it can be simply equated to improved performance.

[5] This aspect is further developed in Section "*Financing and available instruments to incite compliance*"

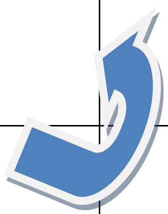
[6] Systematic and comparable "*headcount per 1000 connections, piping material per application based on lifetime costs or optimal leakage targets based on cost-benefit analyses*" (Boscheck, 2013)

[7] Studies referred to : Eureau 1992; Eureau 1996; van Dijk and Schouten 2004

[8] About 40 French municipalities have re-municipalised water services, including Bordeaux and Brest (Hall and Lobina, 2012).

Table 1. Matrix classifying institutional arrangements according to direct/delegated management and public/private management and a transition path followed by several MS.

Private Management (providing service to at least 30% of the population)	England & Wales WS ***Cyprus D****	France WS Spain WS ***Czech Rep. WS*** ***Greece WS*** ***Hungary WS*** ***Poland WS***
Public Management	Denmark WS Luxembourg WS Switzerland WS Sweden WS Austria WS Germany S Finland WS The Netherlands (S-collection) Belgium (S-collection) North. Ireland WS Rep. of Ireland WS Bulgaria WS ***Cyprus WS*** ***Romania WS*** ***Lithuania WS*** ***Slovenia WS*** ***Slovakia WS*** ***Croatia WS***	Belgium (W & S-treatment) The Netherlands (W & S-treatment) Germany W Scotland WS Italy WS Portugal WS ***Malta WS*** ***Latvia WS*** ***Estonia WS***
	Direct Management	**Delegated Management**



W:Drinking water
S: Waste water treatment Sanitation
S-collection: Waste water collection only
S-treatment: Waste water treatment only
D: Desalination
* Under the BOOT (Build, Own, Operate and Transfer) system opened to private operators

Sources: Updated from van Dijk and Schouten (2004), Moreau-Le Golvan and Bréant (2007), Pérard (2012) by authors to include more recent (highlighted) MS, including Croatia.

Structure is also diverse at the level of utility companies themselves. The average number of persons employed per enterprise, which ranged from less than five in Ireland, Austria and Denmark to more than 200 in Bulgaria and Slovakia (Eurostat, 2013).

A process of restructuration, particularly in Eastern European MS, can also be associated to the transition described (Table 1). A first process mainly taking place in the 1990s consisted of the transfer of highly centralised state water management agencies to regional governments and, in most cases, to municipalities. This process created a constellation of fragmented entities with disparities in their managing capacity. A new process aimed at consolidating the sector is sought after, mainly in Eastern European water industries. However, this fragmented structure is also shared by well performing sectors such as the German, Austrian or Danish potentially inhibiting efficiency improvements through consolidation (Wackerbauer, 2009). The current crisis has been a powerful driver for restructuration. This is particularly the case of Greece were the number of entities managing water services was reduced to almost half, following the administrative reforms introduced (Greece, 2010).

Despite being a utility industry, the sector is not subject to the same common regulation of network services as electricity or telecommunications are at European level.

Water supply: The issue of leakages of supply networks.

Leakage in supplying systems remains an issue for many MS, despite the progress made in the last 10-15 years (from Figure 4 to Figure 5).

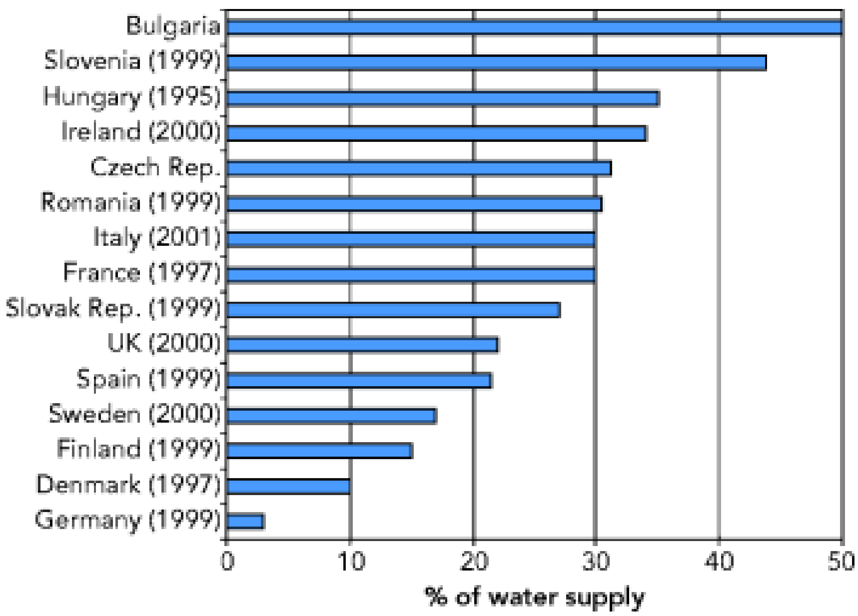


Figure 4. Losses from urban water networks (2003).

Source: EEA (2003).

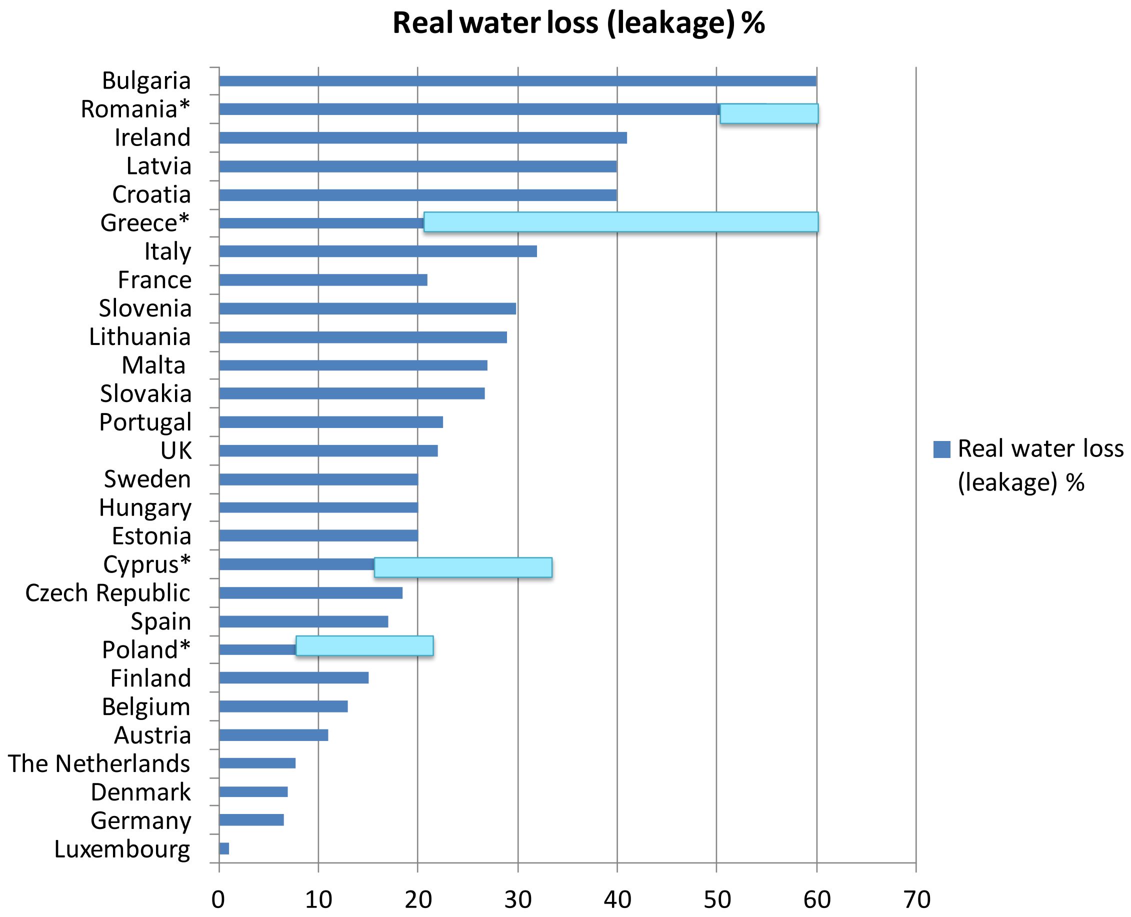


Figure 5. Water losses of water supply networks as averages of volume supplied (%).

Source: National sources (Country Fiches). This figure gathers the national data available for different years, according to availability. * For Romania, Greece, Cyprus and Poland the figure presents average ranges.

Efficiency targets to manage and reduce losses of the networks have been an important tool to address this liability of the supply systems and continue to be so (Box 2).

Box 2– Leakage and the potential provided by efficiency targets in the UK:

By 2015, the water savings that companies will make by meeting water efficiency targets imposed by the regulator Ofwat by reducing leakage, and increasing metering will amount to more than 100 billion litres per year, enough water to supply the cities of Liverpool, Bristol and Brighton for more than a year.

Water industry: water as an economic asset

Water industries, both publicly or privately managed, are **net contributing sectors in terms of added value and employment**. The total gross value added (GVA) of the water industry (collection, treatment, supply and sewerage) reached €43,84 billion, that is 0,35% of the total EU28 value added in 2010 (Eurostat, 2013). For reference, the sustainable water management market[9] was estimated in 2011 at €361 billion worldwide (BMU, 2012).

However, it major strength resides in its **stability, especially in times of economic crisis**. As shown in Figure 6, in fact, the **total GVA** grew fairly steadily until 2007; as an effect of the crisis, the sector showed a slight decrease in the years 2008-2009, but it appeared to recover already in 2010, when many economic sectors were still suffering from the crisis.

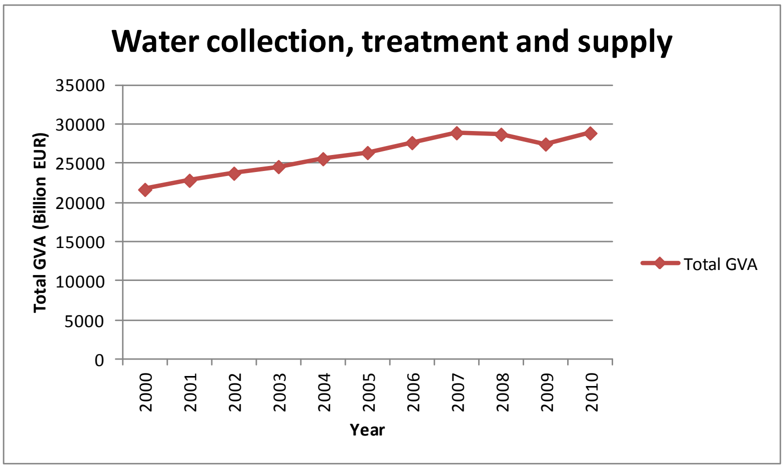


Figure 6. Gross value added of water collection, treatment and supply: trend in the period 2000-2010 (Source: Eurostat).

Similarly, **employment levels** in the water sector industry have remained rather stable in the last decade (see Figure 4): with the onset of the crisis, the **employment index** for the total industry has had a sensible decline, while the same index **for water collection, treatment and supply has remained more or less stable**. This highlights the **stabilising role of the water industry** in periods of economic crisis and recession.

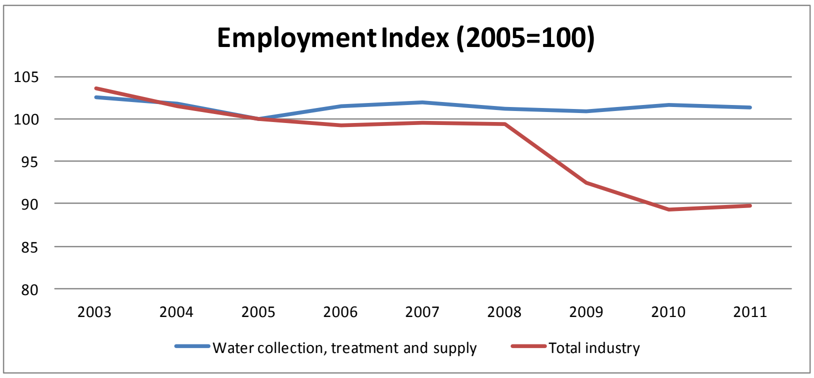


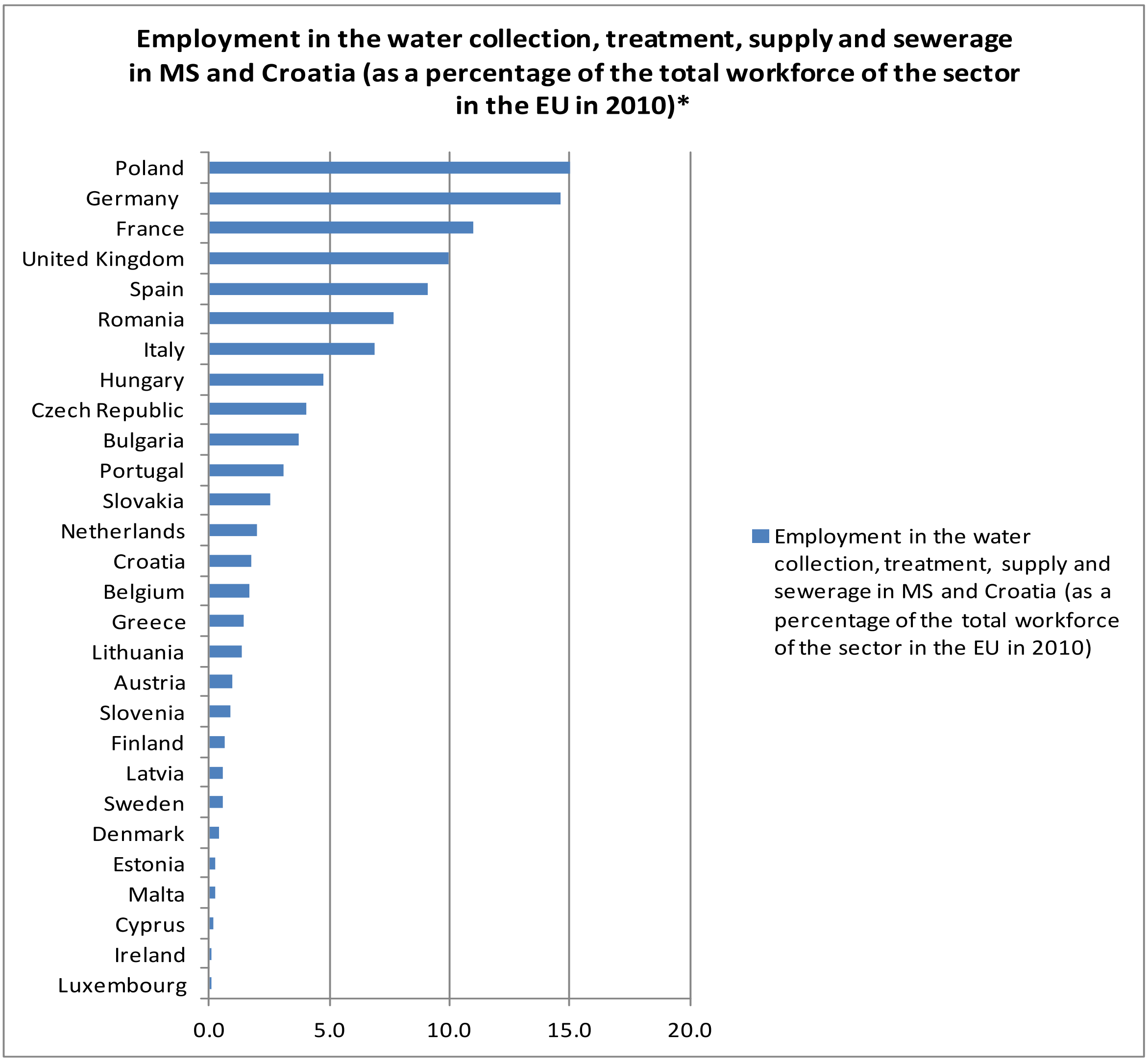
Figure 7. Employment in the water industry – EU level (Source: Eurostat).

More in detail, in 2010 about 499,000 full-time equivalent jobs depended on water supply in the EU28.

[9] This market has segments that follow the water cycle: i) water production and treatment, ii) water distribution, iii) efficiency of water usage and iv) waste water treatment and disposal.

The relative importance terms of number of employees in full time equivalent units in the water collection, treatment, supply and sewerage sectors generally reflects the size of the population in the various countries with Germany employing 15% and France 12% of the total EU workforce in this sector respectively. The sector is also important in Poland, Spain and Romania (Figure 8). However, by comparing the absolute numbers to the served population, that is number of full-time equivalent employee in the sector per 10 000 inhabitants, there is an East-West divide (if we exclude Malta, which cannot benefit from economies of scale due to its size) that emerges with Eastern MS dedicating twice as many jobs to these tasks than their Western counterparts (Figure 9).

Although the sector has remained fairly stable in terms of employment, this divide and the related structural fragmentation of its activity in many of the same countries registering high proportion of jobs to served population, may change in the years to come, potentially reducing the direct employment weight of the sector. Current efforts to consolidate the water industry in some Eastern MS (moving from a very high number of small water service suppliers to larger water services) might in the medium term reduce the employment weight of the sector in these countries. It is important to stress that the relationship between active jobs and number of beneficiaries is not a linear one and that a high spatial distribution of users will also increase the number of needed personnel. Concentrated urban areas required fewer personnel. That said, activity in sewerage (and we would expect in waste water treatment activities in general) translated in the creation of jobs in specific part of the sector in all Easter European countries with the exception of the Czech Republic and the Baltic States.



*Belgium (2009); Estonia (non-full time equivalent, 0,16% of the active population), Greece (2009), Luxembourg (employed in water supply only, non-full time equivalent), Malta (non-full time equivalent-WSC, 2011-), Poland (non-full time equivalent, water supply only-Polish Central Statistical Office, 2012), Slovenia (water supply only).

Figure 8. Employment in the water collection, treatment, and supply sewerage in the EU28 (full-time equivalent employees as a percentage of the total workforce of the sector in the EU) (Source: Eurostat, 2013; Polish Central Statistical Office, 2012; WSC, 2011).

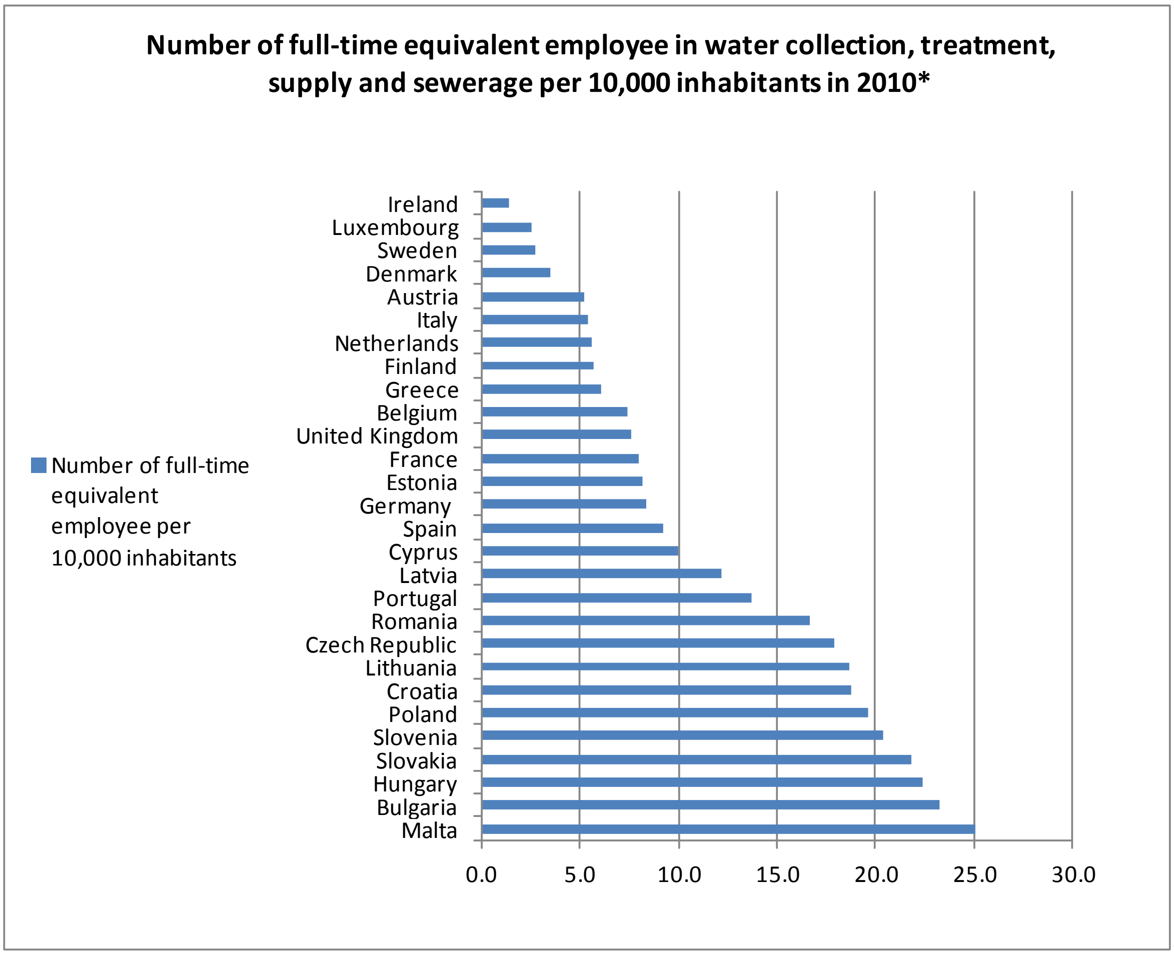


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Figure 9. Number of full-time equivalent employees in water collection, treatment, supply and sewerage per 10,000 inhabitants in the EU28 in 2010 (Source: Eurostat, 2013; Polish Central Statistical Office, 2012; WSC, 2011).

Investigating the employment dimension of the water service industry should go beyond comparing number of jobs directly depending on water supply and sanitation (WSS). Indeed, the water industry offers **a wide range of job types**, from operation & construction to design, research and technology production. An example from France is provided in Box 3.

Furthermore, another major strength of the sector resides in the fact that the largest water industry operators are

Box 3– Diversification of employment in the water sector: an example from France

A good example of the actual ramification of the sector as an employer is the national assessment in France which estimates that water management as a whole represented 174 000 direct jobs in 2011, equivalent to 0.73% of total employment in France (INSEE, 2013). This is well beyond the 52 000 employees reported for the water service industry. It includes for example 3000 researchers and around 133 000 jobs in the private sector.

also active in international markets**, exporting their management expertise and technologies** to non-EU MS[10].

Therefore, water services are not only well-established economic activities, but they are **sources of technological and organizational innovation**, thus supporting economic growth and spurring export opportunities.

[10] This is the case, for example, in France, where the private sector share in 2005 for water and wastewater services was 79%. However, the water industry is very concentrated: three companies (Veolia Eau, Lyonnaise des eaux France and SAUR France) provided water to 69% of the French urban population in 2006, and are also very active in water supply projects abroad.

Chapter 4. Investment needs and growth potential from EU directives' compliance.

4.1 Compliance gaps and investments needs

In contrast to the challenges ahead related to the implementation of the WFD and Floods directives, the implementation of both the DWD and the WWTD is well advanced in most EU15 MS. However, this not yet the case for all of the more recently accessed MS, presenting a general divide between these two groups in terms of investment needs and potential future investment needs.

The Drinking Water Directive (DWD)

The Drinking Water Directive (DWD) 98/83/EC aims to make sure that drinking water everywhere in the EU is wholesome and clean. Improved drinking water service and waste water treatment and the related water infrastructure can significantly reduce the costs on society and at the same time contribute to the achievement of objectives in the Europe 2020 strategy of creating new jobs and stimulating growth. This is especially relevant in New Member States and in areas where lack of water and sanitation still imposes costs to health and potential loss of economic opportunities.

The quality of drinking water in the EU is relatively high. 10 countries (BE, BG, D, FIN, F, EL, LUX, NL, PT,UK) complied with all parameters (microbiological, chemical and indicator). Only few countries reported compliance level below 90 % (KWR, 2011). Connection to public water supply is well developed in Europe and almost all citizens have direct access to public water supply. In general urbanised regions have a slightly higher connection rate than rural areas, where the network is less economically justifiable and population may rely on self supply.

Countries that have good quality public water supplies meeting DWD requirements need to maintain the infrastructure for doing so – and it is the maintenance of infrastructure that the cost associated with meeting DWD is to borne.

Urban Waste Water Treatment Directive (UWWTD)

The Urban Waste Water Treatment Directive (UWWTD) 91/271/EEC has the objective to protect the environment from the adverse effects of urban waste water discharges and discharges from certain industrial sectors (available in Annex III of the Directive) and concerns the collection, treatment and discharge such waste water. Targets:

- The collection and treatment of waste water in all agglomerations of >2000 population equivalents (p.e.);
- Secondary treatment of all discharges from agglomerations of > 2000 p.e., and more advanced treatment for agglomerations >10 000 population equivalents in designated sensitive areas and their catchments.

As for the EU-13, the transition period for the Urban Waste Water Treatment Directive (UWWTD) runs until 2015 (most new MS), 2018 (Romania) and up to 2023 (Croatia).

During the last two decades, waste water treatment has improved throughout Europe as a result of the implementation of the EU Urban Waste Water Treatment Directive (UWWTD) (1991). The last review (EC, 2013a) indicated in its technical report (Umweltbundesamt GmbH, 2012) that:

- 94% of the EU has collective systems (EU 15 97% and EU 12 72%). 18 countries have levels of collection beyond 95% of compliance. Only five Member States would be collecting less than 50 % of the load that should be collected (BG, CY, EE, LV, SI).
- 82% of the EU ensures biological treatment to the effluents (EU-15 88% and EU-12 39%). Ten Member States reach levels of compliance beyond 95%. Nine Member States are on the other hand still below 50% of compliance in this respect (BG, CY, EE, IE, LV, MT, PL, PT, SI)
- As regards provisions in Article 5 (more advanced treatment), the EU as a whole reaches 77% (EU-15 90% and EU-12 14%). Five Member States reach levels of compliance beyond 95% (AT, DE, EL, FI, NL). Twelve Member States are on the other hand still below 50% of compliance in this respect (BG, CY, CZ, EE, HU, IE, LV, LU, MT, PL, PT, SI).

The Directive presents major challenges to several countries and there are still large gaps to live up to the EU regulation requirements. The challenges relate both to i) the establishment (or improvement) of waste water collection systems and ii) the development of the necessary levels of treatment to comply with the Directive.

Significant investments have been made and key infrastructure is in place to a far extent. The current[11] estimated percentage of the population in each EU28 MS which benefits from tertiary level treatment facilities and other less stringent levels is illustrated in Figure 10.

The study on cost of compliance with the UWWTD (COWI, 2010) estimated the compliance costs and financing gaps in MS. It can be seen in Table 2 that some countries have indicated that they might face difficulties in financing the needed investments; Bulgaria, Poland and Romania. Other countries such as Italy, Latvia and Greece have expressed uncertainty about future financing.

[11] As of November 2013.

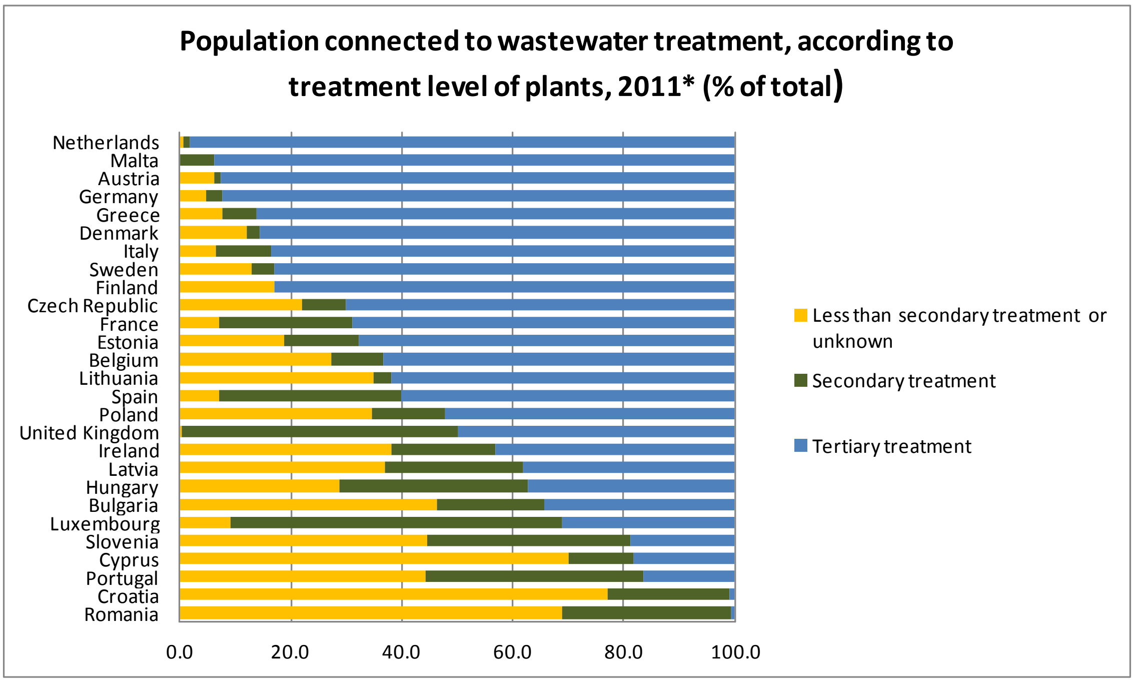

Figure 10. Population connected to wastewater treatment, according to treatment level plants, 2011* (% of total).

*Italy and Cyprus (2005), Croatia and Latvia (2007), France (2008), Belgium and Portugal (2009), Denmark, Germany, The Netherlands, Austria, Sweden and The United Kingdom (2010).

Source: Eurostat (2013), CGDD (2011)

For some Member States (e.g. the Czech Republic) the compliance date is beyond the period 2007 to 2013 but that does not mean that there will be no investment during that period so allocated EU funds might support achieving a later deadline (UWWTD).

Table 2. Indicative financing gaps for 2007 to 2013 and for 2014 until full compliance.

	Compliance costs		**Total reported supply of finance (data incomplete)**		**Financing gap**	
	2007-2013	**2014-**	**2007-2013**	**2014-**	**2007-2013**	**2014-**
Belgium	1161	-	2998	452	1836	452
Bulgaria	3105	2020	939	-	-2166	-2020
Czech Republic	1524	-	6077	-	4553	-
Estonia	178	-	745	127	576	127
Ireland	248	-	1092	-	844	-
Cyprus	363	-	1553	40	1169	40
Lithuania	69	-	263	-	193	-
Luxemburg	67	-	797	-	730	-
Hungary	8	2	2291	140	2283	138
Poland	13756	1300	5078	-	-8678	-1300
Portugal	458	-	1474	-	1017	-
Romania	5003	6338	4067	1077	-936	-5261
Slovenia	150	278	517	-	367	-278
Slovakia	789	87	2181	293	1392	206
UK	348	-	3184	746	2836	746
Denmark	13	-	-	-	13	-
Netherlands	0	-	-	-	-	-
Germany	4	-	342	-	338	-
Greece	890	-	1101	-	211	-
France	1623	-	127	-	-1496	-
Italy	3404	-	228	-	-3176	-
Latvia	171	116	1	-	-170	-116
Malta	58	-	43	-	-16	-
Austria	0	-	-	-	-	-
Finland	243	-	-	-	243	-
Sweden	0	-	-	-	-	-
Spain	1484	4	3826	-	2342	-4

Source: Reproduced from 6th Commission Summary on the Implementation of the UWWTD, SEC(2011) 1561

The financing plans for the next years to ensure compliance of each MS was collected according to availability and important information gaps. The data is presented in Table 6 (page 33) as it is used for the modelling the macroeconomic implication of investing in the sector.

4.2 Growth associated compliance potential and beyond

Benefits

A **well-functioning water supply and sewerage networks are a pre-condition for economic growth**, as it decreases pollution, improves health conditions and cuts down treatment costs for drinking water. Water industry-related investments translate into various benefits that range from (1) health benefits; (2) environmental benefits; (3) benefits for economic sectors and (4) other benefits such as recreational as well as property value improvements (OECD, 2011; WHO, 2004)

Several benefits are associated to the costs of avoiding **no-action** and highlight the preventive benefits of investments (i.e. pollution prevention). However, such investments can be also more **proactively associated to benefits such as the innovation** potential brought about resource management (i.e. potential of energy generation from sewage or agriculture potential for re-use of water and increasingly scarce nutrients).

Indicators, and general economic evidence, on benefits tend to be collected at project level giving place to fragmented account of the economy-wide potential associated with water-industry investments. Such exercises a very rare (OECD, 2011).

However, some examples can be highlighted as of the economic benefits of investing in water industry for illustrative purposes. Table 3 shows a few of such examples. For reference, the 2001 assessment of the benefits of compliance with the environmental acquis (i.e. DWD) for the (then) candidate countries (ECOTEC. 2001), is presented in Annex IV.

Table 3. Examples of benefits from water-industry investments.

Case	Type of benefit	Economic benefit in currency unit million	Source
Valencia region (Spain)	43 WWT plants→overall contribution	€ 164/year	Hernández-Sancho at al. 2010
Improving the quality of recreational waters in the UK	WWT→Recreational	GPB 11900-22800 over a 25-years period	Georgiou etal . (2005) in OECD, 2011
Improving the quality of recreational waters in the Netherlands	WWT→Recreational	€ 2400 for over a 20-years period	Brouwer and Bronda (2005) in OECD, 2011
USA	Water quality improvement*→overall contribution	USD 11000/year	USDA (2000) in OECD, 2011

*Includes both waste water treatment and other measures such as agriculture practice improvements.

As bottled water typically costs hundreds of times more than tap water, the full implementation of the DWD allows for potential savings linked to shifting consumption from bottled water to tap water (COWI et al., 2011), although this may have some employment impacts for the bottling industry. More context specific examples can be illustrated by the extra costs of accelerated compliance investments (Box 4).

Box 4 – Extra costs of accelerated compliance investments

In Italy, a number of smaller water supplies use ground water loaded substances (i.e. arsenic) for which concentrations exceed the DWD thresholds. The Directive allows derogations from these thresholds under very strict conditions and limited in time. Italy now faces a situation where they might not be allowed any longer to apply such derogations. Many of the small water supplies would be able to get water from different source by connecting to larger neighbouring water supplies. This would be the cheapest solution but it will take longer to implement. Thus, small supplies may now face a situation where they have to invest in relatively expensive water treatment equipment which they will only use on a temporary basis until the connection to the larger systems is completed. This is an example of how the compliance costs can be higher if the implementation suddenly has to be accelerated. Due to institutional constrains it has been difficult and slow process for getting the small supplies to take the necessary actions.

COWI (2011) Study on compliance with the Drinking Water Directive.

Going beyond the benefits of avoiding no-action and looking at the proactive benefits, the evidence collected in MS also indicated **research and development** (R&D) as a priority for investment in the EU, particularly in the mature water industries where growth is to depend on innovation rather than compliance.

The records of dynamic water sectors such as the Danish, French, German or Austrian demonstrated that water industry can be cutting edge both with regards to traditional water activities and emerging opportunities activities. One key aspect is the water-energy nexus. For example, the water industry represents 2-3% of net electricity usage in the UK, equivalent to four million tonnes carbon dioxide equivalent every year. Over the last ten years, however, as overall UK GHG emissions have gone down, the water industry's emissions have actually gone up by 30% (Pollutec, 2013). One response is bioenergy from waste water (see Box 5 or bio-plastic). In this sense, a proactive stance towards convergence of water, waste and energy services (Frerot, 2012) is a real possibility.

Box 5 –Self-powered Vienna Waster Water treating plant

The energy-water use link has been explored by Vienna's main wastewater treatment plant which now uses several renewable energy technologies to minimize the required resource input (producing 78 GWh of electricity and 82 GWh of heat).

In the long-term, the plant is to become a net producer of energy (Green Jobs Austria, 2012).

Water industry and economic growth

In turn, such benefits can partially be drivers for economic growth. For an in-depth discussion on the macro-economic interactions of investments in water management, please refer to the report on WFD and economic growth (ACTeon et al. 2013).

Growth models can provide an overview picture of the impact of such investments in the economy as a whole, as developed here through a pan-European perspective. This approach allows an interaction of a sector specific investment (i.e. water industry) with the remaining economy in the short run.

This implies that long-term growth benefits of healthy populations and environments as well as an innovative economy are not captured by these models.

The model baseline for a modelled pan-European perspective)

A forward-looking, ex ante, assessment requires a baseline forecast to which the different policy scenarios can be compared. While this may not necessarily be a forecast of future developments, it is required to provide a neutral viewpoint for the purposes of comparison. Although the model-based results are presented as (percentage) difference from baseline, the values in the baseline can be important themselves.

The baseline used for this modelling exercise is based on the DG Ecfin 'ageing report' (European Commission, 2009), which provides economic projections. We have used the interpretation published by DG Energy (European Commission, 2010) to derive the inputs for E3ME, as this also includes information on energy consumption and emissions that is required by the model. The DG Energy publication is often referred to as the 'PRIMES' projections, after the energy model that is used to produce the figures.

The baseline is summarized in the table below.

Table 4. Summary of Modelling Baseline for EU28

	2010	2030	% pa growth
Population (000s)	502,010	522,904	0.2
GDP (€bn2005)	11,549	15,592	1.5
Employment (000s)	224,777	229,416	0.1
Household consumption (€bn2005)	6,577	8,114	1.1
Investment (€bn2005)	2,691	3,581	1.4
Consumer prices (2005=1)	1.10	1.60	1.9

Sources: Cambridge Econometrics, European Commission.

In order to match the sectoral classifications of E3ME and its annual frequency, it was necessary to carry out the some additional processing and expansion of the PRIMES economic projections. These can be summarised as the following actions:

- Classifications were converted – as E3ME and PRIMES use similar data sources, the classifications also tend to be quite similar. There are, however, some differences, for example E3ME has more disaggregation of service sectors.
- Point estimates for every five years were converted to annual time series – a simple interpolation method is used; short-term forecasts from DG ECFIN's AMECO database were also incorporated to take into account more recent data from the recession.
- Additional social and economic variables were estimated.

This last action is particularly important as, although PRIMES includes a comprehensive set of projections for Europe's energy systems, economic activity is only provided at an aggregate level (e.g. GDP, household spending or value added for some energy-intensive sectors). Since E3ME requires a complete specification of the national accounts, other economic variables must be estimated.

The process of estimating the additional economic indicators was carried out using a methodology that is as consistent as possible between the economic variables, for example ensuring that the components of GDP sum to the correct total, and that similar indicators, such as gross and net output, follow the same patterns of growth.

The published figures provide economic projections for GDP, gross value added (GVA), and household incomes in constant prices. Economic output (which is gross, defined as intermediate demand plus GVA) was set to grow at the same rate as GVA.

E3ME's total consumer spending was set to grow at the same rate as published household income figures, following the standard economic assumption that, in the long run, all income is spent. Detailed consumer spending by spending categories was set to grow using historical trends and was then constrained to the total. Other components of output (at sectoral level), mainly investment and trade, were also set to grow based on historical rolling averages and then constrained to the total output that was based on the GVA projections.

Prices for energy-related industries were set to be consistent with the published energy price assumptions. Prices for other industries were projected using historical trends

The additional processing steps were carried out using software algorithms based in the Ox programming language (Doornik, 2007). The result of this exercise is a set of baseline projections that is both consistent with the published figures and the integrated economy-energy-environment structure of E3ME.

The Policy scenarios

Scenario design

Each scenario is modelled against the baseline scenario which embodies the current level of implementation.

Scenario 1 is the primary scenario set in which investments requirements for the two directives (UWWTD & DWD) that are the focus of this study are modelled.

Scenario 2 is defined only for the 12 member states considered under the parallel study, *Potential for Growth and Job Creation through the Protection of Water Resources* (ACTeon et al 2013). It should be noted that due to complex interaction effects in the model, the impacts from modelling the UWWTD & DWD investments and the WFD, Floods Directive & NSWRE investments separately will not necessarily sum to the impacts from modelling both sets of policies combined (as in Scenario 2).

The investments are modelled as three distinct scenario variants A-B-C(Table 5); one in which financing is achieved through:

A. investments which are **exogenously funded**. Exogenous funding, can be associated with EU or international funding and implies that the impacts of such investments can be seen separately from the impacts of the funding mechanism. Furthermore for some of member states, in which the majority of finance is expected to come from European Regional Development Funding, this may represent a realistic policy option[12].

B. investments that are financed out of general public expenditure via an increase in **direct taxations**;

C. the **application of the cost recovery principle** (via an increase in water prices);

Under scenario variant A the policies are exogenously financed.

Table 5. Summary of Scenario Design.

	Policies		Funding Mechanism		
	UWWTD & DWD	**WFD, Floods Directive & NSWRE**	**Exogenously financed**	**Direct taxation**	**Water prices**
Scenario 1a	✓	×	✓	×	×
Scenario 1b	✓	×	×	✓	×
Scenario 1c	✓	×	×	×	✓
Scenario 2a	✓	✓	✓	×	×
Scenario 2b	✓	✓	×	✓	×
Scenario 2c	✓	✓	×	×	✓

Sources: Cambridge Econometrics.

It is important to remember that in reality a mixture of financing mechanisms are likely to be in place, depending on the nature of the investments and economic factors specific to each Member State. The existing institutional setup with regards to public vs. private ownership and management of the water supply network and prevailing tariff structure are also likely to be key determinants of whether cost recovery will be imposed in practice. Nevertheless, the scenarios, rather than providing an exact representation of reality, have the potential to shed light on best practice (in terms of economic costs and benefits) for the funding of water policy investments in terms of the two financing mechanisms.

Scenario inputs

All main inputs for the scenario are presented in

[12] Clearly this will only hold true at the member state level of analysis and would not be an accurate representation of the funding mechanism at the EU-level.

Table 6 and Table 7. These inputs have been collected by national experts as part of the process of assessing the investment needs and growth potential of water policy at the Member State level.

For each of Member States, and for each of the three water policies, the following data were collected:

- investment required for implementation of policy (in euros or local currency)
- time period over which investments take place
- current level of implementation (as a percentage)

The following processing steps were taken (where necessary) in order to make the inputs consistent across Member States and with E3ME's model definitions:

- conversion from local currency to euros
- conversion to a denominator of millions
- deflation to 2005 prices

In some cases R&D expenditure requirements were provided along with capital expenditure investments. Where this information was provided it has been incorporated appropriately.

For the purposes of this macroeconomic modelling exercise, the level of implementation is defined as the proportion of total planned expenditure currently invested. The adoption of this definition of implementation is for pragmatic reasons only and has the obvious disadvantage that it focuses on inputs rather than an outcome-based measure such as ecological status.

Since the emphasis of this study is on the continued implementation of the Water Framework and Floods Directives, and the first wave of river basin management plans were submitted in 2010, the inputs have been incorporated so as to model the impact of full implementation in the scenarios relative to a baseline with partial implementation (i.e. what has already been done but no more). However, the current level of implementation has been found to vary between Member States and in Spain, in particular, the level of known implementation to date has been low to non-existent. In this case the modelling of a full-implementation scenario versus a no-implementation baseline is thought to be more realistic and relevant from a policy perspective.

Information gaps

The Member State experts have found that detailed (and for some countries even basic) information on future and current investment needs and their time horizon is not readily available. The information gaps encountered and, where possible, the strategies for dealing with them are discussed below.

For some Member States and policies, information on investment requirements as distinct from other implementation costs (such as operating expenditures) was not available. For these Member States, the modelling results will understate the growth potential (and costs) of the continued implementation of EU water policy. Furthermore for some member states, compliance has already been achieved to the extent that no further investment needs have been identified. This is the case for Denmark and Sweden and as such modelling results have not been produced for both of these member states.

Table 6. Summary of Scenario 1 Inputs.

	UWWTD	DWD
AT	€3301.5m investment over 2013-21	€2482.1 investment over 2013-21
BE	€292.5m investment over 2012-13	n/a
BG	€224.9m investment over 2012-13	n/a
CY	€15.5m investment over 2012-13	n/a
CZ	€161.7m investment over 2012-13	n/a
DE	€4218.3m investment over 2012-13	n/a
DK	n/a	n/a
EL	€216.1m investment over 2012-13	n/a
EN	€51.2m investment over 2012-13	n/a
ES	€4377m investment over 2012-13 (UWWTD & DWD combined)	
FI	€167.6m investment over 2012-13	n/a
FR	€5461.3m investment over 2013-18	€1011.2m investment over 2013-18
HR	€4861.7m investment over 2012-23	€867.9m investment over 2012-23
HU	€169.4m investment over 2012-13	€134.2m investment over 2012-13
IE	€217.2m investment over 2012-13	n/a
IT	€1949.5m investment over 2012-13	n/a
LT	€43.1m investment over 2012-13	n/a
LV	€23.7m investment over 2012-13	€81.9m investment over 2012-15
LX	€821.6m investment over 2012-27	n/a
MT	€18.0m investment over 2012-13	n/a
NL	€571.1m investment over 2012-13	n/a
PT	€4739.5 investment over 2012-13 (UWWTD & DWD combined)	
PL	€5789.6m investment over 2012-15	n/a
RO	€152.8m investment over 2012-13	€1496.7m investment over 2012-15
SI	€27.2m investment over 2012-13	€3330.8m investment over 2012-15
SK	€83.4m investment over 2012-13	n/a
SW	n/a	n/a

UK	€6763.8m investment over 2012-22	n/a

Notes: Investment expenditure are expressed in 2005 prices.
Figures or Latvia , Spain and Portugal may include double counting between UWWTD, DWD and WFD-related investments.
Sources: ACTeon, Cambridge Econometrics, Ecorys, REC.

Table 7. Summary of Scenario 2 Inputs

	WFD	Floods Directive	NSWRE
CY	€14.8m investment over 2012-15	n/a	n/a
CZ	€2826m investment over 2012-15	€823m investment over 2012-15	n/a
EL	€1220m investment over 2013-15 €7.9m R&D expenditure over 2013-15	€5.9m investment over 2013-18	€133m investment over 2013-15
ES	n/a	n/a	€6657m investment over 2010-15
FR	€22152m investment over 2012-15	n/a	€3430m investment over 2012-20
HU	€5785m investment over 2012-27 €140m R&D expenditure over 2011-21	€136m investment over 2012-15	n/a
IT	€1605m investment over 2012-21	n/a	n/a
LV	€530m investment over 2012-15	€5.5m investment over 2012-15	n/a
NL	€1370m investment over 2012-15 €48m R&D expenditure over 2012-15	€1347m investment over 2012-18 €296m R&D expenditure over 2012-18	n/a
PT	€3693m investment over 2012-13	n/a	€3693m investment over 2012-20
RO	€17914m investment over 2012-27	€8227m investment over 2012-27	€972m investment over 2012-15
UK	€918m investment over 2012-15 €6m R&D expenditure over	€17259m investment over 2012-27	1. n/a

2012-15

Notes: Scenario 2 inputs also included all inputs modeled under Scenario 1.
Investment and R&D expenditure are expressed in 2005 prices.
WFD figures for Latvia and Portugal may include UWWTD and DWD-related investments.

Sources: ACTeon, AMEC, Cambridge Econometrics, CENIA, IVM, NTUA, REC.

Limitations of the approach

The limitations of the macroeconomic modelling approach should **be borne in mind when interpreting the scenario results**.

The model of the effect of investments in the water industry (UWWTD and DWD) is limited by the fact that information available on the investment requirements and their timing may be subject to significant uncertainty. In general the reliability of the modelling results will depend on a large part on the reliability of the data gathered by the national experts.

Moreover, the dimensions of the model are also a limitation of the analysis insofar as the economic sectors in E3ME are defined at the NACE Rev. 2, 2-digit level. It is therefore not possible to obtain results beyond this level of sectoral detail. Furthermore the geographic scope of the model is defined at the national level, making a regional analysis of the economic impacts of water policy impossible.

In turn, the main limitation of E3ME in relation to these scenarios including investments for the water sector as a whole, as influenced by the WFD and the FD is that it is unable to capture the interaction between environmental water quality and the economy. In the context of this study, this means that the impact of improvements in environmental water quality on the economy and its potential for promoting economic growth cannot be measured.

Water supply and demand in the model is represented in economic terms only. This means that water use that does not result in an economic transaction, and is therefore not recorded in economic statistics, is not covered by the model. This is expected to present a particular problem for modelling the impact of water pricing policies on the agriculture and energy generation industries which are known to rely heavily on self-abstracted water. In the context of this particular study, it means that the cost recovery scenario variants will not include the recovery of costs from sectors that use self-abstracted water

Related to this point is the difficulty in representing water as a traditional economic good. In particular there are known to be considerable non-linearities in the demand for water consumption (Zetland, 2011). Furthermore, in times of scarcity, rationing mechanisms other than the price mechanism are likely to be used. The representation of the water sector in E3ME is there for only appropriate for marginal changes in water prices

The information gaps discussed mean that caution should be exercised when comparing the results between Member States. More specifically, for some countries a lack of economic impact may simply reflect the reality that there are no data available on the future investment requirements. For this reason it is important, when interpreting the modelling results, to refer to the summary of scenario inputs in Table 6 and Table 7 so that the coverage and scale of the policies being modelled can be taken into account.

Model results

Introduction

Before proceeding to the presentation of the results, Figure 11 summarises the expected impacts of the policy scenarios.

Under the scenario variants in which investments are financed by the public sector the associated increase in direct taxation may generate negative impacts on household income, consumption and employment.

For the scenario variants in which cost recovery is achieved, the increase in water prices will be expected to raise industry costs and reduce household incomes. In particular there may be large increases in the costs of industries that are intensive users of water (although this will depend on the extent of self-abstraction). A pass-through of these costs to the price of industry output may result in an increase in the aggregate price level and generate distributional impacts and possible loss of competitiveness.

The investment by the water sector will stimulate demand in infrastructure-related industries such as the construction and engineering sectors. Likewise, any R&D expenditure requirements lead to an increase the output of research and development industries. These direct impacts, if large enough, will result in aggregate economic impacts such as in increase in GDP, employment and prices.

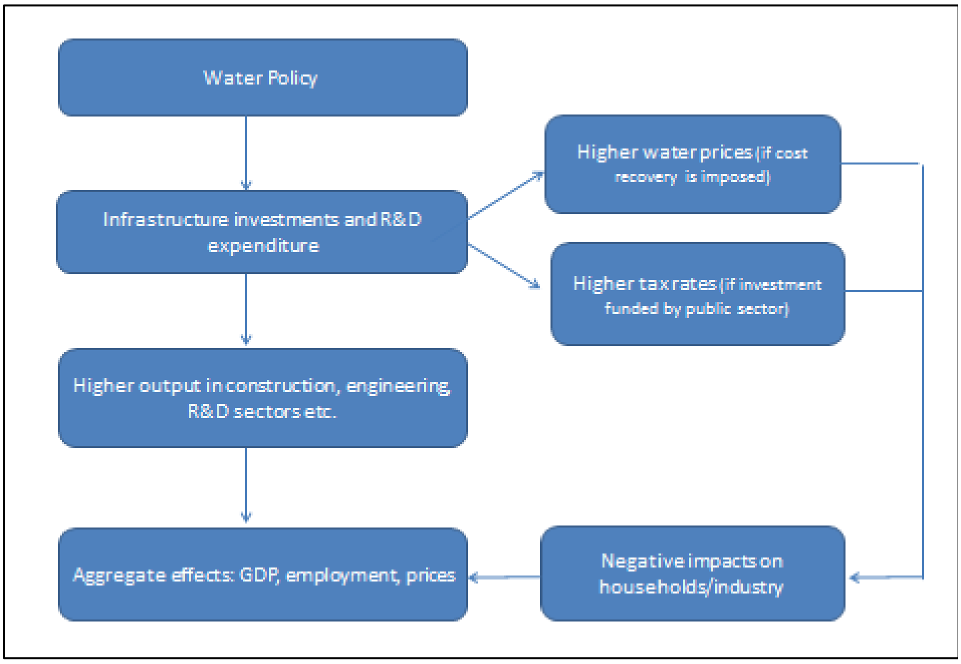

Figure 11. Representation of water policy-related investment impacts in E3ME (Source: Cambridge Econometrics).

In the following sections, results for the main economic aggregates are provided in terms of percentage differences from baseline in 2015, 2021 and 2027.

The next section presents the results for the EU28 as whole. The modelling exercise was also carried out at the MS level, and a detailed report of MS-level results is provided in Annex III.

EU-wide results

The Scenario 1 results for the EU28, as a whole, are presented in Table 8. Focusing on the results of Scenario 1a, the UWWTD and DWD-related investments are not found to have much economic impact at the aggregate level. The additional increase in investment (including direct investments) is modest, at around 0.5% compared to baseline in 2013. The induced increase in imports as a result of higher demand for investment goods leads to a slight reduction in net trade resulting in a net impact on GDP that is close to zero in 2013. There is no evidence of persistence in the impacts and the main economic aggregates return to baseline levels by 2025.

When the investments are funded, either through direct taxation (Scenario 1b) or an increase in water industry prices (Scenario 1c), the impact on GDP is neutral and there is a small but negative impact on household consumption attributable to the reduction in real household income as a result of the reduction in net pay (in the case of the former) and the increase in consumer prices (in the case of the latter).

Table 8. Scenario 1 EU28 Modelling Results.

	Scenario 1a			Scenario 1b			Scenario 1c		
	2013	2020	2025	2013	2020	2025	2013	2020	2025
GDP	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Employment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumption	0.0	0.0	0.0	-0.1	0.0	0.0	-0.1	0.0	0.0
Investment	0.5	0.1	0.0	0.5	0.1	0.0	0.5	0.1	0.0
Imports	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0
Exports	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumer Prices	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

As a very tentative exercise, the percentage evolutions to be stimulated by the water investments suggested in Table 8 are translated in absolute numbers in Table 9. The exercise is based on the baseline values of Table 4 and is only provided here as to provide a better grasp of the magnitude of the changes at EU level but cannot be used as definitive reference on the subject.

Table 9. Scenario 1 EU28 Translated Modelling Results (illustrative only).

	Scenario 1a			Scenario 1b			Scenario 1c		
	2013	2020	2025	2013	2020	2025	2013	2020	2025
GDP (€bn2005[13])	12.08	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

[13] This is the reference year used to have comparable results with past growth.

Employment (000s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Household consumption (€bn2005)	0.0	0.0	0.0	-6.80	0.0	0.0	-6.80	0.0	0.0
Investment (€bn2005)	14.03	15.46	0.0	14.03	3.09	0.0	14.03	3.09	0.0

Notes: Figures shown are difference from baseline

Sources: Cambridge Econometrics, E3ME, ACTeon

In turn, and to provide a broader picture of the potential impacts of investments in water, Table 10 presents the results of the modelling exercise when WFD, Floods Directive and NSWRE-related investments are also modelled, along with the UWWTD and DWD. The size of the GDP impacts is accordingly large, as the additional direct investment is roughly double that in Scenario 1. The pattern of results remains very similar to Scenario 1 although for the case where the direct inputs are exogenously funded (Scenario 2a) there is some evidence of persistence in the positive, but small, GDP impacts through to 2025.

Table 10. Scenario 2 EU12 Modelling Results.

	Scenario 2a			**Scenario 2b**			**Scenario 2c**		
	2013	**2020**	**2025**	**2013**	**2020**	**2025**	**2013**	**2020**	**2025**
GDP	0.2	0.1	0.1	0.1	0.0	0.0	0.1	0.0	0.0
Employment	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Consumption	0.1	0.0	0.0	-0.2	-0.1	0.0	-0.1	0.0	0.0
Investment	1.1	0.2	0.1	1.0	0.1	0.1	1.1	0.1	0.1
Imports	0.2	0.1	0.0	0.1	0.0	0.0	0.2	0.1	0.0
Exports	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
Consumer Prices	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	-0.1

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

As in Table 9, the order of magnitude of the results are also translated for the results of Scenario 2 in the following Table 11.

Table 11. Scenario 2 EU12 Translated Modelling Results (illustrative only).

	Scenario 2a			**Scenario 2b**			**Scenario 2c**		
	2013	**2020**	**2025**	**2013**	**2020**	**2025**	**2013**	**2020**	**2025**
GDP (€bn2005)	24.15	13.40	13.40	12.08	0.0	0.0	12.08	0.0	0.0

Employment (000s)	225.45	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Household consumption (€bn2005)	6.80	0.0	0.0	-14.67	-6.58	0.0	-7.34	0.0	0.0
Investment (€bn2005)	30.86	6.18	2.88	28.06	3.09	2.88	30.86	3.09	2.88

Notes: Figures shown are difference from baseline

Sources: Cambridge Econometrics, E3ME, ACTeon

Conclusions from the model results

The objective of this modelling exercise was to estimate the macroeconomic impacts of the investments required for the continued implementation of the UWWTD and DWD for each of the 28 member states . Scenarios were defined to model the full implementation of the investment requirements for these policies and for the 12 member states analysed in a parallel project (ACTeon et al, 2013), the WFD, Floods Directive and NSWRE as well. The scenarios are modelled relative to a baseline of the current level of implementation of the directives. For each set of policies, three scenario variants are modelled, one in which the investments were exogenously funded, one in which the investments were publically funded via an increase in direct taxation and one in which cost recovery was achieved through an increase in the output price of the water supply sector.

The scenarios look at the implications of a shift in economic activity from current consumption to investment, with financial balances upheld by international flows. In some countries the shift could be expected to have a small positive impact on GDP as, for example, construction is a domestic activity while consumer goods are often imported. However, the relationship between consumption, investment and GDP is likely to vary between countries.

The results of the analysis at EU level show impacts on the main economic aggregates to be modest. The result is far more modest if compliance is limited to DWD or UWWTD. It needs WFD and FD to have a significant effect (here only 12MS are included and it already shows and effect).

The modelling exercise indicated that at EU28 level (including the effect of the 12 case study case study countries on WFD and FD), the direct effect of planned compliance investments showed a potential increase of employment by 0,1%, or about 225,000 additional jobs throughout the EU economy.

However, there are some quite considerable differences in the results at the national level. In general Member States which had the largest direct investments relative to GDP, are those that had the largest impacts on employment and GDP (either positive or negative). This is not a surprising result. The greatest effects are expected to be felt in the new MS, notably in Slovakia, where GDP could growth up to 2% over the first period (2013-2020) thanks to water industry-related investments and make employment growth up to 0.8%. in other new MS, GDP growth associated to water industry investments is more likely to be around [0.2-0.6%] but employment effects are only around 0.2%.

Another dimension to be highlighted is that for similar GDP growth effects, the employment responses are not the same in all countries. In Western MS, a 0.1%

change in GDP is rarely accompanied by any change but for larger investments such as expected in Spain and Portugal.

The results also suggest that in order for persistent impacts on GDP to be realised, the time horizon of investments needs to be spread out over a relatively long period so as to avoid a downward bound in economic activity when large investments are made over a short period of time and then discontinued. This would avoid any possible constraints on production capacity (e.g. a shortage of skilled labour). Most current investment plans fall short of this long-term projection with effects tending to only to last in the short-run.

Of greatest policy relevance is the difference in outcomes modelled under each of the financing mechanisms. For Member States in which the positive impact on GDP was driven by an increase in household consumption, the funding of investments through general taxation had the effect of eroding and in some cases completely neutralising this positive impact. In these situations the funding of investments through an increase in water prices is generally preferable from an economic perspective, provided large increases in water prices are not passed-through to households. Higher water prices of course also have the environmental benefit of lower consumption rates, although this reduces economic output in the water supply sector (as discussed below).

For some Member States the financing reality may lie much closer to the exogenously funded scenario variant (i.e. ESF), provided that there is not a crowding out effect where investment in water infrastructure leads to a reduction in investment elsewhere. A substantial proportion of the funding is expected to come from EU Cohesion funding and ERDF for some countries, including Hungary, Romania and Croatia.

Chapter 5- Financing and available instruments to incite compliance

Current instruments

The basic financing instruments to finance water industry operations are **water tariffs and sewerage/ wastewater treatment tariffs**. This source is completed by various **subsidies** from national or EU budgets. Such financial support, generally dedicated to infrastructure can be **direct transfers** from the budgets to the sectors. The national budgets may be enhanced through **borrowing**[14]. However, **indirect subsidies** are also used in many MS not only covering capital costs but may also support operation and maintenance cost through tax rebates and exemptions.

Tariffs aim at covering the financial costs of providing the services (investment, operation and maintenance costs). Such tariffs can be structured in different ways:

- Flat rates: in the absence of water meters, monthly water tariffs are fixed and can be based, for example, on household or apartment size;
- Volumetric rates: tariffs are calculated based on actual consumption, charging a fixed rate per cubic meter;
- Mixed rate: these tariffs include a flat, fixed component and volumetric charging.

In addition to tariffs, **environmental charges (abstraction and pollution charges)** are often in place, with the goal of internalizing (covering) the environmental and resource costs of water use. These charges are normally charged on a volumetric basis and are included in the final water bill.

The table below provides an overview of the basic economic instruments in place in the EU28, based on the information included in the country fiches (See Annexes I and II).

[14] It is important to highlight that subsidies are supported by current and future taxes through borrowing. In this sense, the European Investment Bank (EIB) was the single larger lender for water services and irrigation systems in the EU with €15 billion in the 2008-2012 periods (EIB, 2013).

Table 12. Water tariffs and pollution charges in the EU28. (Source: own elaboration from national sources; EEA, 2013 and OECD, 2010).

Country	Water and wastewater tariffs			Abstraction charges	Pollution charges
	Flat rate	Volumetric rate	Mixed rate (fixed + volumetric)		
BE					
BG					
CY					
CZ					
DE					
EE					
IE	*(Unclear*)*				
EL					
ES					
FI					
FR					
HR					
HU					
IT					
LT		*(Unclear**)*			
LU					
LV		*(Unclear**)*			
MT					
NL					
AT					
PL					
PT	Wastewater		Water supply	***	***
RO		*(Unclear**)*			
SE					
SK					
SI	*(But unclear)*				
UK			England+Wales		

**In Ireland, only non-domestic users are charged, but the tariff structure was unclear in the country fiche. Domestic users do not pay for water. **In these countries, the reported information does not state clearly whether tariffs are solely volumetric, or a mixed rate is in place. ***Scarcely developed*

Looking in particular at water tariffs, according to article 9 of the WFD these should be set at an adequate level, ensuring the full cost recovery of water services. Cost recovery is also closely linked to the incentiveness of water prices. In many EU countries, achieving cost-recovery would necessary imply an increase of water prices, and higher water prices would incentivize a more targeted, efficient use of water resources.

At present, however, **full recovery of supply costs is achieved only in a few countries**, and in many MS further efforts need to be made to achieve full cost recovery of water services, as shown in the table below. As this is likely to entail water price increases, however, affordability concerns will need to be addressed.

Table 13. Incentiveness and cost recovery capacity of existing economic instruments in the EU28. (Source:own elaboration from national sources).

Cost recovery rates and incentiveness			Countries								
Tariff levels ensuring cost-recovery (>90%) and an efficient water use	DE	DK	FI	FR	NL	AT	SE	RO	UK		
Cost recovery reached in some areas/ by some operators/ increasing prices have led to lower consumption	BE	EE	CZ	EL	ES	HU	HR	MT*	LT	PL	SI
Tariff levels not ensuring full cost recovery and an efficient water use	BG	CY	EI	IT	LU	LV	PT	SK			

*Malta is reaching cost recovery for water supply but fully subsidies waste water treatment

As just mentioned, when full cost-recovery is not achieved, clearly different forms of subsidies are in place. Some indirect subsidies might exist even in those countries with a cost-recovery rate close to 100%. The types of subsidies existing in the EU28 are the followings:

- **Direct subsidies**: public authorities at different levels (e.g. national, regional, river boards) directly finance water- and wastewater-related infrastructures (both in terms of investment, operation and maintenance costs);
- **Indirect subsidies**: in some countries, a reduced VAT rate is applied to water service bills. In other cases, social subsidies directed to low-income households can also be considered as indirect subsidies;
- **EU Structural and Regional Funds**: in some countries (especially countries which recently joined the EU) Structural Funds play an important role in the financing of water infrastructures.

The table below provide an overview (although not exhaustive) of existing subsidies in place in the EU[15].

Table 14. Overview of subsidies to the water sector in the EU. (Source: own elaboration from national sources and EC, 2013b).

Subsidies	Countries																
Direct	BG	CY	CZ	EI	ES	FI	FR	HU	IT	AT	PL	PT	SE	SI	RO		
EU Funds	BG	CZ	EE	HR	HU	LT	LV	PL	PT	RO	SK	SI					
Indirect	BE	CZ	DE	ES	FR	HR	IE	IT	CY	LU	MT	NL	AT	PL	PT	SI	UK

In some countries, EU Structural and Regional Funds can cover a substantial part of the total yearly expenditure for the water sector, as shown in the graph below taking Bulgaria, Slovakia, Romania and Poland as examples[16].

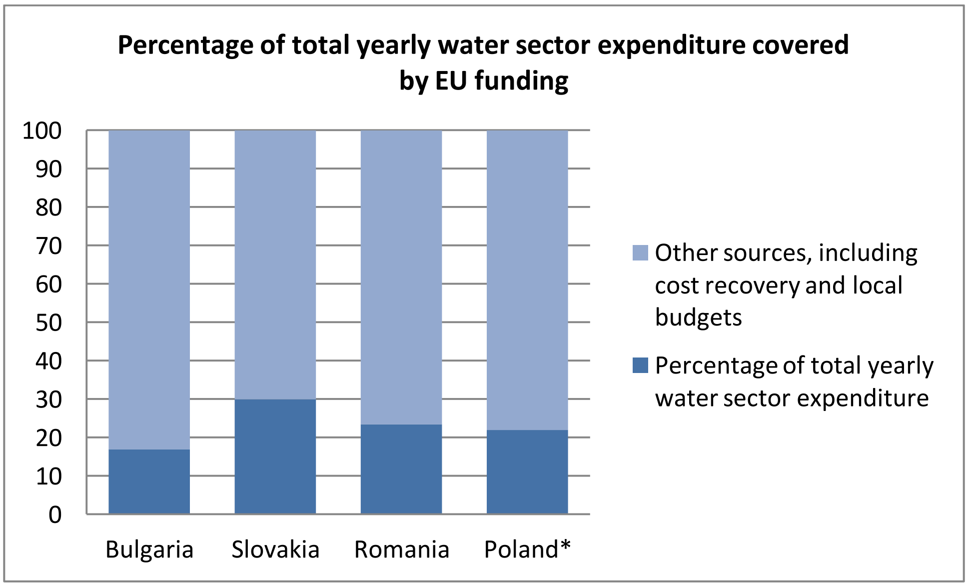

Figure 12. Illustrative example of EU Funds on total yearly expenditure in the water sector as a whole. (Source: own elaboration from national sources)

The EU has increasingly supported water research and the development of new technologies for the water sector since the 1980s. Total EU funding over the last ten

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[15] The table only include the subsidies reported in the country fiches (the list might not be exhaustive in some countries)

[16] The graph only includes those countries for which information was available in the country fiches from national sources as EU data comparing total water-related expenditures and investments to EU contribution is not available.

years exceeded €1.3 billion and equated to more than 800 water research the Sixth and Seventh Framework Programmes (FP6, FP7) (EC, 2012).

Access to EU and external finance are key to many recent MS, not only in terms of infrastructure but also in supporting the development of research and innovation in the sector.

The variety of funding sources for water investment funding can be illustrated by that of Poland (Box 6).

Box 6 –Financing structure in Poland

The current budget of the National Fund to support the National Programme for Municipal Waste Water Treatment for the period 2010-2015 amounts to EUR 27.23 million in addition to the Cohesion Fund.

In 2011, the structure of financing investments in water management was made up of local funds 33.8%; environmental funds, loans and credits 24.3%; external funding (including EU funds) 21.7%; the national budget 17.6%; other sources 2.6%.

Besides these external subsidies, **cross-subsidization** among water use sectors is also common in many EU countries. In the most common type of cross-subsidization (i.e. Hungary, Estonia, Croatia) the industrial or commercial sector pay higher rates, which are then used to finance a part of the provision costs to the domestic sector. In the Netherlands, the domestic and industrial sectors are subsidizing the agricultural sector. In Italy, in contrast, water prices are structured according to rising block tariffs: in this case, customers using larger volumes of water (i.e. belonging to the higher consumption categories) are partly covering the costs of providing the service to low-consumption households. In Malta, as in other MS, higher-end domestic users contribute for the less affluent users.

As previously mentioned, water tariffs normally also include **abstraction and pollution charges**. One of the objectives of abstraction and pollutions charges is to cover the **environmental and resource costs** (ERC) of water use (i.e. over-abstraction and pollution), contributing to enhancing efficiency of water use and water allocation among sectors. Currently, abstraction and pollution charges are set at very low levels in many countries. As an example, the table below shows the incidence of abstraction charges on final water tariffs in six EU countries (data source: EEA, 2013). Thus, and despite current uncertainties in their definition and assessment methods, they are unlikely to fully internalize ERCs.

Table 15. Incidence of abstraction charges on the final water tariff paid by users in six EU countries. (Source: EEA, 2013).

Country	Average tariff	Abstraction charge	% of AC on total tariff
	€/m3	*€/m3*	
England and Wales	1,69	0,0052	0,31%
Scotland	3,02	0,0033	0,11%
The Netherlands	1,43	0,014	0,98%
France	1,55	0,07	4,52%
Germany	2,31	0,051	2,21%
Slovenia	0,84	0,0555	6,61%
Spain	0,85	0,005	0,59%

As a result of low cost recovery and low internalization of ERCs, in many MS, existing water tariffs and water charges do not provide an incentive for an efficient water use as a result of their too low levels. There is however a large diversity of situations, both between and within MS.

Emerging sources

The reviews and assessment highlighted the need for **an improved design of economic instruments** so that they contribute to fulfil both economic and environmental objectives. Special focus needs to be given to: (i) the recovery of the costs of service provision through water and wastewater tariffs, reducing the need for public subsidies; and (ii) the internalization of environmental and resource costs, for example through adequate levels of abstraction and pollution charges.

In particular, **adequate recovery of provision costs** has strong implications for the sustainability of the water industry and for public budgets. When cost recovery is achieved (i.e. no public subsidies come into play[17]) available public resources could be entirely allocated to those strategic water infrastructures and policies aimed at supporting economic growth and/or development of specific economic sectors. In this light, the achievement of full cost-recovery can be considered as a **key component of growth strategies**, especially in Southern Mediterranean countries with a water-dependent economy.

As existing instruments are (partly) failing in achieving the key objectives (cost recovery, incentiveness for a more efficient water use, application of the polluter-pays principles), new (innovative) financing mechanisms could be introduced to complement and support existing ones, especially in the context of the current severe public budget constraints. New financing mechanisms do not only include "new" instruments, but also the reform of existing instruments into innovative structures/forms. The need for finding new financing sources emphasizes the role of proper economic instruments. Pricing schemes, in particular, could be redesigned, for example linking price levels to water productivity: **thus water prices would not necessarily have to be raised, but rather re-structured**. Other options, such as water markets and other incentive-based mechanisms should be investigated.

Alternative funding mechanisms for the water are actively being searched by MS currently experiencing investment constraints. An example from the Netherlands is presented in Box 7.

A bigger role of the private sector in water management may unlock financial resources in a context of reduced public budget. T**he role of both public investments** (i.e. ESF) and **public development banks** (i.e. European Bank for Reconstruction and Development –EBRD the IFC or the European Investment Bank) remain fundamental. It could even become more relevant in a new economic model envisaged by Veolia Environment, the leading private utility. According to its CEO and

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[17] In Italy, for example, it is estimated that public subsidization of domestic water and wastewater services is equal to 10% for water provision and 28% for sewage and wastewater treatment (Monaco, 2011). Irrigation water tariffs, in particular, are normally much lower than industrial and domestic prices, as the sector is often heavily subsidized (e.g. in Italy, Greece, Spain).

Chairman, Antoine Frerot (2012), a sustainable water management would only be viable in the long-term if based on ***solidarity financing*** phrased as "a mixed user-taxpayer system of funding" where users pay through pricing and the remaining, common good-related dimension of water management is borne tax payers. It is important to highlight that this revised approach to ensure a sustainable provision of water services, also reduces the burden of full cost recovery to the poorest, as taxation is less regressive than direct pricing. As matter of fact, this type of system can be foreseen in several Eastern European projects beyond Public-Private Partnerships (PPP), with public financial **institutions investing in private companies through equity**, buying shares of the main companies and local subsidiaries (Hall and Lobina, 2010). Moreover the emerging context of high profile "**re-municipalisation" of outsourced** water utility services (i.e. Paris (France[18]), Berlin (Germany) or Pecs (Hungary – Hall and Lobina, 2012) needs to be accounted for in order to move towards a more sustainable financing model.

Appropriate pricing whether through traditional per volume or per water productivity make operators more likely to access credit, which is the basis for large investments once direct public resources are allocated. That said, **public financing on this type of infrastructure has the distinctive advantage of very low capital costs** (zero if based on taxes) compared to private operators access to capital (Massarutto et al. 2008).

At a more general level, the adaptation of fiscal multipliers for countries that are under fiscal cuts might also open up a larger room for greener revenue. In any case, it appears that possible reforms of the water management sector aimed at an improved financial sustainability will need to rely on comprehensive policy packages including different types of measures and taking into account not only water resources but also water-related sectors (e.g.; agriculture). Going beyond current policies and liking it to innovation, **a proactive development towards the convergence between water, waste and energy management** (i.e. bioenergy, bio-plastics, etc.) could also provide dynamic sources of funding for future investments.

The bulk of recent investments in Eastern European MS, was delivered through exogenous public financing through EU financial mechanisms whether through loans or public investment. This is and will remain the main source of financing for investments. However, a fundamental issue raised by the review of most Easter EU MS, relates to a low **absorption capacity of such opportunities** which needs to be addressed. **Whether to support the "consolidation" process of the water utilities** in a given MS or region should thus be assessed on a case-to case basis. In most Eastern MS, the municipalisation from single handed state companies following the end of the Soviet era created a constellation of structures that may be regrouped at sub- and regional level given their operational difficulties given their ill-adapted

Box 7 – The need for alternative "creative" financing solutions in the Netherlands

To face public finance restrictions on investments in water infrastructure, alternative financing solution need to be explored. Sewerage, wastewater treatment and the management of surface and groundwater in NL are public tasks, to a large extent performed by decentralized governmental bodies (municipalities, water boards and provinces). These bodies have recently reached an agreement with the central government on their share in limiting the government budget deficit to the 3% that applies to Eurozone MS. This agreement may restrict the possibilities for municipalities, water boards and provinces to invest in water infrastructure that has high initial (capital) costs, but low recurrent (operational) costs (e.g. energy efficient WWTPs). "Creative" solutions should be found to enable them to continue (or start) investing in such 'expensive but efficient' water infrastructure, e.g. through public-private arrangements. The central government should enable and facilitate such solutions.

size. That said, the fragmented nature of the same sector in many mature EU economies (i.e. Germany, highlighted by Wackerbauer, 2009) indicate that this is not necessarily ill-adapted but that it may offer opportunities to improve efficiency that need investigating.

In addition, private involvement can go beyond the direct co-financing question by setting-up **cooperative mechanisms**, for examples. Such schemes can come into play where competition over water use and consequent benefits exists among water stakeholders, and it usually takes the form of voluntary pricing and trading mechanisms where stakeholders agree on mutually beneficial actions to conserve assets, share benefits, etc. Experiences so far in this field showed that these mechanisms can be effective in tackling water management issues such as, for example, diffuse pollution. A successful example of a cooperative mechanism implemented in the UK is described in Box 8 and a similar experience has been supported by the Paris water utility (Eau de Paris), in the Voulzie area, upstream of the Seine basin..

Box 8– Cooperative agreements between water supply companies and farmers in Dorset, UK

Cooperative agreements were developed in Dorset because the local water company (Wessex Water) found itself facing increasing issues related to nitrates contamination, mainly the result of farming activities. Due to the extent of the problem, relatively inexpensive technical solutions (e.g., blending water from different sources) were no longer viable, so the company could choose to apply expensive treatment technologies or implement a catchment-based approach. Wessex Waters chose to approach the farmers and involve them in cooperation agreements, with the aim of improving water quality by promoting better practices. The main focus of program activities is the on-farm advice on best practices, in which catchment officers work closely with farmers, as well as N monitoring activities. The program also involved phased grant payments as an incentive at the beginning of the initiative. Such agreements are established on a voluntary based between farmers and the company, and are based on self-regulation among the key actors. The company has an important role in the negotiation process and the provision of financial resources.

The program has been very successful in securing farmers' participation and now covers between 80 and 100% of the farmers in the catchment at medium and high risk. Nitrogen levels in the areas covered by the mechanism are now similar to the average national levels, indicating good farming practices and appropriate fertilizer uses. Last but not least, this approach to diffuse water pollution implies an annual cost equal to 8% of the annual treatment costs.

Chapter 6a. Conclusions

Mobilising relevant economic information: a clear challenge.

Assessing the macro-economic impact of implementing key EU water industry directives represents a clear challenge in terms of data collection and structuring. While cost information related to the full implementations of the UWWTD is available from various national sources and from an EC study (COWI, 2010), the implementation of the DWD is mainly reported on technical grounds with no systematic economic assessment of past implementation or future potential needs to fully comply with the DWD obligations. With more systematic cost assessments and reporting been required under the WFD, and despite the limitations and uncertainties of current cost assessments (ACTeon et al, 2012), it is expected that the availability of cost information for water industry directives will also progressively be improved in coming years.

Information on the economic dimension of the water industry and related investments is available for some MS and from project-based studies. However, the available evidence is not sufficient to link water industry investments and economic growth potential. Thus, the collection of available evidence was complemented by the application of a pan-European macro-economic model that proved to be critical to bring a robust macroeconomic perspective in the study. However, detailed (and sometimes even basic) information on future and current investment needs and on the time horizon of investments is not readily available. Thus, the modelling results for these MS will understate the costs and growth potential of the continued implementation of EU water industry policies.

The water industry in a nutshell

The water industry has a macroeconomic weight of 28.9 billion € at the level of the EU equivalent to 0.26% of the total 2010 EU28 value added. The sector combines increased private sector involvement in some countries with high profile re-municipalisation" of outsourced water utility services stressing the dynamic structure of the water industry sector.

With almost 500 000 full-time equivalent jobs, the water industry is considered as a mature industry that has proven to be relatively resilient in terms of employment despite the current economic and financial crisis. However, the crisis has played the role of a driver for restructuration. Although the industry as a whole has maintained its staff level, current efforts to consolidate the water industry in some Eastern MS (moving from a very high number of small water service suppliers to larger water services) might in the medium term reduce the employment weight of the sector in these countries.

European large water utility companies are well positioned in the €361billion/year global market of water services (BMU, 2011), exporting their expertise (i.e. water service management for French operators; innovative technologies for Danish companies) well beyond EU borders.

Leakage from water supply networks remains an issue, despite important investments and progress in controlling such losses in the last 15 years in both old and newer MS.

Funding the water industry

Cost-recovery through tariffs for water services is the corner stone of the financing of the water industry; although it is diversely applied depending on MS (only 9 MS are considered as fully implementing the (financial) cost-recovery principle). Revenues from water tariffs are completed by both direct and indirect subsidies (such as tax rebates), the later being widely used throughout the Union (17 out of 28 MS).

The role of the private sector and of public international financial institution (i.e. EBRD, EIB, etc.) in the water industry sector is increasing overall. It offers new opportunities for supporting a sustainable water industry, in particular in MS that record a reduction (sometimes accelerated by the economic crisis) in the public budget allocation to the water industry sector.

Which prospects for economic growth from investments in the water industry sector?

Water industry investments have a role to play in supporting economic growth. However, macro-economic results show that the overall EU-wide impacts of the full compliance with the water sector industry directives are modest. The result is far more modest if compliance is limited to the DWD or UWWTD. Indeed, it is the new requirements of the WFD and of the FD that drive potential economic growth at EU level. The direct effect of planned compliance investments for all water directives showed a potential increase of employment by 0,1%, or about 225,000 additional jobs throughout the EU.

There are, however, large differences in potential impacts for individual MS: As it can be expected, MS with the largest direct investments relative to GDP are those that show the largest impacts on employment and GDP (either positive or negative).

The greatest economic effects are expected to be felt in new MS where GDP growth associated to water industry investments is more likely to be around 0.2-0.6%, employment effects being limited to around 0.2% in most of the cases.

The macro-modelling results highlight three important policy lessons:

- For impacts on GDP to be persistent, the time horizon of investments needs to be spread out over a relatively long period. This avoids the downward bound in economic activity that would result from large investments made and discounted over a short period of time;
- The financing mechanisms selected for supporting investments in the water industry matter. For MS in which the positive impact on GDP was driven by an increase in household consumption, the funding of investments through the general taxation had the effect of eroding or neutralising this positive impact. And the funding of investments through an increase in water tariffs is favoured from an economic perspective, provided large increases in water tariffs are not entirely passed-through to households. Higher water tariffs of course have also additional environmental benefit linked to lower water consumption, although this reduces the economic output of the water supply sector.
- For some MS, the financing reality may lie closer to the exogenously-funded scenario (i.e. ESF), provided that there is not a crowding out effect where investment in water infrastructure leads to a reduction in investment elsewhere. A substantial proportion of the funding is expected to come from EU Cohesion funding and ERDF for some MS, including Hungary, Romania and Croatia.

The water industry as driver of innovation?

Being mature does not prevent the water industry to be at the forefront of innovation. Thus, it contributes to growth paths for the future, particularly for the more mature water operators of the EU15 MS that are active in a growing international market.

As such, innovation is understood to be the driver of growth in the sector in mature markets, as opposed to compliance investments in newer MS.

By entering into the field of energy production and mining of scarce materiel (e.g. the Vienna WWT plant has become energy self-sufficient and will soon be selling energy by harnessing organic loads into biogas), the water industry sector is also contributing to innovation and ultimately growth. .

Chapter 6b. Recommendations

In the context of this report, policy recommendations are formulated as to contribute to the following three policy objectives:

- Support the compliance of the water industry-related EU Directives, namely the DWD and the UWWTD;
- Sustain economic growth through water industry-related investments (distinguishing between short, medium and long term support); and
- Strengthen financing that can support water industry development in the EU.

The following Table 16 presents the key recommendations that originate from the analysis of the study results. Each recommendation is described with:

- Its **identity card** which includes:
  i) the recommendation name ;
  ii) its description ;
  iii) its type (distinguishing between guidance, conditionality in EU support, communication and awareness raising, knowledge development/research...);
  iv) the stakeholders targeted by the recommendation;
  v) the objective(s) it contributes to.

- First suggestions for implementation, in particular:
  vi) the time frame and priority (short, medium and long-term) ;
  vii) the organisations/partners that might be responsible for its implementation ;
  viii) possible synergies that might be established with parallel (EU-wide) process and initiatives (e.g. the EIP, the WFD CIS process, etc.).

Table 16: Recommendations identity cards.

Policy objective	Recommendation	Description	Type	Target	Time frame	Stakeholders to be involved	Possible synergies
Support compliance	Request basic financial information along technical reporting of DWD compliance.	A financial appraisal of the compliance of the DWD, based on updated reports that would not only gather technical information but also on the economics of compliance could allow to fine tune investments for this dimension of the water industry.	Information / Research	All MS	Short term (1 year)	European Commission (DG ENV), MS.	Link to WFD CIS Economics Group reporting on WFD art. 9 implementation
Support compliance	Continue to herald water supply and sanitation investments as an EU priority.	In some countries (e.g. some Eastern European countries, Portugal), water supply and wastewater collection network still reach (sometimes considerably) less than 90% of the population, thus investment in basic water services should remain a priority.	Guidance	All MS, Most new MS	Long term (+5 years)	EU Parliament, European Commission (DG ENV, DG REGIO).	
Support compliance	Commission an economic assessment of the implementation and compliance of the DWD.	Commission a service contract in the path of what was developed for the UWWTD. If too costly, this could only be focused on MS that are supplying less than 90% of their population with water services.	Information / Research	(All MS)	Medium term (1-3 years)	European Commission (DG ENV), MS.	

Policy objective	Recommendation	Description	Type	Target	Time frame	Stakeholders to be involved	Possible synergies
Support growth	Develop guidance on how to accompany the recorded evolution of water industries towards a less labour intensive structure.	Develop methodology guidelines to help MS to successfully accompany the restructuration of their water industry sector. A support to transition is expected to be needed to accompany the modernisation of the water industry sector towards a certain degree of convergence with the Western MS less labour intensive water industries.	Guidance	Most new MS	Medium term (1-3 years)	European Commission (DG REGIO at design level and as policy-orientated steering committees, DG ECFIN), European Employment Observatory	Link to development of the European employment strategy
Funding water industry activity	Develop guidance to enhance financial absorptive capacity of EU funding recipients in the water policy with an emphasis on water industry.	Enhance the absorptive capacity of recipient countries to harness the full potential of external funds whether from EU schemes or international sources. This will enhance the multiplier effect of such investments.	Guidance	Most new MS, Portugal and Greece	Short term (1 year)	European Commission (DG REGIO, MS, International Financial Institutions).	Link to EU Parliament Committee on Regional Development work
Funding water industry activity	Develop a consistent conditionality in Partnership agreements (and other relevant funding agreements).	Explore the options to condition Partnership agreements and similar cooperation instruments to the uptake of technical support package, such as the guidance to enhance financial absorptive capacity.	Conditionality	All eligible countries (beyond simply Greece, Latvia, and Romania	Short term (1 year)	European Commission (DG REGIO, Member States, International Financial Institutions).	Link to EU Parliament Committee on Regional Development work

Policy objective	Recommendation	Description	Type	Target	Time frame	Stakeholders to be involved	Possible synergies
				already under conditioning)			
Support Growth	Commission a study on the implication of indirect water industry subsidies.	Review the implication of indirect subsidies to water supply and sewerage services to customers (i.e. exempt from VAT) which arguably amounts to an environmentally harmful subsidy. In cases, both water and energy services have this subsidy.	Information / Research	All MS	Long term (+5 years)	European Commission (DG ENV)	
Funding water industry activity	Explore the implications of an explicit "solidarity funding" approach for EU water policy.	Explore the implications of an explicit "solidarity funding" approach which advocates for both optimising cost-recovery mechanisms and subsidies from tax payers for the societal services associated with good water supply and sanitation services in terms of: • resource efficiency; • future financial stability of the water industry; • governance stability. This could take the shape of a focused task force combining experts and a study.	Information / Research	All MS	Medium term (1-3 years	European Commission (DG ENV, DG Research), EU and International Financial Institutions, MS,	Link to WFD CIS Economics Group reporting on WFD art. 9 implementation
Funding water industry activity	Consider introducing the "solidarity funding" concept where both water users and tax	If the "solidarity funding" approach offers better sustainability for the water industry and responds to the EU broader objectives in terms of efficiency and sustainability,	Guidance	All MS	Long term (+5 years)	EU Parliament; European Commission (DG ENV), EU	Link to WFD CIS Economics Group reporting on WFD art. 9

Policy objective	Recommendation	Description	Type	Target	Time frame	Stakeholders to be involved	Possible synergies
	payers contribute in an optimised fashion.	propose to introduce it into EU policy.				and International Financial Institutions, MS	implementation
Funding water industry activity	Develop guidance to improve water tariff structures.	Support the adequate calibration and structure of tariffs by reviewing not only water pricing levels but structures (i.e. not necessarily increasing prices). A review programme should distinguish between the two complementary approaches: • raising tariffs • re-structuring tariffs to improve cost-recovery levels.	Guidance	Utilities, All MS, Research centres	Medium term (1-3 years	European Commission (DG ENV, DG Research, JRC)	Link to WFD CIS Economics Group reporting on WFD art. 9 implementation
Support growth	Develop guidance for the promotion of Sustainable Economic Leakage Levels (SELL).	Implement the case-by-case approach promoted by the *BluePrint* so to evaluate the environmental and economic benefits of reducing leakage. The water industry will play an essential role in developing and spreading examples of best practice in Sustainable Economic Leakage Levels (SELL).	Information / Research	All MS, Utilities	Long term (+5 years)	Water industry, MS, European Commission (DG ENV),	Link to CIS Programme of Measures Working Group
Support growth	Improve the time sequencing of EU funding strategies so to enhance EU funding to growth in recipient	Funds from international sources offer the largest effect on growth and employment. However, if the investments in the water industry sector to sustain growth they need to be spread over a relatively long period	Guidance	Most new MS, all MS	Long term (+5 years)	European Commission (DG REGIO, DG ECFIN), EU and	Link to EU Semester process

Policy objective	Recommendation	Description	Type	Target	Time frame	Stakeholders to be involved	Possible synergies
	countries.	so as to avoid a downward bound in economic activity when large investments are made over a short period of time and then discontinued. Great care should be placed on the financing mechanisms and whether these are levied through: • Taxation; • Pricing; • International cooperation.				International Financial Institutions, MS.	
Support growth	Consider this macroeconomic dimension of water a key topic for Horizon 2020 funding.	Support the enhancement of macroeconomic models at EU, national and RB level so to refine the understanding of the interaction of water industry, water policy and economic growth.	Information / Research	All MS, Research centres	Medium term (1-3 years	European Commission (DG ENV, DG ECFIN, DG Research, JRC), European Employment Observatory	Link to both the drafting of future Horizon 2020 calls and give priority to proposals that are responding to this objective.
Support growth	Develop guidance for improved integration of innovation support policies at MS level.	Respond to the identified weakness of the scattered nature of R&D in the water industry sector particularly within each MS.	Information / Research	All MS	Long term (+5 years)	European Commission (DG Research, JRC)	Link to EIP for Water.

Policy objective	Recommendation	Description	Type	Target	Time frame	Stakeholders to be involved	Possible synergies
Support growth	Specifically target the water-energy nexus in innovation support initiatives and funding.	Support innovation and dissemination of water-energy nexus solutions so to contribute to both of these Europe2020 resources with efficiency objectives. This action can have two part, namely:	Information / Research	All MS, Research and technological centres, Utilities	Medium term (1-3 years	European Commission (DG Research, JRC)	Link to both the drafting of future Horizon 2020 calls and give priority to proposals that are responding to this objective.
Support growth	Review and ease (on a temporary basis) the match funding required by new MS research institutions.	Explore mechanisms (at least on a temporary basis) so to ease access to support where it is most needed because of critically low co-financing possibilities	Information / Research	Most new MS – or municipalities and service providers ?	Short term (1 year)	EU Parliament; European Commission (DG Research, JRC)	Link to Horizon 2020 calls and Partnership agreements.
Funding water industry activity	Commission a detailed study on the implication for public financial institution investing through equity in private water utilities.	Assess the implications public financial institutions investing in private companies through equity into private utilities to evaluate: • whether this contributes to ease funding to the water industry sector in the long term; • the internal incentive effects this may have on the water industry sector for continued investment.	Information / Research	Private utilities (but not exclusively), Public financial institutions	Medium term (1-3 years	European Commission (DG ENV, DG ECFIN, DG Research, JRC), Public financial institutions	Link to: • WFD CIS Economics • EU Semester

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Annexes

Annex I: Member States fiches and Table Annexes

(*Separate files*)

Annex II: Member State recommendations

(*Separate files*)

Annex III – Country-specific EU 28 model results[19]

Austria

The results of the modelling exercise for Austria (see Table 0.1) are very similar to those for the EU28 as a whole, when the investments are unfunded or funded through an increase in direct taxation. However, when water prices are used to finance the investments (Scenario 1c) there is a moderate negative impact on household consumption over around 0.4%. This is due to the erosion of real incomes that results from the increase in consumer prices, compared to baseline of (1% in 2013). The net effect of the direct investment expenditure and reduction in household consumption is a reduction in GDP, compared to baseline, of 0.1% in 2013. By 2020, however, the economic aggregates return to their baseline value.

Table 0.1: Scenario 1 Austria Modelling Results

	Scenario 1a			Scenario 1b			Scenario 1c		
	2013	2020	2025	2013	2020	2025	2013	2020	2025
GDP	0.2	0.1	0.0	0.1	0.1	0.0	-0.1	-0.1	0.0
Employment	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Consumption	0.1	0.0	0.0	-0.1	-0.2	0.0	-0.4	-0.5	-0.1
Investment	1.4	0.8	0.0	1.3	0.7	0.0	1.2	0.6	0.0
Imports	0.3	0.1	0.0	0.2	0.1	0.0	0.2	0.0	0.0
Exports	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumer Prices	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.9	0.0

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

Belgium

Table 0.2 presents the results of the modelling exercise for Belgium. The size of the direct water-related investments is modest, both in absolute terms and as a

[19] As indicated in the text, no modelling was performed for Denmark, Malta or Sweden.

proportion of GDP, and the resulting impacts on household consumption and GDP are therefore close to zero. When the investments are funded either through direct taxation or an increase in the price of water industry output (Scenarios 1b and 1c), the impact on GDP is neutralised as a result of its negative effect on household income.

Table 0.2: Scenario 1 Belgium Modelling Results

	Scenario 1a			**Scenario 1b**			**Scenario 1c**		
	2013	**2020**	**2025**	**2013**	**2020**	**2025**	**2013**	**2020**	**2025**
GDP	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Employment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumption	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Investment	0.2	0.0	0.0	0.2	0.0	0.0	0.2	0.1	0.0
Imports	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exports	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumer Prices	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

Bulgaria

Table 0.3 presents the modelling results for Bulgaria. The increase in total investment compared to baseline in 2013 is 1.9%. This investment stimulates an increase in GDP, compared to baseline, of around 0.3% in 2013 as well as a positive (but small) employment impact. There is a slight reduction in net trade in 2013 that is brought about as a result of increased investment demand for imports of metal and engineering products to meet the additional investment.

Table 0.3: Scenario 1 Bulgaria Modelling Results

	Scenario 1a			**Scenario 1b**			**Scenario 1c**		
	2013	**2020**	**2025**	**2013**	**2020**	**2025**	**2013**	**2020**	**2025**
GDP	0.3	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Employment	0.1	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
Consumption	0.0	0.0	0.0	-0.4	0.0	0.0	-0.2	0.0	0.0
Investment	1.9	0.0	0.0	1.9	0.0	0.0	1.9	0.0	0.0
Imports	0.3	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.0
Exports	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
Consumer Prices	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

When the additional investments are funded through direct taxation (Scenario 1b), the positive impact on GDP is neutralised, as household income, and therefore consumption, falls by around 0.4% compared to baseline in 2013. This fall in household expenditure attenuates the increase in total imports (which were driven by investment demand).

When the investments are funded by an increase in the output price of the water industry (Scenario 1c) there is a modest overall impact on GDP in 2013. The price increase and its pass-through to the cost of the output of other industries, results in a reduction in international competitiveness. The result is exports fall by 0.1% compared to baseline in 2013. Furthermore the inflationary impact on consumer prices results in a reduction in household consumption as real incomes are eroded.

Croatia

The direct investment requirement for Croatia is the second largest in absolute size of all the 28 countries modelled, and relative to GDP, is the largest. The period over which the investments are made is also longer, reflecting the current state of implementation of the directives in Croatia and the derogations it has been granted for achieving compliance. When interpreting the results for Croatia in Table 3.6, it is important to bear in mind the limitations placed by the available completeness and disaggregation of the National Accounts data for Croatia.

Focusing initially on the results of Scenario 1a in which the direct investments are funded exogenously, much of the potential GDP gains are lost through an increase in imports (1.6% compared to baseline in 2013). This is attributable to the relative market size of the investment which results in a marked increase in investment demand for capital goods which cannot be met by domestic production. Nevertheless there is still a positive impact on GDP compared to baseline, throughout the period of analysis, which is as high as 0.7% in 2020, along with small but positive employment impacts.

Table 0.4: Scenario 1 Croatia Modelling Results

	Scenario 1a			**Scenario 1b**			**Scenario 1c**		
	2013	**2020**	**2025**	**2013**	**2020**	**2025**	**2013**	**2020**	**2025**
GDP	0.6	0.7	0.3	-0.4	0.0	0.2	-0.4	-0.8	0.1
Employment	0.2	0.3	0.1	0.1	0.2	0.1	0.3	0.2	-0.2
Consumption	0.3	0.7	0.8	-1.8	-1.0	0.8	-1.7	-2.3	1.2
Investment	4.6	3.8	0.1	4.5	3.6	-0.1	4.8	3.6	-0.1
Imports	1.6	1.2	0.1	1.0	0.8	0.2	1.2	1.0	0.8
Exports	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumer Prices	0.0	-0.1	-0.1	0.1	0.0	-0.1	3.5	4.9	-0.3

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

When the investments are funded by direct taxation (Scenario 1b) the impact of GDP is negative due to the large sums of finance that must be raised and the effect that this has on household incomes. Household consumption falls by over 1.7%, compared to baseline, in 2013, which somewhat attenuates the increase in imports that is driven by investment demand.

Substantial price increases are required to finance the direct investments through an increase in water industry tariffs alone (Scenario 1c). These put significant upward pressure on aggregate consumer prices: by 2020 the consumer price level of almost 5% higher than in the baseline. The is erosion of real household incomes that results leads to a considerable reduction in household consumption such that the net effect of the policies is a reduction in GDP of 0.4% compared to baseline in 2013 and 0.8% in 2020. Once the period of direct investment is complete, household consumption rebounds and GDP returns to its baseline level.

Cyprus

Table 0.5 presents the Scenario 1 modelling results for Cyprus. The size of the water policy-related investment program in Cyprus is modest, both in relative and absolute terms, meaning that the consequent economic impacts are also small.

When the water policy investment program is funded by an increase in water industry output prices (Scenario 1c) there are small but negative effects on exports and household spending due to the increase in input and consumer prices, respectively. However, the overall impact on GDP is close to zero.

Table 0.5: Scenario 1 Cyprus Modelling Results

	Scenario 1a			Scenario 1b			Scenario 1c		
	2013	2020	2025	2013	2020	2025	2013	2020	2025
GDP	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Employment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumption	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
Investment	0.3	0.0	0.0	0.3	0.0	0.0	0.3	0.0	0.0
Imports	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Exports	0.1	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.1
Consumer Prices	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

Table 0.6 presents the Scenario 2 modelling results for Cyprus in which WFD, Floods Directive and NSWRE-related investments are also modelled. The scale of the direct investments remains modest. There is a positive impact on GDP in 2013 when investments are exogenously funded or funded through direct taxation, although the size of this effect is close to zero. The slight upward pressure on the price level and erosion in household incomes neutralises the positive GDP impact when investments are funded by an increase in water industry prices (Scenario 2c).

Table 0.6: Scenario 2 Cyprus Modelling Results

	Scenario 2a			Scenario 2b			Scenario 2c		
	2013	**2020**	**2025**	**2013**	**2020**	**2025**	**2013**	**2020**	**2025**
GDP	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Employment	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumption	0.0	0.0	0.0	-0.1	0.0	0.0	-0.1	0.0	0.0
Investment	0.4	0.0	0.0	0.4	0.0	0.0	0.4	0.0	0.0
Imports	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1
Exports	0.1	0.0	0.0	0.0	0.0	0.1	-0.2	0.0	0.1
Consumer Prices	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

Czech Republic

The Scenario 1 results for the Czech Republic are presented in Table 0.7. The total increase in investments (including direct investments) is around 2.4% in 2013. This stimulates an increase in household consumption and GDP of around 0.2% and 0.5%, respectively, compared to baseline in 2013. The additional demand for engineering and construction from the investment is met in part through imports, which increase by around 0.4% in 2013, resulting in a small reduction in net trade.

When the investments are financed by an increase in direct taxation (Scenario 1b), the required reduction in household incomes leads to a fall in household consumption, relative to baseline, of over 0.5% in 2013. This negative income effect means that the net impact on GDP of the policy measures is only 0.2% compared to baseline in 2013.

More of the positive impact on GDP is preserved when the investment programs are financed through an increase in the price of water industry output (Scenario 1c). In this scenario, GDP is 0.4% higher, compared to baseline in 2013. While nominal incomes increase under this scenario, the percentage rise in consumer prices (due to the cost pass through of higher inputs prices for industry) is greater, resulting in a reduction in real incomes and household consumption. This offsets some of the positive impact on GDP of the investment program.

Table 0.7: Scenario 1 Czech Republic Modelling Results

	Scenario 1a			Scenario 1b			Scenario 1c		
	2013	**2020**	**2025**	**2013**	**2020**	**2025**	**2013**	**2020**	**2025**
GDP	0.5	-0.1	0.0	0.2	0.0	0.0	0.4	0.0	0.1

Employment	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Consumption	0.2	0.0	0.0	-0.6	0.0	0.1	-0.2	0.0	0.1
Investment	2.4	0.0	0.0	2.3	0.0	0.0	2.3	0.0	0.0
Imports	0.4	0.1	0.0	0.3	0.1	0.0	0.3	0.0	0.0
Exports	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0
Consumer Prices	0.0	0.0	0.0	0.0	0.0	-0.1	0.6	0.0	-0.1

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

The results when WFD, Flood Directive and NSWRE-related investments are also modelled are presented in Table 0.8. The pattern of the results is similar to Scenario 1 and the greatest GDP impacts are achieved in the exogenously funded investment case (Scenario 2a) whereas the lowest GDP impacts occur when investments are funded by direct taxation (Scenario 2b). In this latter case, the reduction in real incomes causes household consumption to fall by over 1% in 2013, thereby eroding much of the positive GDP impacts that occurred in Scenario 2a. The overall impact on GDP is also smaller when the additional investments are funded by the water industry (Scenario 2c), as the upward pressure on consumer prices lowers real household consumption.

Table 0.8: Scenario 2 Czech Republic Modelling Results

	Scenario 2a			**Scenario 2b**			**Scenario 2c**		
	2013	**2020**	**2025**	**2013**	**2020**	**2025**	**2013**	**2020**	**2025**
GDP	1.0	-0.1	0.0	0.3	-0.1	0.0	2. 0.6	3. 0.0	4. 0.1
5. Employment	6. 0.2	7. 0.1	8. 0.0	9. 0.0	10.0.0	11.0.0	12.0.1	13.0.0	14.0.0
15.Consumption	16.0.3	17.0.1	18.0.0	19.-1.1	20.0.0	21.0.1	22.-0.4	23.0.0	24.0.1
25.Investment	26.4.2	27.0.0	28.0.0	29.4.1	30.0.0	31.0.0	32.4.2	33.0.0	34.0.0
35.Imports	36.0.7	37.0.3	38.0.0	39.0.5	40.0.1	41.0.0	42.0.6	43.0.1	44.0.0
45.Exports	46.0.2	47.0.1	48.0.0	49.0.1	50.0.0	51.0.0	52.0.1	53.0.1	54.0.0
55.Consumer Prices	56.0.0	57.-0.1	58.0.0	59.0.1	60.-0.1	61.-0.2	62.1.1	63.0.0	64.-0.1

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

Estonia

The results of the modelling exercise for Estonia are presented in Table 0.9. The positive impacts on GDP range from between 0.2% to 0.4% of baseline in 2013, depending on the funding mechanism for the direct investments.

Under Scenario 1b, in which the investment program is financed through direct taxation, the reduction in real household incomes causes a reduction in household consumption which off-sets some of the positive impact of the investment program on GDP. When investments are funded through an increase in the price of water industry output (Scenario 1c), there is some small upward pressure on consumer prices in 2013 which also leads to a reduction in household consumption and a smaller overall impact on GDP, relative to the exogenous funding scenario (Scenario 1a).

Table 0.9: Scenario 1 Estonia Modelling Results

	Scenario 1a			Scenario 1b			Scenario 1c		
	2013	2020	2025	2013	2020	2025	2013	2020	2025
GDP	0.4	0.0	0.0	0.2	0.0	0.0	0.3	0.0	0.0
Employment	0.2	0.0	0.0	0.1	0.0	0.0	0.2	0.0	0.0
Consumption	0.1	0.0	0.0	-0.3	0.0	0.0	-0.1	0.0	0.0
Investment	1.3	0.0	0.0	1.3	0.0	0.0	1.3	0.0	0.0
Imports	0.2	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.1
Exports	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Consumer Prices	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

Finland

Table 0.10 presents the results of the modelling exercise for Finland. The size of the policy-related investment for Finland is very modest, both in absolute terms as well as relative to the size of the Finnish economy. For this reason, the impacts on GDP, along with the other economic aggregates are close to zero under all three scenario variants.

Table 0.10: Scenario 1 Finland Modelling Results

	Scenario 1a			Scenario 1b			Scenario 1c		
	2013	2020	2025	2013	2020	2025	2013	2020	2025
GDP	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Employment	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumption	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Investment	0.3	0.0	0.0	0.3	0.0	0.0	0.3	0.0	0.0

Imports	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Exports	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumer Prices	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

France

The Scenario 1 results for France are presented in Table 0.11. Although the absolute size of the investment requirement is large, in terms of value relative to the size of the French economy, the scale of the program is modest. The resulting macroeconomic impacts (as a percentage of the baseline) under all three scenario variants are close to zero as a direct consequence.

Table 0.11: Scenario 1 France Modelling Results

	Scenario 1a			Scenario 1b			Scenario 1c		
	2013	**2020**	**2025**	**2013**	**2020**	**2025**	**2013**	**2020**	**2025**
GDP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Employment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumption	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Investment	0.2	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.0
Imports	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Exports	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumer Prices	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

Table 0.12 presents the Scenario 2 results for France, in which WFD, Floods Directive and NSWRE-related investments are also modelled. The inclusion of a broader range of policies, increase the relative market size of the direct investments such that there are some small positive impacts on GDP of around 0.3% compared to baseline in 2013. The GDP impact is smaller when investments are funded by an increase in direct taxation (Scenario 2b) as household incomes are reduced and the small positive impact of the investment on employment is neutralised. The resultant reduction in household consumption reduces the net positive impact on GDP.

There are some small competitiveness impacts under all three scenario variants as imports of materials, machinery and equipment rise to meet the increase in demand for investment goods.

Table 0.12: Scenario 2 France Modelling Results

	Scenario 2a			Scenario 2b			Scenario 2c		
	2013	2020	2025	2013	2020	2025	2013	2020	2025
GDP	0.3	0.1	0.1	0.2	0.0	0.0	0.3	0.0	0.1
Employment	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.0	0.1
Consumption	0.1	0.1	0.1	-0.1	-0.1	-0.1	0.0	0.0	0.1
Investment	1.7	0.2	0.1	1.4	0.0	0.0	1.6	0.1	0.1
Imports	0.4	0.1	0.1	0.4	0.0	0.0	0.4	0.0	0.0
Exports	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1
Consumer Prices	0.1	-0.1	0.0	0.3	-0.1	0.0	0.6	-0.1	0.0

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

Germany

Table 0.13 presents the modelling results for Germany. As with France, while the water policy-related investments are large in absolute terms, relative to the size of the German economy they are modest. The resulting macroeconomic impacts are also small.

Under the exogenously funded investment scenario variant (Scenario 1a) there is a positive but small impact on GDP and imports, the latter of which rise slightly to meet the increase in demand for investment goods. When the direct investments are funded through direct taxation (Scenario 1b) the overall impact on GDP is neutral due to the negative effect of the increase in taxation on household incomes and consumption.

When the direct investments are financed through an increase in the price of water industry output (Scenario 1c), there is upward pressure on consumer prices which erodes household incomes and result in a fall in household consumption of around 0.4%, compared to baseline in 2013. However the increase in the price level does not harm international competitiveness and net trade remains unchanged, relative to baseline, in 2013.

Table 0.13: Scenario 1 Germany Modelling Results

	Scenario 1a			Scenario 1b			Scenario 1c		
	2013	2020	2025	2013	2020	2025	2013	2020	2025
GDP	0.1	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
Employment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumption	0.0	0.0	0.0	-0.1	0.0	0.0	-0.4	0.0	0.0

Investment	0.4	0.0	0.0	0.4	0.0	0.0	0.4	0.0	0.0
Imports	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exports	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumer Prices	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

Greece

Table 0.14 reports the Scenario 1 results for Greece. The relative size of the investment programmes is small and as a consequence the associated macroeconomic impact is broadly neutral under all three scenario variants. When the direct investments are financed through an increase in water industry prices (Scenario 1c), there is a small but negative impact on household consumption, compared to baseline, in 2013. This is caused by the reduction in real household incomes (and hence spending) that results from the increase in consumer prices. The economic aggregates return to their baseline levels under all scenario variants by 2025.

Table 0.14: Scenario 1 Greece Modelling Results

	Scenario 1a			Scenario 1b			Scenario 1c		
	2013	**2020**	**2025**	**2013**	**2020**	**2025**	**2013**	**2020**	**2025**
GDP	0.1	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
Employment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumption	0.0	0.0	0.0	-0.1	0.0	0.0	-0.1	0.0	0.0
Investment	0.4	0.0	0.0	0.4	0.0	0.0	0.3	0.0	0.0
Imports	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exports	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumer Prices	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

When the WFD, Floods Directive and NSWRE-related investment programmes are also modelled, the macroeconomic impacts are slightly larger in the exogenous and taxation funding scenarios (see Table 0.15) but remain small.

Table 0.15: Scenario 2 Greece Modelling Results

	Scenario 2a			Scenario 2b			Scenario 2c		
	2013	**2020**	**2025**	**2013**	**2020**	**2025**	**2013**	**2020**	**2025**
GDP	0.2	0.0	0.0	0.1	0.0	0.0	-0.1	0.0	0.0

Employment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumption	0.1	0.0	0.0	-0.1	-0.1	0.0	-0.3	0.0	0.1
Investment	1.1	0.0	0.0	1.1	0.0	0.0	1.0	0.0	0.0
Imports	0.2	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0
Exports	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumer Prices	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

Hungary

The Scenario 1 results for Hungary are presented in Table 0.16. The impact on GDP in 2013 is an increase of 0.2%, relative to baseline, under the exogenous funding scenario variant (Scenario 1a). When investments are financed through an increase in direct taxation, household income and consumption fall (by around 0.3% compared to baseline in 2013), which neutralises the positive impact of the investment program on GDP. Under Scenario 1c, in which the direct investments are funded via an increase in the output price of the water industry, the positive impact on GDP is also offset by a reduction in household consumption which is caused by the pass-through of industry input costs to consumers. The impact on the aggregate consumer price level is an increase of 0.3%, compared to baseline, in 2013. The implied erosion of real household incomes results in a reduction in household income of around -0.2% in 2013, which is slightly smaller than that which occurs under the direct taxation finance scenario (Scenario 1b).

Table 0.16: Scenario 1 Hungary Modelling Results

	Scenario 1a			**Scenario 1b**			**Scenario 1c**		
	2013	**2020**	**2025**	**2013**	**2020**	**2025**	**2013**	**2020**	**2025**
GDP	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Employment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumption	0.1	0.0	0.0	-0.3	0.0	0.0	-0.2	0.0	0.0
Investment	0.9	0.0	0.0	0.9	0.0	0.0	0.9	0.0	0.0
Imports	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0
Exports	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumer Prices	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

The results under Scenario 2, in which the broader package of investment programmes are modelled, are presented in Table 0.17. When investments are exogenously funded (Scenario 2a) the investment programme is large enough to stimulate a 0.6% increase in GDP, compared to baseline in 2013. However, for the other scenario variants, the accompanying increases in direct taxation (Scenario 2b) or water industry prices (Scenario 2c) are also large and result in reductions in household consumption of 1.2% and 0.9%, respectively in 2013. Such large falls in household consumption act to attenuate the positive macroeconomic effect of the investments, such that the net impact on GDP is broadly neutral under these scenario variants.

The increase in imports that is induced by the increased demand for investment goods leads to some small impacts on net trade under all three scenario variants in 2013. However the net competitiveness effect is smaller under Scenario 2b and 2c due a reduction in import demand arising from the fall in real household incomes.

Table 0.17: Scenario 2 Hungary Modelling Results

	Scenario 2a			Scenario 2b			Scenario 2c		
	2013	2020	2025	2013	2020	2025	2013	2020	2025
GDP	0.6	0.2	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Employment	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumption	0.3	0.1	0.0	-1.2	-0.3	0.0	-0.9	-0.3	0.1
Investment	3.9	1.3	0.1	3.8	1.2	0.0	4.0	1.2	0.0
Imports	0.4	0.1	0.0	0.2	0.1	0.0	0.3	0.1	0.0
Exports	0.1	0.1	0.0	0.1	0.0	0.0	0.1	0.1	0.0
Consumer Prices	-0.1	0.0	0.0	0.0	0.0	0.0	1.3	0.5	0.0

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

Ireland

Table 0.18 presents the modelling results for Ireland. The water policy-related investment requirements for Ireland are relatively modest, both in absolute terms and as a proportion of Irish GDP. The subsequent macroeconomic impacts are therefore also small. When the direct investments are exogenously funded or financed through an increase in the price of water industry output, there is a positive impact on GDP in 2013 of around 0.1%, relative to baseline. However, when the water policy-related investments are funded through direct taxation, there is a slight reduction in household consumption due to the negative effect of tax increases on household incomes. The net impact of the policies measures on GDP in scenario 1b is therefore neutral.

Table 0.18: Scenario1 Ireland Modelling Results

	Scenario 1a			Scenario 1b			Scenario 1c		
	2013	2020	2025	2013	2020	2025	2013	2020	2025

GDP	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Employment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumption	0.1	0.0	0.0	-0.1	0.0	0.0	0.1	0.0	0.0
Investment	0.6	0.0	0.0	0.4	0.0	0.0	0.6	-0.1	0.0
Imports	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exports	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumer Prices	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

Italy

The modelling results for Italy for Scenarios 1 & 2 are presented in Table 0.19 and Table 0.20, respectively. Since the known future investment requirements for the WFD, Floods Directive and NSWRE are small, the results for Scenario 2 are very similar to those of Scenario 1. Furthermore the size of the future UWWTD and DWD investment programmes is small relative to GDP, such that the macroeconomic impacts are close to zero under all six scenario variants.

Table 0.19: Scenario 1 Italy Modelling Results

	Scenario 1a			**Scenario 1b**			**Scenario 1c**		
	2013	**2020**	**2025**	**2013**	**2020**	**2025**	**2013**	**2020**	**2025**
GDP	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0
Employment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumption	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Investment	0.4	0.0	0.0	0.3	0.0	0.0	0.4	0.0	0.0
Imports	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0
Exports	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumer Prices	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	-0.1

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

Table 0.20: Scenario 2 Italy Modelling Results

	Scenario 2a			Scenario 2b			Scenario 2c		
	2013	**2020**	**2025**	**2013**	**2020**	**2025**	**2013**	**2020**	**2025**
GDP	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0
Employment	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Consumption	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
Investment	0.4	0.1	0.0	0.4	0.1	0.0	0.4	0.0	0.0
Imports	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0
Exports	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumer Prices	0.0	0.0	0.0	0.0	0.0	-0.1	0.2	0.0	-0.2

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

Latvia

The Scenario 1 modelling results for Latvia are presented in Table 0.21. For Scenario 1a, in which the direct investments are exogenously funded, there are small positive impacts on GDP and employment, relative to baseline, of around 0.3% and 0.1%, respectively, in 2013. When investments are funded through an increase in direct taxation, most of this GDP impact is lost due to the reduction in household incomes and the associated fall in household expenditure (0.3% relative to baseline in 2013. More of the positive impact on GDP is retained under Scenario 1c, in which investments are financed through an increase in water industry output prices, although there is still a negative offsetting effect from a reduction in household expenditure relative to the exogenously funded investment scenario. This comes about due to the erosion of household income that occurs when the increase in industry input costs is passed through to consumer prices.

Table 0.21: Scenario 1 Latvia Modelling Results

	Scenario 1a			Scenario 1b			Scenario 1c		
	2013	**2020**	**2025**	**2013**	**2020**	**2025**	**2013**	**2020**	**2025**
GDP	0.3	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0
Employment	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Consumption	0.1	0.0	0.0	-0.3	0.0	0.0	-0.1	0.0	0.0
Investment	0.8	0.0	0.0	0.7	0.0	0.0	0.8	0.0	-0.1
Imports	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0
Exports	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Consumer Prices	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	-0.1

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

The Scenario 2 modelling results for Latvia are presented in Table 0.22. When the investments are exogenously financed (Scenario 2a) the impact on GDP in 2013 is an increase of around 1% compared to baseline. Some negative net trade impacts also result due to the rise investment demand for imports. The GDP impact of the investment programme is neutral when funded by an increase in direct taxation (scenario 2b). This is due to the large fall in household consumption that occurs as a result of the reduction in employment and real incomes. Positive GDP impacts are still achieved when the investment programme is funded through an increase in the price of water industry output (Scenario 2c), although it is attenuated to some extent by the increase in consumer prices and associated reduction in real household income and household consumption.

Table 0.22: Scenario 2 Latvia Modelling Results

	Scenario 2a			**Scenario 2b**			**Scenario 2c**		
	2013	**2020**	**2025**	**2013**	**2020**	**2025**	**2013**	**2020**	**2025**
GDP	1.0	-0.1	0.1	0.0	-0.1	0.0	0.7	-0.1	0.2
Employment	0.2	0.0	0.1	-0.1	0.1	0.0	0.1	0.1	0.1
Consumption	0.3	0.0	0.0	-1.7	0.1	-0.1	-0.4	0.0	0.1
Investment	3.9	0.0	0.0	3.7	0.1	0.0	3.9	0.0	-0.2
Imports	0.6	0.1	0.0	0.1	0.2	-0.1	0.4	0.2	-0.2
Exports	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Consumer Prices	-0.1	0.0	0.0	-0.2	-0.1	0.2	0.8	0.0	-0.1

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

Lithuania

Table 0.23 presents the modelling results for Lithuania. The water policy-related investment program has a minimal impact on the macroeconomic aggregates. GDP is slightly higher, relative to baseline, in 2013 but by only 0.1%. There is also a slight rise in imports in 2013, induced by the increase in household consumption. When the investment program is funded by direct taxation, there is a reduction in household incomes and consumption, which neutralises the positive impact on GDP. Likewise when an increase in water industry output prices is used to finance the investments, the cost to industry is passed through to consumers, which erodes real household incomes leading to a reduction in household expenditure.

Table 0.23: Scenario 1 Lithuania Modelling Results

	Scenario 1a			Scenario 1b			Scenario 1c		
	2013	2020	2025	2013	2020	2025	2013	2020	2025
GDP	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Employment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumption	0.1	0.0	0.0	-0.1	0.0	0.0	-0.1	0.0	0.1
Investment	0.5	0.0	0.0	0.4	0.0	0.0	0.4	0.0	0.0
Imports	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exports	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumer Prices	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	-0.1

Notes: Figures shown are % difference from baseline.

Sources: Cambridge Econometrics, E3ME.

Luxembourg

The modelling results for Luxembourg are presented in Table 0.24. The water policy-related investment requirements for Luxembourg are among the lowest of the 28 countries modelled under this study, both in absolute terms as well as relative to GDP. As a consequence, the resulting macroeconomic impacts are close to zero under all three scenario variants. GDP increases by around 0.1% compared to baseline throughout the duration of the investment programme.

When investments are funded by an increase in direct taxation (Scenario 1b) there is an associated reduction in household incomes and consumption of around between 0.1% and 0.2%. Under Scenario 1c in which the investments are funded by an increase in the price of water industry output, there is some small upward pressure on consumer prices as the cost of industry inputs is passed through. This amounts to an increase in the aggregate consumer price level of around 0.3%, compared to baseline, and a reduction in household consumption of around 0.2%.

Table 0.24: Scenario 1 Luxembourg Modelling Results

	Scenario 1a			Scenario 1b			Scenario 1c		
	2013	2020	2025	2013	2020	2025	2013	2020	2025
GDP	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Employment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumption	0.0	0.0	0.0	-0.2	-0.1	-0.1	-0.2	-0.2	-0.3

Investment	0.6	0.5	0.5	0.6	0.5	0.4	0.6	0.5	0.4
Imports	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exports	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumer Prices	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.2	0.3

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

Netherlands

The results of Scenario 1 for the Netherlands are presented in Table 0.25. The water policy-related investment requirements for the Netherlands are amongst the lowest, relative to GDP, of each of the 28 countries modelled. As a consequence, the resulting macroeconomic impacts are close to zero for all scenario variants.

Table 0.25: Scenario 1 Netherlands Modelling Results

	Scenario 1a			**Scenario 1b**			**Scenario 1c**		
	2013	**2020**	**2025**	**2013**	**2020**	**2025**	**2013**	**2020**	**2025**
GDP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Employment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumption	0.0	0.0	0.0	-0.1	0.0	0.0	-0.1	0.0	0.0
Investment	0.2	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.0
Imports	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exports	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumer Prices	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

Table 0.26 presents the results of the modelling exercise for Scenario 2. Once WFD, DWD and NSWRE-related investments are also modelled there are some positive, but very small macroeconomic impacts. Under the exogenous funding scenario there is a 0.2% increase in GDP, relative to baseline in 2013. When investments are funded by an increase in direct taxation (Scenario 2b) the impacts on GDP are neutralised by a reduction in household incomes and consumption. GDP impacts are also attenuated, but still positive under Scenario 2c, due to the erosion of real household incomes that is brought about from an increase in water industry prices.

Table 0.26: Scenario 2 Netherlands Modelling Results

	Scenario 2a			**Scenario 2b**			**Scenario 2c**		
	2013	**2020**	**2025**	**2013**	**2020**	**2025**	**2013**	**2020**	**2025**

GDP	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0
Employment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumption	0.1	0.0	0.0	-0.3	0.1	0.0	-0.3	0.2	0.0
Investment	0.9	0.0	0.0	0.9	0.0	0.0	0.8	0.0	0.1
Imports	0.2	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0
Exports	0.1	0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.0
Consumer Prices	0.0	0.0	-0.1	0.1	-0.1	0.0	0.6	-0.1	-0.1

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

Poland

Table 0.27 presents the results for Poland under Scenario 1. The water policy-related investment program in Poland is among largest of the 28 countries modelled, both in absolute terms and relative to GDP. When the direct investments are exogenously funded (Scenario 1a) there is a small positive impact on GDP in 2013 (0.4% of baseline). Employment also increases relative to baseline, although the size of this impact is close to zero. The positive effects of the direct investments on GDP are offset to some extent by the increase in imports that is induced by higher household consumption and investment demand for goods.

When the direct investments are funded by an increase in direct taxation (Scenario 1b), the positive impacts on GDP and employment are neutralised. This is due to the reduction in household incomes, and therefore consumption, that occurs when direct taxation is increased.

Under Scenario 1c, in which the direct investments are funded by an increase in the price of water industry output, the pass-through of costs from industry to consumer results in an increase in the consumer price level of 0.3% compared to baseline in 2013. This has the effect of eroding real household incomes such that some of the positive macroeconomic effects of the investment program are reversed resulting in net GDP impact of 0.2% compared to baseline in 2013.

Table 0.27: Scenario 1 Poland Modelling Results

	Scenario 1a			Scenario 1b			Scenario 1c		
	2013	**2020**	**2025**	**2013**	**2020**	**2025**	**2013**	**2020**	**2025**
GDP	0.4	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0
Employment	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Consumption	0.1	0.0	0.0	-0.6	0.0	0.0	-0.2	0.0	0.0
Investment	1.8	0.0	0.0	1.6	0.0	0.0	1.7	0.0	0.0
Imports	0.4	0.0	0.0	0.2	0.0	0.0	0.3	0.0	0.0
Exports	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Consumer Prices	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

Portugal

Table 0.28 presents the Scenario 1 results for Portugal. The scale of the investment programmes is relatively large and results in an increase in GDP, relative to baseline, of 0.9% in 2013. Employment also rises slightly, by around 0.2%, in 2013. However, Portugal's net trade position weakens as imports rise by over 1% in order to satisfy the increased demand for investment goods. Imports also rise to meet in the increase in demand for consumer goods brought about as a result of the increase in household incomes (and consumption).

When the investment programs are funded by an increase in direct taxation (Scenario 1b), there is a strong negative impact on household incomes and consumption (which falls by around 0.5%). This attenuates the positive macroeconomic effects of the investments such that the net impact on GDP is an increase of around 0.3% compared to baseline in 2013. Household consumption also falls when investments are funded by an increase in water industry prices (Scenario 1c), this time due to the erosion of real household incomes as firms pass-through the costs to consumers.

Table 0.28: Scenario 1 Portugal Modelling Results

	Scenario 1a			Scenario 1b			Scenario 1c		
	2013	2020	2025	2013	2020	2025	2013	2020	2025
GDP	0.9	0.0	0.0	0.3	0.0	0.0	0.5	0.0	0.0
Employment	0.2	0.1	0.0	0.1	0.1	0.0	0.2	0.0	0.0
Consumption	0.6	-0.1	0.0	-0.5	0.0	0.0	-0.2	0.0	0.0
Investment	5.1	0.0	0.0	4.4	0.0	0.0	4.6	-0.1	0.0
Imports	1.1	0.0	0.1	0.6	0.0	0.1	0.7	0.0	0.1
Exports	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumer Prices	-0.3	0.1	0.0	-0.3	0.1	0.0	0.7	0.1	0.0

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

Table 0.29 presents the Scenario 2 modelling results for Portugal which include DWD, Floods Directive and NSWRE-related investments as well as those modelled under Scenario 1. When investments are exogenously funded (Scenario 2a) GDP increases by 1.6%of the baseline in 2013 and employment by 0.3%. The results follow a similar pattern to Scenario 1 in terms of the path of the impacts over time and across scenario variants such that the smallest GDP impact is realised when investments are funded through an increase in direct taxation.

Table 0.29: Scenario2 Portugal Modelling Results

	Scenario 2a			Scenario 2b			Scenario 2c		
	2013	**2020**	**2025**	**2013**	**2020**	**2025**	**2013**	**2020**	**2025**
GDP	1.6	0.0	0.0	0.6	0.0	0.0	0.9	0.0	0.0
Employment	0.3	0.1	0.0	0.1	0.1	0.1	0.3	0.0	0.0
Consumption	1.1	-0.1	0.0	-0.6	0.0	0.0	-0.1	0.0	0.0
Investment	8.4	0.1	0.0	7.3	0.1	0.1	7.7	0.1	0.0
Imports	1.8	0.1	0.1	1.1	0.1	0.1	1.3	0.1	0.1
Exports	0.2	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.1
Consumer Prices	-0.4	0.2	0.0	-0.4	0.2	0.0	1.2	0.2	0.0

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

Romania

The results of the Scenario 1 modelling exercise for the Romania are presented in Table 0.30. When the direct investments are exogenously funded (Scenario 1a) there is an increase in GDP of around 0.4%, compared to baseline in 2013, and a positive but small impact on employment. The positive effect on GDP is attenuated to some degree by a rise in imports that is driven by the increase in household incomes and investment demand for goods.

When direct investments are funded by an increase in direct taxation, the net impact on GDP is small but negative (-0.1% of baseline in 2013). This is due to the offsetting effect of the rise in direct taxation in household incomes, which causes household expenditure to fall by 0.6% compared to baseline in 2013. The funding of direct investments through an increase in the price of water industry output results in better outcomes in terms of GDP impacts. The pass though of industry cost increases to consumer prices results in a slight reduction in household consumption in 2013 (-0.1% of baseline) and a small reduction in international competitiveness. The net policy impact on GDP is still positive (-0.2% of baseline in 2013) however not as large as when investments are exogenously funded (Scenario 1a).

Table 0.30: Scenario 1 Romania Modelling Results

	Scenario 1a			Scenario 1b			Scenario 1c		
	2013	**2020**	**2025**	**2013**	**2020**	**2025**	**2013**	**2020**	**2025**
GDP	0.4	0.0	0.0	-0.1	0.0	-0.1	0.2	0.0	0.0
Employment	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0

Consumption	0.1	0.0	0.0	-0.6	0.0	0.0	-0.1	0.0	0.0
Investment	1.6	0.1	0.1	1.4	-0.2	-0.3	1.6	-0.1	-0.1
Imports	0.3	0.0	0.0	0.1	0.0	0.0	0.3	0.0	0.0
Exports	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumer Prices	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

Table 0.32 presents the Scenario 2 results in which a broader range of water policy-related investments are included. The large market size of the investment programme leads to positive GDP impacts when financed either exogenously or through an increase in the price of water industry output. When investments are funded through direct taxation (Scenario 2b) the impact on GDP is negative, with a reduction of around 0.3%, compared to baseline in 2013. This is largely driven by a reduction in household consumption, compared to baseline, of around 3.6% in 2013, which is in turn caused by the effect of higher taxes on household incomes.

When investments are funded by higher water prices (Scenario 2c), the pass through of these costs to consumers results in a reduction in real household incomes and consumption. This weakens, to some extent, the positive macroeconomic impacts of the direct investments and as a consequence the increase in GDP compared to baseline is only 1.3% in 2012, compared to 2.3% when investments are exogenously funded (Scenario 2a).

Under all three scenario variants there is a reduction in net trade as imports rise to satisfy demand for investment goods, and in the cases of Scenario 2a, increased household demand.

Table 0.31: Scenario 2 Romania Modelling Results

	Scenario 2a			**Scenario 2b**			**Scenario 2c**		
	2013	**2020**	**2025**	**2013**	**2020**	**2025**	**2013**	**2020**	**2025**
GDP	2.3	0.8	1.0	-0.3	0.0	0.1	1.3	0.5	0.6
Employment	0.4	0.2	0.3	0.0	0.1	0.0	0.3	0.2	0.2
Consumption	0.7	0.3	0.3	-3.6	-0.9	-1.3	-0.7	-0.1	-0.2
Investment	9.5	3.6	5.3	8.1	2.4	3.8	9.1	3.1	4.6
Imports	1.9	0.8	1.0	0.5	0.1	0.3	1.6	0.6	0.9
Exports	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1
Consumer Prices	-0.1	-0.1	-0.1	0.0	0.2	0.1	1.2	0.3	0.4

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

Slovakia

Table 0.32 presents the results of Scenario 1 for Slovakia. The size of the investment program relative to the Slovak economy means that the GDP impacts are close to zero under all three scenario variants. When investments are exogenously financed there is an increase in GDP of 0.1% compared to baseline in 2013 and 2020. However when investments are financed either through direct taxation or an increase in water industry output prices, the impact on GDP is neutral and there are small but negative impacts on household incomes and consumption.

Table 0.32: Scenario 1 Slovakia Modelling Results

	Scenario 1a			Scenario 1b			Scenario 1c		
	2013	2020	2025	2013	2020	2025	2013	2020	2025
GDP	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Employment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumption	0.0	0.0	0.0	-0.2	0.0	0.0	-0.1	0.0	0.0
Investment	0.4	0.1	0.1	0.3	0.0	0.0	0.4	0.0	0.0
Imports	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Exports	0.1	0.1	0.0	0.0	0.0	0.0	-0.1	0.1	0.1
Consumer Prices	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

Slovenia

The results for Slovenia under Scenario 1 are presented in Table 0.33. The size of the water-policy-related investment is relatively large and the total increase in investment (direct and indirect) compared to baseline in 2013 is around 12% under all three scenario variants.

When exogenously funded, the direct investments stimulate a GDP rise of around 2%, compared baseline, in 2013. Employment and household consumption also rise by around 0.9%, compared to baseline. The resultant increase in consumer demand and the scale of the investment program results in a deterioration in net as imports rise by around 1.8% compared to baseline in 2013. However there is no persistence in these macroeconomic impacts beyond the lifetime of the investment programme and by 2020 all of the economic aggregates return to their baseline levels.

When the direct investments are funded by an increase in direct taxation (Scenario 1b) the positive impact on GDP is almost entirely offset by a large reduction in household consumption (around 3.2% in 2013). The GDP impact is larger when the additional investment is funded by an increase the price of water industry outputs (Scenario 1c). Although the pass-through of water prices to households leads to a reduction in real incomes and consumption compared to baseline, it is not large enough to completely off-set the increase in investment expenditure. The net impact on GDP is an increase of around 1.2% compared to baseline in 2013.

Table 0.33: Scenario 1 Slovenia Modelling Results

	Scenario 1a			Scenario 1b			Scenario 1c		
	2013	2020	2025	2013	2020	2025	2013	2020	2025
GDP	2.0	0.0	0.0	0.2	0.0	0.0	1.2	0.0	0.0
Employment	0.8	0.0	0.0	-0.2	0.1	0.0	0.5	0.0	0.0
Consumption	0.9	0.0	0.0	-3.2	0.0	0.0	-0.9	0.1	0.1
Investment	12.4	0.0	0.0	12.2	0.0	-0.1	12.0	0.0	0.0
Imports	1.8	0.0	0.0	0.9	0.0	0.0	1.3	0.0	0.0
Exports	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumer Prices	0.0	0.0	0.0	0.2	0.0	0.0	2.1	0.0	-0.1

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

Spain

Table 0.34 presents the Scenario 1 results for Spain. The size of the known water-policy related investment requirements for Spain reflects both the existing state of policy implementation and the extent of current knowledge over future investment requirements. The known investment needs for implementing the two directives are relatively modest, and as a result so are the macroeconomic impacts.

There is an increase in GDP of around 0.2% compared to baseline in 2013 and a small increase in overall employment if investments are exogenously funded (Scenario 1a). When investments are funded by an increase in direct taxation (Scenario 1b) the positive impact on GDP is offset by a reduction in household consumption. Finally, when investments are funded through an increase in water industry output prices the impact on GDP is positive but small, as the increase in the general price level erodes real household incomes and prevents any increase in household consumption.

Table 0.34: Scenario 1 Spain Modelling Results

	Scenario 1a			Scenario 1b			Scenario 1c		
	2013	2020	2025	2013	2020	2025	2013	2020	2025
GDP	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Employment	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Consumption	0.1	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
Investment	0.6	0.0	0.0	0.5	0.0	0.0	0.6	-0.1	0.0
Imports	0.2	0.0	0.0	0.1	0.0	0.0	0.2	0.0	0.0
Exports	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumer Prices	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

Table 0.35 presents the results under Scenario 2, which include WFD, Floods Directive and NSWRE policy-related investments as well as those modelled in Scenario 1. The GDP impacts are larger than in Scenario 1 due to the increase in the size of the direct investments modelled, however the patter of the results is broadly similar to that of Scenario 1.

Table 0.35: Scenario 2 Spain Modelling Results

	Scenario 2a			Scenario 2b			Scenario 2c		
	2013	2020	2025	2013	2020	2025	2013	2020	2025
GDP	0.4	0.1	0.1	0.2	0.0	0.0	0.3	0.1	0.1
Employment	0.2	0.1	0.0	0.1	0.0	0.0	0.2	0.1	0.0
Consumption	0.2	0.1	0.0	-0.1	0.0	0.0	0.1	0.1	0.0
Investment	1.2	0.0	0.1	1.0	0.0	0.0	1.2	-0.1	0.1
Imports	0.4	0.0	0.0	0.2	0.0	0.0	0.4	0.0	0.0
Exports	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumer Prices	0.0	0.0	0.0	0.1	0.0	0.0	0.2	-0.2	-0.1

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

UK

The results of the Scenario 1 for the UK are presented in Table 0.36. The macroeconomic impacts of the investment program under all three scenario variants are close to zero. This is a direct consequence of the size of the known water-policy related investments relative to UK GDP. When WFD, Floods Directive, and NSWRE-related investments are also included in the modelling (see Table 0.37) the GDP impacts remain of a similar magnitude.

Table 0.36: Scenario 1 UK Modelling Results

	Scenario 1a			Scenario 1b			Scenario 1c		
	2013	2020	2025	2013	2020	2025	2013	2020	2025
GDP	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Employment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumption	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Investment	0.3	0.2	0.0	0.2	0.2	0.0	0.3	0.2	0.0

Imports	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Exports	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumer Prices	-0.1	0.0	-0.1	0.0	0.0	-0.1	0.1	0.0	-0.1

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

Table 0.37: Scenario 2 UK Modelling Results

	Scenario 2a			**Scenario 2b**			**Scenario 2c**		
	2013	**2020**	**2025**	**2013**	**2020**	**2025**	**2013**	**2020**	**2025**
GDP	0.1	0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.0
Employment	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.0	0.1
Consumption	0.1	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
Investment	0.6	0.4	0.2	0.5	0.4	0.2	0.5	0.4	0.2
Imports	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1
Exports	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Consumer Prices	-0.1	0.0	-0.1	0.0	0.0	-0.1	0.1	0.1	-0.1

Notes: Figures shown are % difference from baseline.
Sources: Cambridge Econometrics, E3ME.

Annex III – Description of the E3ME model

This appendix provides a short non-technical description of the Energy-Environment-Economy Model for Europe (E3ME), developed by Cambridge Econometrics (CE).

For further details, including the full technical manual, the reader is referred to the E3ME website: http://www.e3me.com. E3ME is also described in the IA Tools model inventory.

For a list of acknowledgements see the preface of the model manual.

Introduction to E3ME

E3ME is a computer-based model of Europe's economic and energy systems and the environment. It was originally developed through the European Commission's research framework programmes and is now widely used in Europe for policy assessment, for forecasting and for research purposes.

E3ME's structure

The structure of E3ME is based on the system of national accounts, as defined by ESA95 (European Commission, 1996), with further linkages to energy demand and environmental emissions. The labour market is also covered in detail, with estimated sets of equations for labour demand, supply, wages and working hours. In total there are 33 sets of econometrically estimated equations, also including the components of GDP (consumption, investment, and international trade), prices, energy demand and materials demand. Each equation set is disaggregated by country and by sector.

E3ME's historical database covers the period 1970-2008 and the model projects forward annually to 2050[20]. The main data sources are Eurostat, DG Ecfin's AMECO database and the IEA, supplemented by the OECD's STAN database and other sources where appropriate. Gaps in the data are estimated using customised software algorithms.

The main dimensions of the model

The other main dimensions of the model are:

- 33 countries (the EU27 member states plus Norway and Switzerland)
- 69 economic sectors, including disaggregation of the energy sectors and 16 service sectors
- 43 categories of household expenditure
- 19 different users of 12 different fuel types
- 14 types of air-borne emission (where data are available) including the six greenhouse gases monitored under the Kyoto protocol.
- 13 types of household, including income quintiles and socio-economic groups such as the unemployed, inactive and retired, plus an urban/rural split

Typical outputs from the model include GDP and sectoral output, household expenditure, investment, international trade, inflation, employment and unemployment, energy demand and CO_2 emissions. Each of these is available at national and EU level, and most are also defined by economic sector.

The econometric specification of E3ME gives the model a strong empirical grounding and means it is not reliant on the assumptions common to Computable General

[20] See Chewpreecha and Pollitt (2009).

Equilibrium (CGE) models, such as perfect competition or rational expectations. E3ME uses a system of error correction, allowing short-term dynamic (or transition) outcomes, moving towards a long-term trend. The dynamic specification is important when considering short and medium-term analysis (e.g. up to 2020) and rebound effects[21], which are included as standard in the model's results.

E3ME's key strengths

In summary the key strengths of E3ME lie in three different areas:

- the close integration of the economy, energy systems and the environment, with two-way linkages between each component
- the detailed sectoral disaggregation in the model's classifications, allowing for the analysis of similarly detailed scenarios
- the econometric specification of the model, making it suitable for short and medium-term assessment, as well as longer-term trends

A brief history of E3ME

Quantifying the short and long-term effects of E3 policies

E3ME was originally intended to meet an expressed need of researchers and policy makers for a framework for analysing the long-term implications of Energy-Environment-Economy (E3) policies, especially those concerning R&D and environmental taxation and regulation. The model is also capable of addressing the short-term and medium-term economic effects as well as, more broadly, the long-term effects of such policies, such as those from the supply side of the labour market.

The European contribution

The first version of the E3ME model was built by an international European team under a succession of contracts in the JOULE/THERMIE and EC research programmes. The projects 'Completion and Extension of E3ME'[22] and 'Applications of E3ME'[23], were completed in 1999. The 2001 contract, 'Sectoral Economic Analysis and Forecasts'[24] generated an update of the E3ME industry output, product and investment classifications to bring the model into compliance with the European System of Accounts, ESA 95. This led to a significant disaggregation of the service sector. The 2003 contract, Tipmac[25], led to a full development of the E3ME transport module to include detailed country models for several modes of passenger and freight transport and Seamate (2003/2004)[26] resulted in the improvement of the E3ME technology indices. The COMETR[27] (2005-07), Matisse[28] (2005-08) and CEDEFOP[29] (2007-2010) projects allowed the expansion of E3ME to cover 29 European countries,

[21] Where an initial increase in efficiency reduces demand, but this is negated in the long run as greater efficiency lowers the relative cost and increases consumption. See Barker et al (2009).

[22] European Commission contract no. JOS3-CT95-0011

[23] European Commission contract no. JOS3-CT97-0019

[24] European Commission contract no. B2000/A7050/001

[25] European Commission contract no. GRD1/2000/25347-SI2.316061

[26] European Commission contract no. IST-2000-31104

[27] European Commission contract no. 501993 (SCS8)

[28] European Commission contract no. 004059 (GOCE)

[29] European Commission project no. 2007-0089/AO/AZU/Skillsnet-Supply/010/07 and European Commission project no. 2006/S 125-132790

including the twelve accession countries. More recently the model has been used to contribute to European Impact Assessments, including reviews of the EU ETS, Energy Taxation Directive and TEN-E infrastructure policy. E3ME is now applied at the national, as well as European, level.

A full list of recent projects involving E3ME, and references from related publications, is available from the model website.

E3ME is the latest in a succession of models developed for energy-economy and, later, E3 (energy-environment-economy) interactions in Europe, starting with EXPLOR, built in the 1970s, then HERMES in the 1980s. Each model has required substantial resources from international teams and has learned from earlier problems and developed new techniques. E3ME is now firmly established as a tool for policy analysis in Europe. The current version is closely linked to the global E3MG[30] model, which is similar in structure and dimensions.

The theoretical background to E3ME

Economic activity undertaken by persons, households, firms and other groups in society has effects on other groups after a time lag, and the effects persist into future generations, although many of the effects soon become so small as to be negligible. But there are many actors, and the effects, both beneficial and damaging, accumulate in economic and physical stocks. The effects are transmitted through the environment (with externalities such as greenhouse gas emissions contributing to global warming), through the economy and the price and money system (via the markets for labour and commodities), and through the global transport and information networks. The markets transmit effects in three main ways: through the level of activity creating demand for inputs of materials, fuels and labour; through wages and prices affecting incomes; and through incomes leading in turn to further demands for goods and services. These interdependencies suggest that an E3 model should be comprehensive, and include many linkages between different parts of the economic and energy systems.

These economic and energy systems have the following characteristics: economies and diseconomies of scale in both production and consumption; markets with different degrees of competition; the prevalence of institutional behaviour whose aim may be maximisation, but may also be the satisfaction of more restricted objectives; and rapid and uneven changes in technology and consumer preferences, certainly within the time scale of greenhouse gas mitigation policy. Labour markets in particular may be characterised by long-term unemployment. An E3 model capable of representing these features must therefore be flexible, capable of embodying a variety of behaviours and of simulating a dynamic system. This approach can be contrasted with that adopted by general equilibrium models: they typically assume constant returns to scale; perfect competition in all markets; maximisation of social welfare measured by total discounted private consumption; no involuntary unemployment; and exogenous technical progress following a constant time trend (see Barker, 1998, for a more detailed discussion).

E3ME as an E3 model

The E3ME model comprises:

[30] See www.e3mgmodel.com

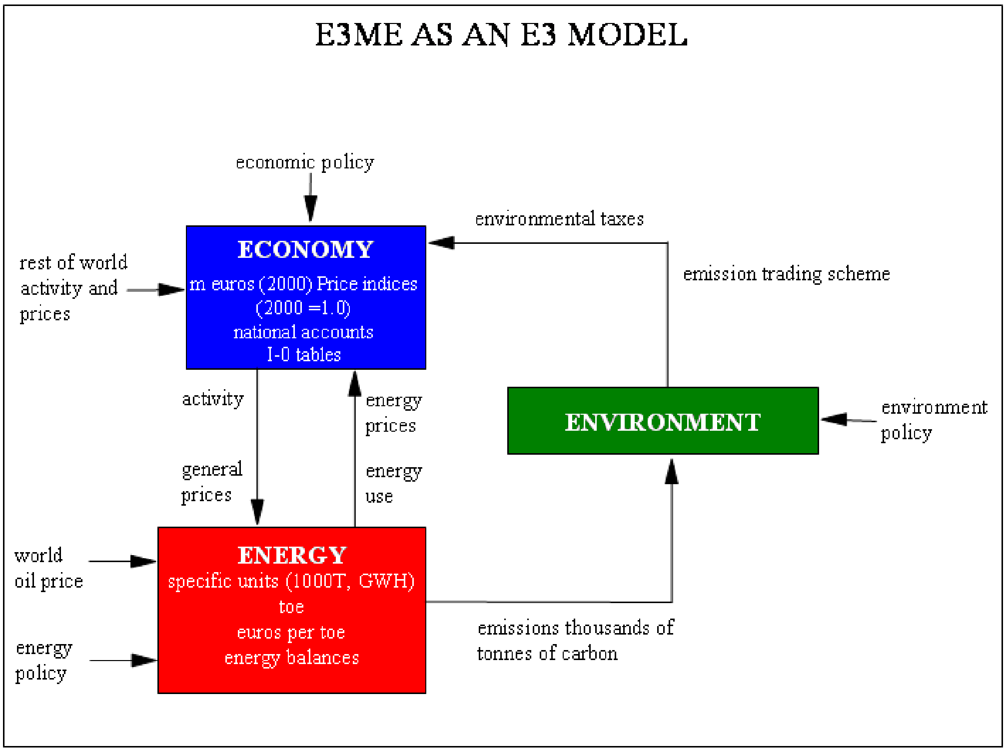
- the accounting balances for commodities from input-output tables, for energy carriers from energy balances and for institutional incomes and expenditures from the national accounts
- environmental emission flows
- 33 sets of time-series econometric equations (aggregate energy demands, fuel substitution equations for coal, heavy oil, gas and electricity; intra-EU and extra-EU commodity exports and imports; total consumers' expenditure; disaggregated consumers' expenditure; industrial fixed investment; industrial employment; industrial hours worked; labour participation; industrial prices; export and import prices; industrial wage rates; residual incomes; investment in dwellings; normal output equations and physical demand for seven types of materials)

Energy supplies and population stocks and flows are treated as exogenous.

The E3 interactions

Figure A. 1 shows how the three components (modules) of the model - energy, environment and economy - fit together. Each component is shown in its own box with its own units of account and sources of data. Each data set has been constructed by statistical offices to conform to accounting conventions. Exogenous factors coming from outside the modelling framework are shown on the outside edge of the chart as inputs into each component. For the EU economy, these factors are economic activity and prices in non-EU world areas and economic policy (including tax rates, growth in government expenditures, interest rates and exchange rates). For the energy system, the outside factors are the world oil prices and energy policy (including regulation of energy industries). For the environment component, exogenous factors include policies such as reduction in SO2 emissions by means of end-of-pipe filters from large combustion plants. The linkages between the components of the model are shown explicitly by the arrows that indicate which values are transmitted between components.

Figure A. 1: E3ME as an E3 model

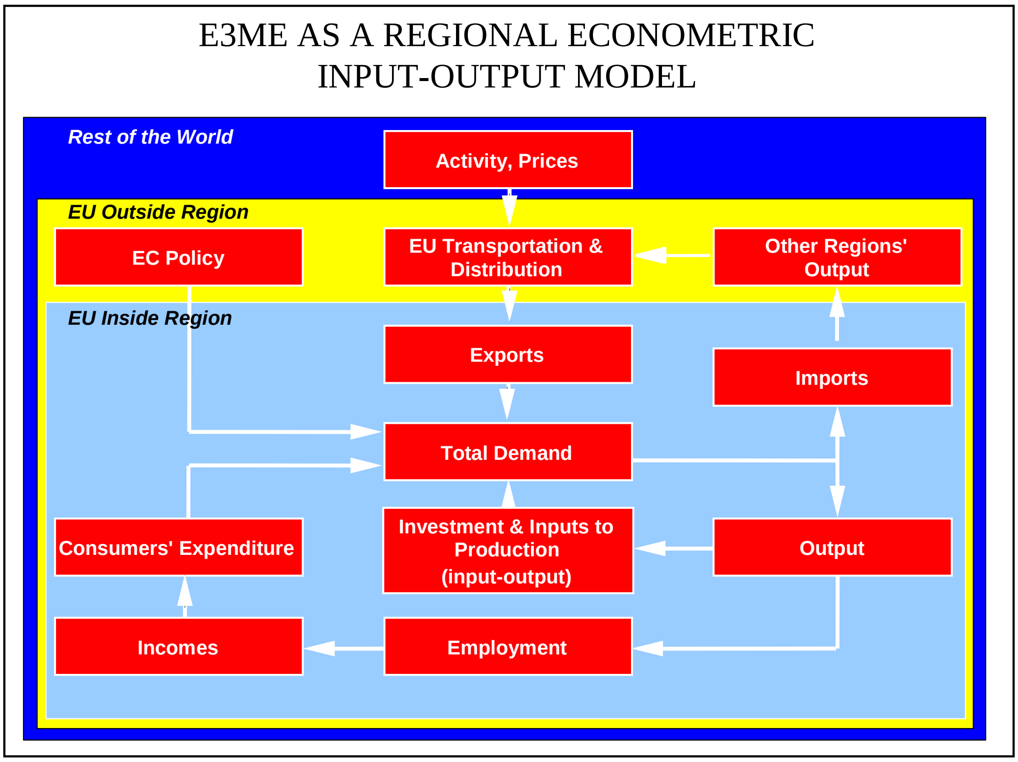


The economy module provides measures of economic activity and general price levels to the energy module; the energy module provides measures of emissions of the main air pollutants to the environment module, which in turn gives measures of damage to health and buildings (estimated using the most recent ExternE[31] coefficients). The energy module provides detailed price levels for energy carriers distinguished in the economy module and the overall price of energy as well as energy use in the economy.

The E3ME regional econometric input-output model

Figure A. 2 shows how the economic module is solved as an integrated EU regional model. Most of the economic variables shown in the chart are at a 69-industry level. The whole system is solved simultaneously for all industries and all 33 countries, although single-country solutions are also possible. The chart shows interactions at three spatial levels: the outermost area is the rest of the world; the next level is the European Union outside the country in question; and finally, the inside level contains the relationships within the country.

Figure A. 2: E3ME as a regional econometric input-output model



The chart shows three loops or circuits of economic interdependence, which are described in some detail below. These are the export loop, the output-investment loop and the income loop.

The export loop

The export loop runs from the EU transport and distribution network to the region's exports, then to total demand. The region's imports feed into other EU regions' exports and output and finally to these other regions' demand from the EU pool and back to the exports of the region in question.

[31] http://www.externe.info/tools.html

Treatment of international trade

An important part of the modelling concerns international trade. The basic assumption is that, for most commodities, there is a European 'pool' into which each region supplies part of its production and from which each region satisfies part of its demand. *This might be compared to national electricity supplies and demands: each power plant supplies to the national grid and each user draws power from the grid and it is not possible or necessary to link a particular supply to a particular demand.*

The demand for a region's exports of a commodity is related to three factors:

- domestic demand for the commodity in all the other EU regions, weighted by their economic distance from the region in question
- activity in the main external EU export markets, as measured by GDP or industrial production
- relative prices, including the effects of exchange rate changes

Economic distance

Economic distance is measured by a special distance variable. For a given region, this variable is normalised to be 1 for the home region and values less than one for external regions. The economic distance to other regions is inversely proportional to trade between the regions. In E3ME regional imports are determined for the demand and relative prices by commodity and region. In addition, measures of innovation (including spending on R&D) have been introduced into the trade equations to pick up an important long-term dynamic effect on economic development.

The output-investment loop

The output-investment loop includes industrial demand for goods and services and runs from total demand to output and then to investment and back to total demand. For each region, total demand for the gross output of goods and services is formed from industrial demand, consumers' expenditure, government consumption, investment (fixed domestic capital formation and stockbuilding) and exports. These totals are divided between imports and output depending on relative prices, levels of activity and utilisation of capacity. Industrial demand represents the inputs of goods and services from other industries required for current production, and is calculated using input-output coefficients. The coefficients are calculated as inputs of commodities from whatever source, including imports, per unit of gross industrial output.

Determination of investment demand

Forecast changes in output are important determinants of investment in the model. Investment in new equipment and new buildings is one of the ways in which companies adjust to the new challenges introduced by energy and environmental policies. Consequently, the quality of the data and the way data are modelled are of great importance to the performance of the whole model. Regional investment by the investing industry is determined in the model as intertemporal choices depending on capacity output and investment prices. When investment by user industry is determined, it is converted, using coefficients derived from input-output tables, into demands on the industries producing the investment goods and services, mainly engineering and construction. These demands then constitute one of the components of total demand.

Accumulation of knowledge and technology

Gross fixed investment, enhanced by R&D expenditure in constant prices, is accumulated to provide a measure of the technological capital stock. This avoids problems with the usual definition of the capital stock and lack of data on economic scrapping. The accumulation measure is designed to get round the worst of these problems. Investment is central to the determination of long-term growth and the model embodies endogenous technical change and a theory of endogenous growth which underlies the long-term behaviour of the trade and employment equations.

The income loop

In the income loop, industrial output generates employment and incomes, which leads to further consumers' expenditure, adding to total demand. Changes in output are used to determine changes in employment, along with changes in real wage costs, interest rates and energy costs. With wage rates explained by price levels and conditions in the labour market, the wage and salary payments by industry can be calculated from the industrial employment levels. These are some of the largest payments to the personal sector, but not the only ones. There are also payments of interest and dividends, transfers from government in the form of state pensions, unemployment benefits and other social security benefits. Payments made by the personal sector include mortgage interest payments and personal income taxes. Personal disposable income is calculated from these accounts, and deflated by the consumer price index to give real personal disposable income.

Determination of consumers' demand

Totals of consumer spending by region are derived from consumption functions estimated from time-series data (this is a similar treatment to that adopted in the HERMES model). These equations relate consumption to regional personal disposable income, a measure of wealth for the personal sector, inflation and interest rates. Sets of equations have been estimated from time-series data for each of the 43 consumption categories reported by Eurostat in each country.

Energy-Environment links

Top-down and bottom-up methodologies

E3ME is intended to be an integrated top-down, bottom-up model of E3 interaction. In particular, the model includes a detailed engineering-based treatment of the electricity supply industry (ESI). Demand for energy by the other fuel-user groups is top-down, but it is important to be aware of the comparative strengths and weaknesses of the two approaches. Top-down economic analyses and bottom-up engineering analyses of changes in the pattern of energy consumption possess distinct intellectual origins and distinct strengths and weaknesses (see Barker, Ekins and Johnstone, 1995).

A top-down submodel of energy use

The energy submodel in E3ME is constructed, estimated and solved for 19 fuel users, 12 energy carriers (termed fuels for convenience below) and 33 countries. Figure A. 3 shows the inputs from the economy and the environment into the components of the submodel and Figure A. 4 shows the feedback from the submodel to the rest of the economy.

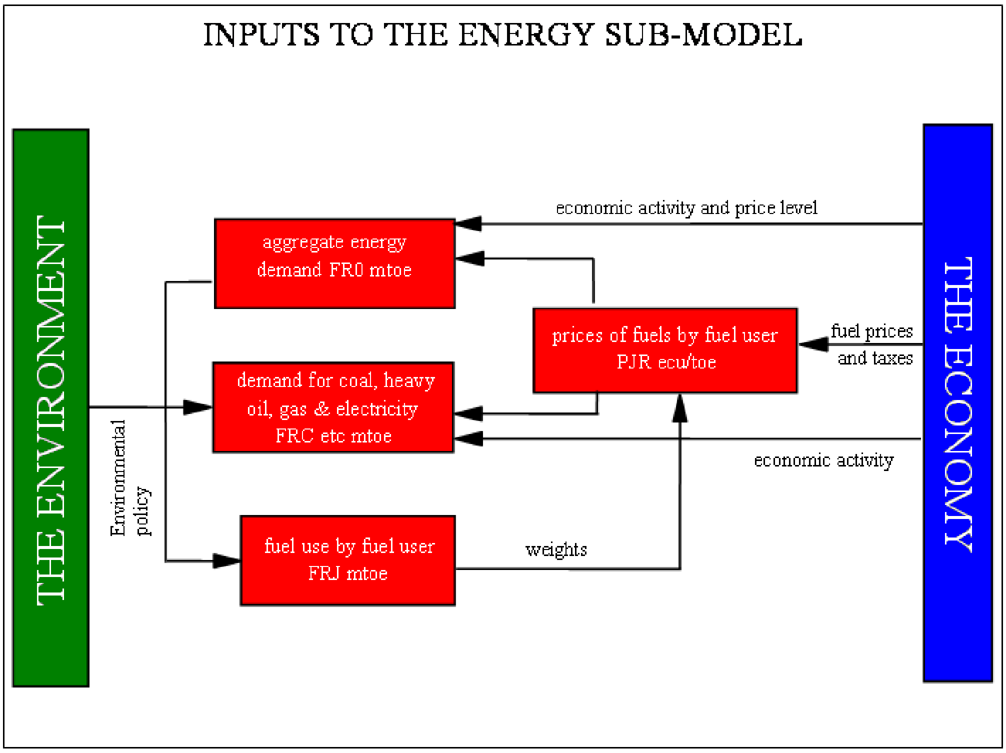
Determination of fuel demand

Aggregate energy demand, shown at the top of Figure A. 3, is determined by a set of co-integrating equations[32], whose the main explanatory variables are:

- economic activity in each of the 19 fuel users
- average energy prices by the fuel users relative to the overall price levels
- technological variables, represented by investment and R&D expenditure, and spillovers in key industries producing energy-using equipment and vehicles

[32] Cointegration is an econometric technique that defines a long-run relationship between two variables resulting in a form of 'equilibrium'. For instance, if income and consumption are cointegrated, then any temporary shock (expected or unexpected) affecting these two variables is gradually absorbed since in the long run they return to their 'equilibrium' levels. Note that a cointegration relationship is much stronger relationship than a simple correlation: two variables can show similar patterns simply because they are driven by some common factors but without necessarily being involved in a long-run relationship.

Figure A. 3: Inputs to the energy sub-model



Fuel substitution

Fuel use equations are estimated for four fuels - coal, heavy oils, gas and electricity – and the four sets of equations are estimated for the fuel users in each region. These equations are intended to allow substitution between these energy carriers by users on the basis of relative prices, although overall fuel use and the technological variables are allowed to affect the choice. Since the substitution equations cover only four of the twelve fuels, the remaining fuels are determined as fixed ratios to similar fuels or to aggregate energy use. The final set of fuels used must then be scaled to ensure that it adds up to the aggregate energy demand (for each fuel user and each region).

Emissions submodel

The emissions submodel calculates air pollution generated from end-use of different fuels and from primary use of fuels in the energy industries themselves, particularly electricity generation. Provision is made for emissions to the atmosphere of carbon dioxide (CO_2), sulphur dioxide (SO2), nitrogen oxides (NOx), carbon monoxide (CO), methane (CH4), black smoke (PM10), volatile organic compounds (VOC), nuclear emissions to air, lead emissions to air, chlorofluorocarbons (CFCs) and the other four greenhouse gases: nitrous oxide (N2O), hydrofluorocarbons (HFC), perfluorocarbons (PFC), sulphur hexafluoride (SF6). These four gases together with CO2 and CH4 constitute the six greenhouse gases (GHGs) monitored under the Kyoto protocol. Using estimated (ExternE) damage coefficients, E3ME may also estimate ancillary benefits relating to reduction in associated emissions e.g. PM10, SO2, NOx.

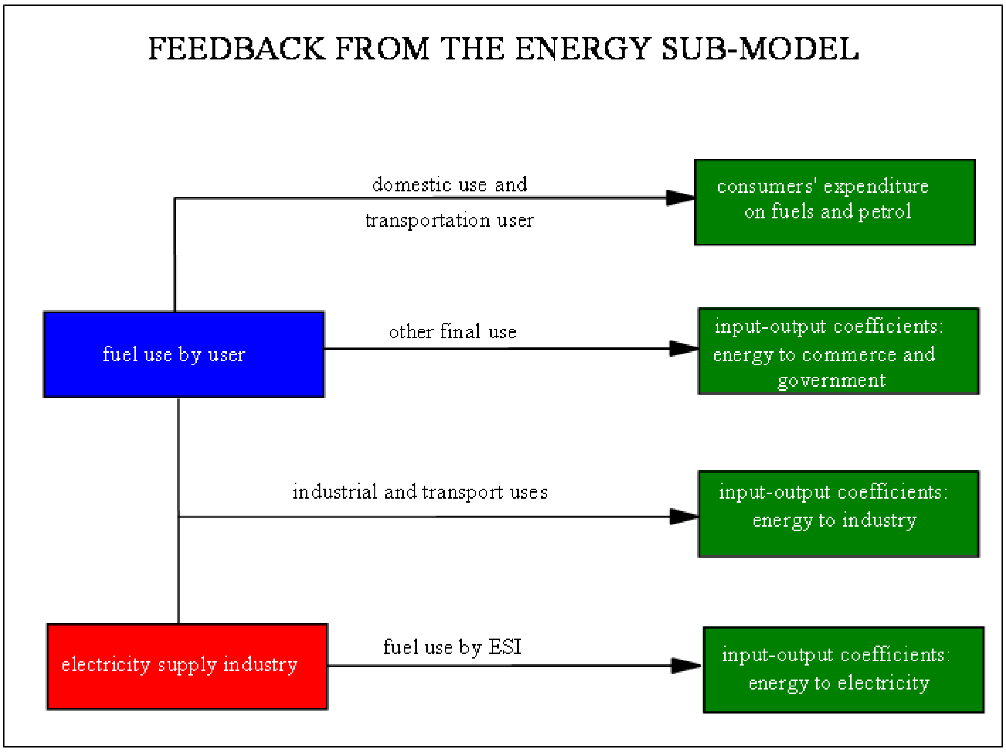
CO_2 emissions

Emissions data for CO_2 are available for fuel users of solid fuels, oil products and gas separately. The energy submodel estimates of fuel by fuel user are aggregated into these groups (solid, oil and gas) and emission coefficients (tonnes of carbon in CO_2 emitted per toe) are calculated and stored. The coefficients are calculated for each year when data are available, then used at their last historical values to project future emissions. Other emissions data are available at various levels of disaggregation from a number of sources and have been constructed carefully to ensure consistency.

Feedback to the rest of the economy

Figure A. 4 shows the main feedbacks from the energy submodel to the rest of the economy. Changes in consumers' expenditures on fuels and petrol are formed from changes in fuel use estimated in the energy submodel, although the levels are calibrated on historical time-series data. The model software provides an option for choosing either the consumers' expenditure equation solution, or the energy equation solution. Whichever option is chosen, total consumer demand in constant values matches the results of the aggregate consumption function, with any residual held in the unallocated category of consumers' expenditure. The other feedbacks all affect industrial, including electricity, demand via changes in the input-output coefficients.

Figure A. 4: Feedback from the energy sub-model



Parameter estimation

The econometric model has a complete specification of the long-term solution in the form of an estimated equation that has long-term restrictions imposed on its parameters. Economic theory, for example the recent theories of endogenous growth, informs the specification of the long-term equations and hence properties of the model; dynamic equations that embody these long-term properties are estimated by econometric methods to allow the model to provide forecasts. The method utilises developments in time-series econometrics, in which dynamic relationships are specified in terms of error correction models (ECM) that allow dynamic convergence to a long-term outcome. The specific functional form of the equations is based on the econometric techniques of cointegration and error-correction, particularly as promoted by Engle and Granger (1987) and Hendry et al (1984).

Application of E3ME

Scenario-based analysis

Although E3ME can be used for forecasting, the model is more commonly used for evaluating the impacts of an input shock through a scenario-based analysis. The shock may be either a change in policy, a change in economic assumptions or another change to a model variable. The analysis can be either forward looking (ex-ante) or evaluating previous developments in an ex-post manner. Scenarios can be used either to assess policy, or to assess sensitivities to key inputs (e.g. international energy prices).

For ex-ante analysis a baseline forecast up to 2050 is required; E3ME is usually calibrated to match a set of projections that are published by the European Commission. The scenarios represent alternative versions of the future based on a different set of inputs. By comparing the outcomes to the baseline (usually in percentage terms), the effects of the change in inputs can be determined.

Typical scenarios

It is important to design scenarios carefully so that they do not present a biased set of outcomes, for example in a scenario where public spending increases there should be a similar increase in tax receipts (ensuring 'revenue neutrality', so that the scenario represents a shift in resources rather than an increase or decrease).

It is possible to set up a scenario in which any of the model's inputs or variables are changed. In the case of exogenous inputs, such as population or energy prices, this is straight forward. However, it is also possible to add shocks to other model variables. For example, investment is endogenously determined by E3ME, but additional exogenous investment (e.g. through an increase in public investment expenditure) can also be modelled as part of a scenario input.

Price or tax scenarios

Model-based scenario analyses often focus on changes in price because this is easy to quantify and represent in the model structure. Examples include:

- changes in tax rates
- changes in international energy prices
- emission trading schemes

Regulatory impacts

All of these can be represented in E3ME's framework reasonably well, given the level of disaggregation available. However, it is also possible to assess the effects of regulation, albeit with an assumption about effectiveness and cost. For example, an increase in vehicle fuel-efficiency standards could be assessed in the model with an assumption about how efficient vehicles become, and the cost of these measures. This would be entered into the model as a higher price for cars and a reduction in fuel consumption (all other things being equal). E3ME could then be used to determine:

- secondary effects, for example on fuel suppliers
- rebound effects[33]

[33] In the example, the higher fuel efficiency effectively reduces the cost of motoring. In the long-run this is likely to lead to an increase in demand, meaning some of the initial savings are lost. Barker et al (2009) demonstrate that this can be as high as 50% of the original reduction.

Standard outputs from the model

As a general model of the economy, based on the full structure of the national accounts, E3ME is capable of producing a broad range of economic indicators. In addition there is range of energy and environment indicators. The following list provides a summary of the most common outputs:

- GDP and the aggregate components of GDP (household expenditure, investment, government expenditure and international trade)
- sectoral output and GVA, prices, trade and competitiveness effects
- consumer prices and expenditures, and implied household distributional effects
- sectoral employment, unemployment, sectoral wage rates and labour supply
- energy demand, by sector and by fuel, energy prices
- CO_2 emissions by sector and by fuel
- other air-borne emissions
- material demands

This list is by no means exhaustive and the delivered outputs often depend on the requirements of the specific project. In addition to the sectoral dimension mentioned in the list, all indicators are produced at the member state level and annually over the period up to 2050.

Limitations to the analysis

The main limitation of E3ME is the sectoral disaggregation of its sectors. The industry classification is relatively detailed, covering 69 sectors at the NACE 2-digit level. However, due to the availability of the data, it is not possible to go into more detail, for example to the firm-based level, or to very detailed product groups. For this type of analysis our recommendation is that the model (which provides an indication of indirect effects) is used in conjunction with a more detailed bottom-up or econometric analysis (which can capture detailed industry-specific effects).

The other main limitations to the model relate to its dimensions and boundaries. Broadly speaking E3ME covers the economy, energy and material demands and atmospheric emissions. While it is possible to provide an assessment of other policy areas, it is necessary to make assumptions about how this is translated into model inputs. Other limitations, such as the geographical scope (Europe) and time horizon (2050) are more obvious, although it should be noted that the global E3MG model can be used to address the first of these issues.

Annex IV – Benefits of full compliance with Drinking water regulation for the (then) candidate countries in 2001

	Annual Benefits of Full Compliance (million EUR)		***Present Value (million EUR) over the period until 2020***	
Country	Low	High	Low	High
Bulgaria	160	435	1580	4200
Cyprus	25	100	260	960
Czech Republic	1560	2475	15230	24050
Estonia	27	100	260	985
Hungary	280	1080	2720	10490
Latvia	40	140	380	1340
Lithuania	125	280	1230	2750
Malta	13	47	125	460
Poland	1400	3280	13590	31960
Romania	405	1250	3960	12150
Slovakia	305	680	3000	6610
Slovenia	150	350	1470	3440
Turkey	880	3400	8640	33200
Total	**5380**	**13600**	**52400**	**132600**

Source: Ecotec (2001)