

## CHALLENGES AND SOLUTIONS

The E4Water project is focused particularly on the societal, environmental and economical challenges where innovative solutions are needed.

**Societal needs:** closure of industrial water loops; the competition between industrial water use and municipal/agricultural water use for scarce fresh water resources

**Environmental needs:** reduction of water stress to aquatic ecosystems; avoidance of incineration of high concentrated streams

**Economic needs:** decoupling economic growth from an increase of resources use; increasing production efficiency and stability through increased independency of fresh water resources; better compliance with EU regulatory requirements.

### E4Water is envisioning the realization of its concept by:

- creating water loop interfaces, synergies and symbiosis: (a) in industry (b) with urban & agricultural water management
- developing and testing innovative materials, process technologies, tools and methodologies for an integrated water management (e.g. closure of industrial water loops; reuse/recycling of waste water)
- providing an open innovation approach for testing E4Water developments with respect to other industries
- implementing and validating the developments in 6 industrial case studies, representing critical problems for the chemical industry and other process industries,
- implementing improved tools for process efficiency optimization, linking water processes with production processes, and eco-efficiency assessment.

For the realization of the E4Water concept chemical industry along the whole value chain is involved.

## WHAT IS E4WATER?

E4Water addresses crucial process industry needs, to overcome bottle necks and barriers for an integrated and energy efficient water management.

The main objective of E4Water is to develop, test and validate new integrated approaches, methodologies and process technologies for a more efficient and sustainable management of water in chemical industry with cross-fertilization possibilities to other industrial sectors.

E4water unites in its consortium large chemical industries, leading European water sector companies and innovative RTD centers and universities, active in the area of water management and also involved in WssTP and SusChem and collaborating with water authorities.

## EXPECTED IMPACT

- Lead to a 20% reduction in water and related energy usage, as well as in industrial waste water production. (Reduction of 20 – 40% in water use, 30 – 70% in waste water production, 15 – 40% in energy use)
- Enable industries to be fully compliant with the EU policies on water pollution and industrial emission. E4Water enables Chemical Industry to comply with the requirements in an economical efficient way (IED – 2010/75/EC; BAT's/ BREF; 2000/60/EC; 2006/118/EC)
- Generate direct economic benefits for the process industry (up to 60% are expected at the E4Water demonstration sites). The expected economical benefits in E4Water seem to be achievable in Chemical Industry and related sectors to a high degree.

## CONSORTIUM

<b>DECHEMA</b>	<b>DECHEMA Gesellschaft für Technik und Biotechnologie e.V.</b> – Germany
<b>TNO</b>	<b>Nederlandse Organisatie voor Toegepast-Natuurwetenschappelijk Onderzoek TNO</b> – Netherlands
<b>UCM</b>	<b>Universidad Complutense de Madrid</b> – Spain
<b>VITO</b>	<b>Vlaamse Instelling voor Technologisch Onderzoek N.V.</b> – Belgium
<b>CEFIC</b>	<b>Conseil Européen de l'Industrie Chimique, AISB</b> – Belgium
<b>SOLVIC</b>	<b>Solvic NV</b> – Belgium
<b>SOLVIN</b>	<b>Solvin Spain SL</b> – Spain
<b>DOW</b>	<b>Dow Benelux B.V.</b> – Netherlands
<b>PGB</b>	<b>Procter &amp; Gamble Eurocor N.V.</b> – Belgium
<b>TOTAL</b>	<b>Total Petrochemicals France SA</b> – France
<b>ONDEO IS</b>	<b>Ondeo Industrial Solutions SA</b> – France
<b>CBD</b>	<b>Kalundborg Kommune</b> – Denmark
<b>DTU</b>	<b>Danmarks Tekniske Universitet</b> – Denmark
<b>FHNW</b>	<b>Fachhochschule Nordwestschweiz</b> – Switzerland
<b>TUB</b>	<b>Technische Universität Berlin</b> – Germany
<b>IVL</b>	<b>IVL Svenska Miljöinstitutet AB</b> – Sweden
<b>EVIDES</b>	<b>Evides Industriewater BV</b> – Netherlands
<b>CAMPDEN</b>	<b>Campden BRI</b> – United Kingdom
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**Economically and Ecologically  
 Efficient Water Management  
 in the European  
 Chemical Industry**

[www.e4water.eu](http://www.e4water.eu)

# CONCEPT

## INDUSTRIAL CASE STUDIES

The industry sector addressed in the E4Water project is characterised by a large diversity along the chemical industry value chain and a wide range of scales for integrated management and symbiosis. To ensure the dissemination and exploitation of the E4Water results to industrial application it is essential to show their value for industrial practice.

The 6 industrial case studies of E4Water are the result of an intensive stakeholder dialogue in the proposal preparation, to ensure the high relevance of the E4Water approach for chemical industry.

**CS1: Mild desalination of water streams for optimum reuse in industry or agriculture at affordable costs**  
Lead by Dow, Netherlands

**CS2: Enhance the water reuse by global management and synergy identification on a multi-company site**  
Lead by Solvic NV, Belgium

**CS3: Ensure process continuation by closing the water loop and minimizing fresh water use**  
Lead by Solvin Ibérica SL Spain

**CS4: Enhance in-process water loop closure by integrating biocidal with wastewater treatment technologies**  
Lead by PGB, N.V., Belgium

**CS5: Towards integrated water management system in petrochemical site**  
Lead by Total, France

**CS6: Bioextraction technology in a symbiotic industrial wastewater treatment concept creating added value**  
Lead by CBD, Denmark

## TECHNOLOGY DEVELOPMENT

**E4Water will bring clear advances** in relation to the current state-of-the-art developing innovative methods and technologies addressing the following broad lines of action:

- Development of innovative treatment technologies for **complex (concentrated) wastewater streams**.
- Development of selective treatment technologies and treatment trains unlocking barriers for **recycling and reuse** of industrial water streams.
- Stronger integration of **eco-efficient water management** in industrial processes.
- Integrated water management networks to **reduce freshwater withdrawal**.
- **Demonstration and evaluation of innovative water management options on industrial sites**, related to various chemical sub-sectors all over Europe using a wide range of new treatment technologies.

E4Water will work on following technology developments:

- **Technological reduction and management of risks associated with advanced loop closure**  
Lead by VITO, Belgium (technologies for CS 4, 5)
- **Optimization and debottlenecking of separation processes**  
Lead by UCM Spain (technologies for CS 3, 4)
- **Mild and extensive demineralization technologies for process water production**  
Lead by TNO, Netherlands (technologies for CS 1, 2, 3)
- **Integration of processes to allow residual heat, nutrients and value products to be reused**  
Lead by DTU (technologies for CS 1, 2, 3)

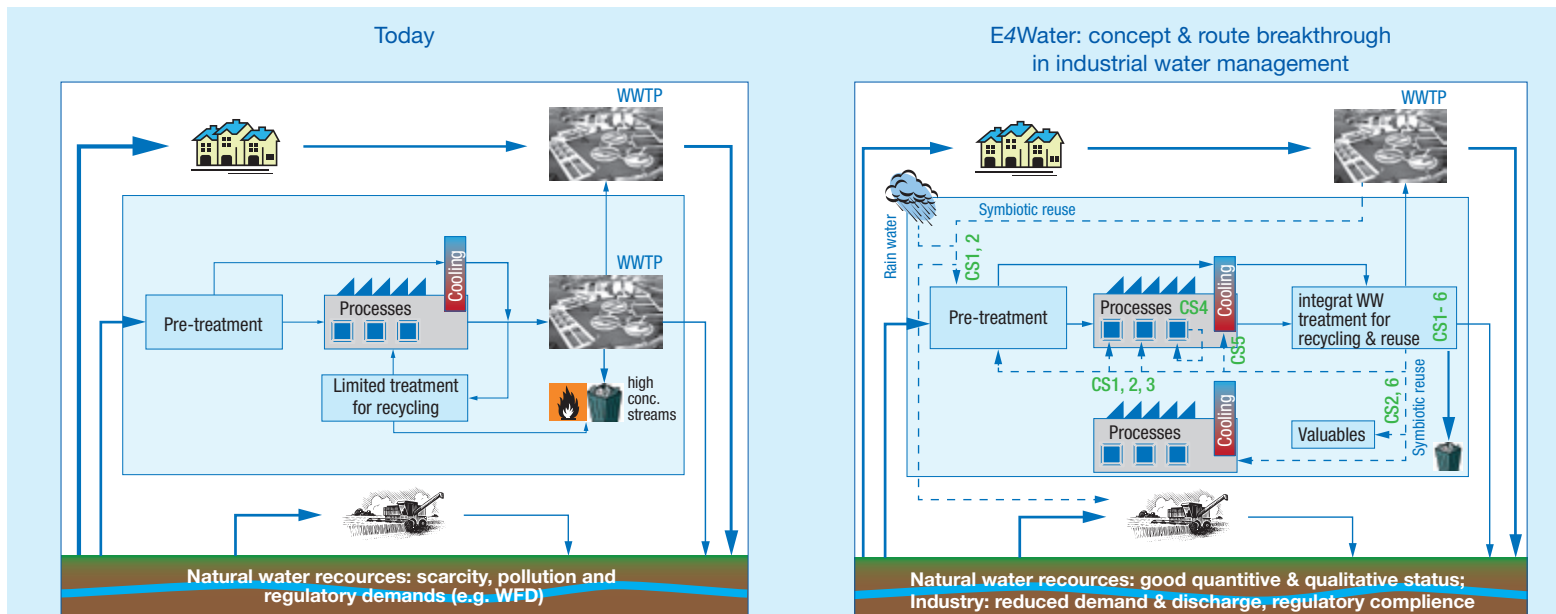
## MODELLING, ASSESSMENT & POLICY

Modeling and assessment tools provide an important information basis for industrial decision making. Both activities address in their concept a variety of complexity scales, from single treatment technologies to integrated site scale, to provide assessment information in an appropriate depth. To realize this within E4Water both activities focus on one case study as master site for the full integrated site scale assessment to provide a full prove of applicability and elaborate for the other case studies modeling and assessment on treatment train level.

The dissemination and exploitation approach of E4Water is addressing EU policies and industry. With respect to EU policies the E4Water outputs will be linked to the industrial emissions directive (IED – 2010/75/EC) through the mechanisms of the BREF documents (Best Available Technique Reference Documents).

This will require the following working steps:

- **Development of a tool for the management of industrial water, related mass and heat flows**  
Lead by TUB, Germany
- **Environmental and economic evaluation**  
Lead by IVL, Sweden
- **EU POLICY evaluation and compliance**  
Lead by CEFIC, Belgium



Today's situation with limited recycling/reuse components and limited connections across sectors (the width of arrows is in both figures an indicator for the water demands).

The E4Water concept, following an integrated, multi-disciplinary and holistic approach in different industrial scales and across sectors. The dashed lines indicate the impact by E4Water, CS (= case study) indicate where on site industrial pilot testing and demonstration are focused on, the number allows their identification.

