SUCCESS STORY

NEW INTEGRATED APPROACHES FOR EFFICIENT AND SUSTAINABLE WATER MANAGEMENT IN THE CHEMICAL INDUSTRY

Sustainable integrated water systems are essential for efficient water management, a key element for circular economy approaches and addressing global societal, environmental and economic challenges.

The outcomes of E4Water illustrate the possibility to decouple economic growth in the chemical sector from actual water use.

For further information: www.e4water.eu

E4Water has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 280756.
E4WATER PAVES THE WAY FOR THE PROCESS INDUSTRY

Water is a scarce resource and a key element for the development of our society and economy. The continuing increase in urbanisation and agricultural production, combined with the demands from the new, emerging industries, plus the need to preserve biodiversity and the environment, puts high demands on water management.

The chemical industry is a significant water user and an important solution provider of innovative products, technologies and services that enable more sustainable water management. Water is used in the chemical industry for many purposes including processing, washing, diluting and heating, cooling, and transporting product.

To deal with critical challenges, such as the need to reduce water use, wastewater production and energy use, the EU FP7 funded project E4Water applied new research and development concepts to boost eco-efficiency and sustainability.

The success of the E4Water project has shown what is possible in the chemical and related process industry sectors in terms of ‘fit for purpose’ water management effectively decoupling industrial production from the use of fresh water, other natural resources and energy.

From May 2012 to April 2016 the E4Water project brought together large chemical enterprises, leading European water sector companies and innovative research and technological development (RTD) centres and universities active in the area of water management. The European Technology Platform for Water (WssTP), the European Technology Platform for Sustainable Chemistry (SusChem), the Society for Chemical Engineering and Biotechnology (DEHEMA), the SPIRE Public-Private Partnership (PPP) and water authorities were also linked through their members in the project.

RELEVANCE TO MAJOR EU POLICIES

Circular Industry: Integrated industrial water management approach

A sustainable integrated water system is essential for efficient water management in the chemical and process industries. It is also a key element for approaches to the circular economy.

The Circular Economy action plan includes several actions that address legislative barriers identified by the E4Water project (compliance with operating permits, valorisation of highly concentrated streams, water reuse standards). Further deployment of the action plan during 2015 – 2019 will offer the opportunity to create a legislative framework supporting economically and ecologically Efficient Water Management in the European Chemical Industry and other process sectors.

Water: Key to resource efficiency, climate action and other major societal challenges

Efficient water management is also essential to enhancing resource efficiency, improving energy efficiency and thereby tackling climate change and ensuring the continuing supply of raw materials. The results are also key to implementing process intensification concepts that will form the basis of the chemical and process plants of the future.

Dow manufacturing site in Terneuzen (the Netherlands)
E4WATER IMPACT

Through six industrial case studies that formed the core of the project, E4Water illustrated the possibility to decouple economic growth in the chemical sector from actual water use. By carefully selecting the right water treatment and management processes and systems the six case studies were able to demonstrate on an industrial scale how process water can be reused again and again.

The ambitious goal of near zero discharge of water is getting within reach!

The results and impact achieved by E4Water can also be applied to other process industry sectors. Tailored solutions are required to optimise each integrated water management system.

REPLICABLE RESULTS:

- **Fresh water saved:** Reduced fresh water uptake of 40-80% with loop closure (close to 100%) in one case resulting in, for example, reduced water use of ~3 million m³/year;

- **Wastewater avoided:** Reduced wastewater production of 30-80% with close to 100% (loop closure) in one case resulting in reduction of waste water production by ~2.5 million m³/year;

- **Resource use reduced:** Resource recovery, for example, efficiently extracting resources from water and returning these to the prime process or a local increase in resource efficiency by use of algae;

- **Lower energy use:** Reduced energy use up to 20% by using low energy technology, heat recovery, or optimising the integrated process with the use of improved modelling;

Cost efficiency: Significant economic benefit can be gained, for example, operating expenditure (OPEX) was reduced by up to 30% for every m³ of saved freshwater/year (depending on local conditions); or eliminating the need for incineration (5000 tonnes/annum/plant) leading to revenue generation;

Policy compliance ensured: Policy compliance was achieved in each case study, for example reducing wastewater discharge by 4 million m³/year (59%);

Best practice with partners: for example, replication of systems in all comparable EU plants, or realising symbiotic working relationships with neighbouring companies;

Applicable for other process industry sectors: Transfer of technologies, treatment units or concepts/approaches to other sites, other industry processes or, other industry sectors are possible for each case study.

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THE SIX INDUSTRY PILOT CASES IN A NUTSHELL

All six industrial case studies were at industry scale demonstration or pilot plant level and took research and new concepts from the laboratory and implemented them in real industrial processes. The cases were carefully designed to ensure and demonstrate the relevance of E4Water integrated approaches to the chemical industry.

- **Dow Benelux**
  Mild desalination of water for optimum reuse in industry or agriculture at affordable cost.

- **INOVYN Belgium**
  Enhanced water reuse by effective and integral water management and synergy identification on a multi-company site.

- **INOVYN Spain**
  Minimising fresh water use while ensuring process continuity by closing the water loop.

- **Procter & Gamble**
  In-process water loop closure and resource recovery by integrating biocidal with wastewater treatment technologies.

- **TOTAL France**
  Reduced fresh water intake through a site-wide integrated water management system enabling reuse and recycling.

- **Kalundborg Denmark**
  Adding Value: Bioextraction technology in a symbiotic industrial process water treatment concept.

RECOMMENDATIONS

- **Efficient and integral industrial water management systems/schemes for sites**: Optimisation by, for example, greater integration of cooling water with process water management and integration of existing water streams inside and outside the site fence with greater consideration of interactions, interdependencies and synergy potentials between different water uses and water/wastewater treatment at various scales (process – plant – site – local – regional) is required.

- **Online/automated processes**: Online process monitoring and automated process control and dynamic process performance related to demand, including simulation and modelling, will help optimise integrated industrial water management and link water treatment, management and quality with production processes.

- **Reuse/Recycle**: Water loop closure and concentrates management are linked to the circular economy. Concentrates are important elements in water loop closing approaches when considering how to achieve low or zero fresh water intake, or in advanced industrial symbiotic approaches. Disposal of concentrates is a significant challenge and could be a barrier for the implementation of some technical solutions. Creative ideas, innovative technologies and approaches are needed.

- **Energy use**: Advanced low energy water treatment technologies and solutions are required.

- **Up scaling/large scale innovation is needed**: Complex industrial water systems require a close interaction between all scales of development, testing and implementation, from the lab, via pilot studies, to the field to realise efficient water management solutions for industrial water streams that fluctuate in quantity and quality.

- **Innovation**: Demonstration and evaluation of innovative water management activities can assist innovation to markets, e.g. by Environmental Technology Verification (ETV). E4Water has paved the way for the use of a wide range of new treatment technologies.