PUBLISHABLE SUMMARY

ATWARM (Advanced Technologies for Water Resource Management)

Marie Curie Initial Training Network No. 238273

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ATWARM Website: **http://www.atwarm.com**

Summary of project objectives

The ATWARM ITN established a European multi-site network of 14 Early Stage Researchers (ESRs) and 2 Experienced Researchers (ERs) at seven host organisations: Queen's University Belfast (UK), Dublin City University (IE), University of Duisburg-Essen (DE), Cranfield University (UK), IWW Water Centre (DE), Northern Ireland Water (UK) and T.E. Laboratories Ltd (IE).
The fundamental objective of the ATWARM ITN was to provide the ESRs and ERs with greatly enhanced scientific and technical knowledge combined with multidisciplinary and business skills that would enable them to contribute to the security of water quality and quantity within the EU. Key scientific objectives of the ITN included the development of:

- Novel technologies to improve the efficiency and sustainability of water and wastewater treatment processes, including nutrient recovery.
- Technologies that produce a paradigm shift from energy intensive wastewater treatment processes to processes that produce energy.
- Technologies that allow the accurate measurement of emissions from water and wastewater treatment plants and establish the carbon footprint of technology options.
- Novel technologies for the detection and remediation of pollutants using a new generation of analysis and remote sensing technologies.

Work performed within the project

ITN TRAINING ACTIVITIES
Each fellow was encouraged to undertake the maximum level of training for career development, and each developed a Personal Development Plan, updated every 6 months. Network training included 3 summer schools, secondments to another ATWARM host and an international conference. Local complementary training was also available to each fellow as required

MAIN SCIENTIFIC RESULTS ACHIEVED
The ATWARM research programme was delivered through 16 specific but inter-related projects. Results included:

- A novel method of water treatment based on an underwater electrical discharge phenomenon, which opens opportunities of chemical-free tertiary treatment.
- A sustainable water purification technique using sunlight and a TiO_2 nanocomposite.
- Increased P removal from a defined wastewater medium using certain bacterial isolates under environmental stress.
- The selection of microalgae autochthon strains for improved nutrient (N, P) removal from wastewater and growth of the microalgae – a potential feedstock for AD plant.
- The application of fluorescence spectroscopy for cost effective detection of polycyclic aromatic hydrocarbons in sewer biofilms.
- The potential of algae to simultaneously contribute to water purification and energy production.
- Pilot plant trials for energy reduction in wastewater treatment by increasing methane production and reducing sludge formation in an up-flow anaerobic sludge blanket (UASB) system.
- Recommendations for accounting for carbon emissions, cost benefit analysis on embedded carbon, and delivery of systems for data collection, delivering options for cost savings through increasing resource and energy efficiency.
- GC coupled to DMS (differential mobility spectrometer) was developed for rapid, cost-effective field tests for groundwater contaminated with gasoline; time required for measuring the contaminated groundwater is less than 2 minutes and gives results comparable to conventional lab-based instruments.
- Rapid methods based on DNA and RNA analyses to assess the biodegradation potential in a diesel contaminated site; functional gene probes were developed and tested in contaminated sites.
- A fast cost-effective and precise analytical method for detection of TPH (Total Petroleum Hydrocarbons) at improved detection limits in the range C_9-C_{40} applicable for waste, surface, drinking and seawater.
- Cost effective methods to produce iron and aluminium oxide- and oxyhydroxide- based sorbents for removing arsenic from groundwater.
- A faecal matter sensor for freshwater and marine environments developed and deployed in real conditions for rapid detection of faecal contamination in recreational waters.
- A methodology to characterise sewage and manure inputs to surface waters for rapid detection of sources of pollution.
- A tool for prompt in-situ water analysis using actuated sensors; the now patented point-of-use system has a number of advantages, including de-centralised in-situ testing , low cost and rapid real time monitoring capabilities.

DISSEMINATION
ATWARM fellows presented their research at international conferences, workshops, seminars and meetings. The group also delivered an outreach programme, publishing articles in newspapers, trade magazines, internal publications and through the ATWARM blog and partner websites. Copies of posters, scientific papers and other dissemination material is available on the ATWARM website. The ATWARM ITN also held a three day International Conference, held in Dublin, where fellows had the opportunity to disseminate their results to a wider research and industrial audience. . Fellows also presented their findings to QUESTOR member companies every 6 months, thus increasing private sector involvement.

DELIVERABLES AND MILESTONES
All deliverables and milestones of the project were successfully completed.

Final Results and Their Potential Impact and Use

The outcomes of the project are highly relevant to all EU citizens, benefitting society, the environment, the water industry and other sectors. The ATWARM network was committed to pursuing technology transfer and commercial opportunities arising from the research - all projects were assessed for exploitation potential in the market-place. Already a number of potential products and services are being developed and there will be opportunity for companies to exploit these in partnership with the research teams involved.