Department of Biotechnology
Ministry of Science & Technology,
Government of India

European Commission

सत्यमेव जयते
Department of Science and Technology
Ministry of Science and Technology
Government of India

bIo-mimetic and phyto-techNologies DesIgned for low-cost purificAtion and recycling of water

INDIA-H_2O

Participant No	Participant organisation name	Country
1 **(EU-CO)**	**UNIVERSITY OF BIRMINGHAM (UOB)**	UK (UNITED KINGDOM)
2 **(IND-CO)**	**PANDIT DEENDAYAL PETROLEUM UNIVERSITY (PDPU)**	IN (INDIA)
3	ASTON UNIVERSITY (AU)	UK (UNITED KINGDOM)
4	PLATAFORMA SOLAR DE ALMERÍA (CIEMAT)	ES (ESPAIN)
5	NATIONAL ENVIRONMENTAL ENGINEERING RESEARCH INSTITUTE (NEERI)	IN (INDIA)
6	AQUAPORIN (AQP)	DK (DNMARK)
7	AQUAPORIN ASIA (AQPA)	SG (SINGAPORE)
8	UNESCO-IHE. (IHE)	NL (NETHERLAND)
9	ACONDICIONAMIENTO TARRASENSE ASSOCIACION (LEITAT)	ES (ESPAIN)
10	GB PANT UNIVERSITY OF AGRICULTURAL TECHNOLOGY (GBP)	IN (INDIA)
11	CSIR-CENTRAL ELECTRONICS ENGINEERING RESEARCH INSTITUTE (CEERI)	IN (INDIA)
12	ARVIND MILLS (ARV)	IN (INDIA)
13	MODUS RESEARCH AND INNOVATION (MOD)	UK (UNITED KINGDOM)
14	BEN GURION UNIVERSITY (BGU)	IS (ISRAEL)
15	DAVEY (DAV)	IN (INDIA)
16	ACWADAM (ACW)	IN (INDIA)
17	JADAVPUR UNIVERSITY (JU)	IN (INDIA)
18	ENVIROCHEM SERVICES (ECS)	IN (INDIA)
19	GUJARAT CHEMICAL ASSOCIATION (GCCI)	IN (INDIA)
20	MADHUR MILK DAIRY (MMD)	IN (INDIA)
21	FUNDACION CENTRO TECNOLOGICO DE INVESTIGATION MULTISECTORAL (CITEM)	ES (ESPAIN)

The overall aim of INDIA-H_2O is to develop, design and demonstrate high-recovery low-cost water treatment systems for saline groundwater and for domestic and industrial wastewaters. The focus for developments will be in the arid state of Gujarat, where surface water resources are very scarce. Cost-effective technologies and systems are proposed with the aim of lowering energy costs through dramatic improvements in energy efficiency, new bio-based approaches to water recycling, and use of renewable energy. Reject waste streams will be minimised or reduced to zero, thus protecting the environment. The specific objectives are to:

1. **Develop and introduce novel batch-reverse osmosis technology for a 4-fold reduction in specific energy consumption with high, 80%, recovery ratio**
2. **Develop forward osmosis based on revolutionary biomimetic membrane technology, for use in wastewater recovery applications including hybrid arrangements with reverse osmosis for further reduction in energy consumption, resulting in an order of magnitude overall reduction in SEC.**
3. **Pilot small-scale (5–50 m^3/day) rurally-relevant low-cost systems for brackish groundwater treatment to provide safe drinking water at costs below €0.35/m^3 (<30 rupees/m^3).**
4. **Develop phyto-technology solutions for rural domestic wastewater treatment to remove emerging pollutants (e.g. agricultural products), manage rejected brines, and recover energy from the resulting biomass.**
5. **Develop and demonstrate cost-effective high-efficiency FO/BRO systems with complementary hybrid technologies for industrial desalination, wastewater treatment and recycling with minimum liquid discharge (up to 80% water recovery).**
6. **Create a Centre of Excellence in water treatment membrane technologies, design operation, piloting, demonstration, training and dissemination in India.**
7. **Develop and support the evolution of business models to exploit the developed solutions to mutual EU/India economic advantage**
8. **Brief and influence policymakers on economic models and governance arrangements for viable adoption of these technologies in India.**

Focusing initially on the arid regions of North-West India, where water is most scarce due to limited and seasonal rainfall, this project will develop solutions for widespread applications and perform pilot system demonstrations to improve levels of quality water available for re-use and resource recovery - thus addressing the urgent challenge of increasing water-scarcity across India as a whole.

Advanced membrane processes, including biomimetic FO and RO and layer-by-layer assembly of ultra/nano-filtration membranes, will be developed and combined to provide new methods of purifying water from saline groundwater and from municipal and industrial wastewaters, providing water that is safe for drinking or suitable for irrigation. They will be implemented in cost-effective modes in systems incorporating phytoremediation and complementary processes.

Low-cost sensors for real-time monitoring of the key parameters important for efficient operation of membrane processes will be integrated with monitoring and management systems to ease maintenance of performance and ensure sustainability of these systems which have previously suffered from a lack of robust and reliable operational data, leading to frequent early failure and redundancy. The remote monitoring will also make possible collection of data to enable knowledge to be built up about long term performance, feeding into decision support tools for design and operation.

Systems will be developed and integrated to TRL6 as advanced prototypes that will be integrated with renewable energy sources under real operational conditions in the arid and industrialised state of Gujarat, with prospective applications in many other water-stressed and salinized areas such as Rajasthan, Punjab and Tamil Nadu. The development of business models will maximise the use of indigenous supply chains to reduce costs and ensure sustained implementation of the technologies.