



innovative water recovery solutions



Recycling water in combination with heat and/or substances in energy and resource intensive industries by developing innovative Heat Pipe Condensing Economisers and other integrated water-smart strategies

The Challenge

Two centuries after the first industrial revolution, the white plumes from industry's chimneys are still the symbol of industry, fostering societal prosperity, but they are also a symbol of environmental pollution.

These gaseous emissions are in effect an unexploited source of water and energy as they represent one of the main streams that discharges used water during the manufacturing of ceramics, chemical products, steel, food, paper pulp, aluminium and other industrial goods. Transforming

these industrial processes towards near zero discharge water to reduce exhaust gases, recover water and save energy constitutes an exciting and strategic important challenge to address to meet the policy goals of the European Green Deal.

The iWAYS project develops a set of technologies and systems for industrial processes capable of recovering water and heat, and in some cases materials, from exhaust streams with the aim of reducing resource consumption, harmful emissions and increasing energy efficiency.



Water recovery and recycle from gaseous emissions

Between 30% to 60% less freshwater consumed. Up to 90% of discarded water will be recovered from condensate stream.



Unrecoverable heat recovery

Between 10% to 80% reduction in waste heat and energy consumption by recovering thermal energy and sensible heat via Heat Pipe Condensing Economiser systems.



Material Recovery

Recovery of material by valorising challenging exhaust streams. The iWAYS systems will allow the removal of elements in the exhaust gases, like Boron, VOCs, and acid gases (HF, SO_x, NO_x, HCl).

The iWAYS Solutions

Heat Pipe Condensing Economisers (HPCE)

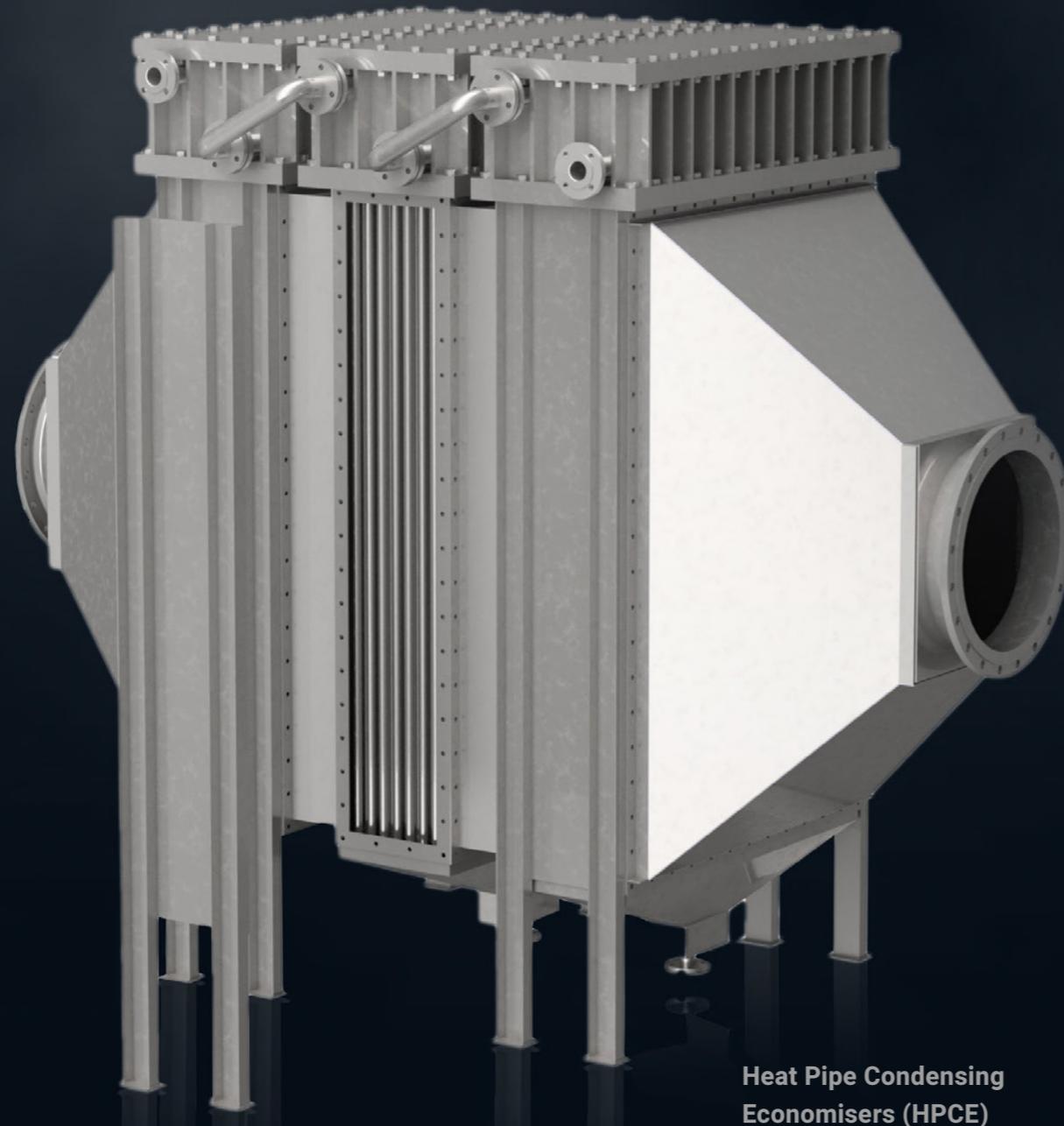
Common Heat Exchangers faces several challenges in industrial applications due to the corrosive nature of exhaust and fouling occurring on pipes (particulates or suspensions that settle onto surfaces). The fouling, caused by solid particles and other contaminants in exhaust gases, can be mitigated by Heat Pipe Condensing Economisers (HPCEs) with the appropriated design and by coatings and/or surface post treatment.

HPCEs are constructed as a box containing Heat Pipes placed in a defined arrangement. A heat pipe is a sealed tube containing a saturated working fluid. When heat is applied on the lower section, a corresponding quantity of the working fluid vaporises. This vapour travels to the condenser section where it condenses on its internal surface, releasing the latent heat of vaporisation to the condenser section and through its wall to the heat sink fluid. This two-phase heat transfer process allows for a superior control of surface temperatures which is a crucial element of fouling, corrosion and condensation management; which cannot be achieved with traditional heat exchangers' designs.

Through the use of HPCEs with new materials and special designs capable of operating in peak conditions, iWAYS differentiates itself from other projects in the field and fosters the development of novel heat exchangers to better withstand the corrosive and high particle loaded exhaust.

The project will exploit two main HPCE applications:

- a) recovery of water vapor generated during moisture removal processes and
- b) water recovery from combustion.



Heat Pipe Condensing Economisers (HPCE)



Sensors

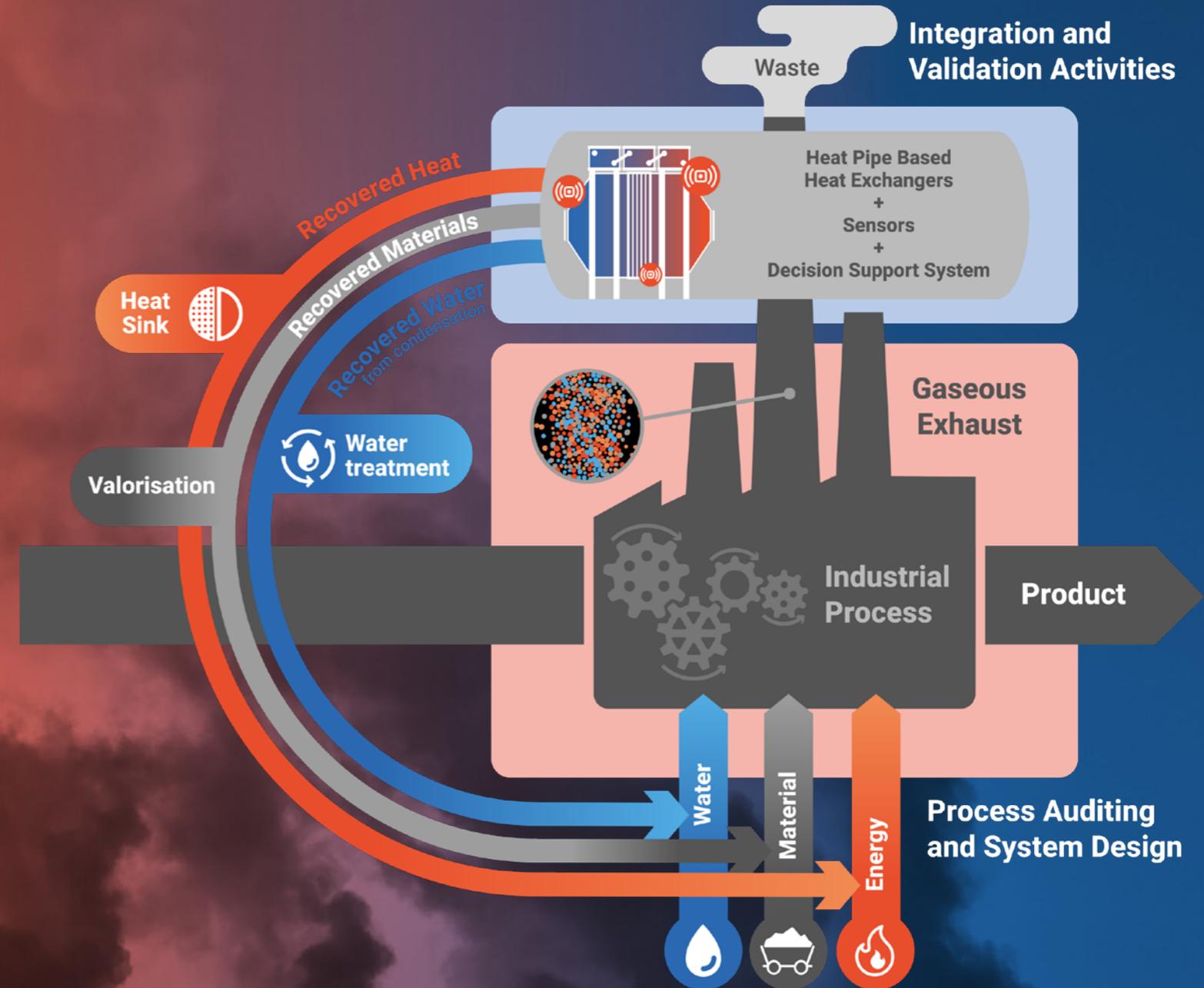
Sensors will be deployed to accurately report on the qualitative and quantitative attributes of sustainable water sources. The type and quality of the sensors will be determined according to the demand and nature of the demo cases and its water loops, as well as the cost, effectiveness and the reliability of the solutions. State of the art sensors and actuators will be deployed in industrial processes that currently are not monitored.

Decision-Support Systems

Real-time Decision-Support Systems (DSS) enable operators to evaluate the future management of hydraulic structures. The iWAYS project will develop a flexible process monitoring, control and optimisation dashboard for evidence-based decision making. A software platform with improved 3D visualisation and data analytics will be developed. The DSS will serve as a basis for full-scale implementation of the selected measures in real conditions.

Water treatment systems

Versatile and advanced water treatment systems will be used for industrial waste streams, recovering resources and materials. iWAYS aims to purify steam condensates that are currently considered as impossible or not cost-effective. As water vapour will be condensed, treated and reused as process water, water efficiency will be greatly improved, leading up to 95% water recovery. The water treatment systems will rely on reverse osmosis, an integrated photocatalysisnanofiltration process, membrane distillation and evaporator crystallizer as key components.



Ceramic Industry

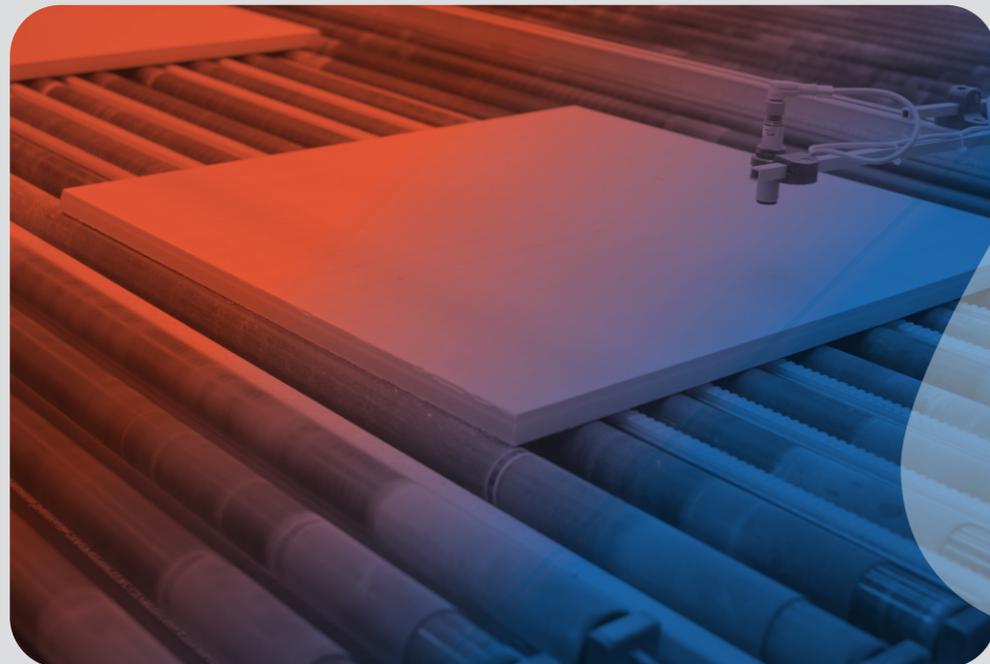
Ceramiche Atlas Concorde – Italy

Ceramiche Atlas Concorde is a leading tile manufacturer. The wall and floor tiles subsector is highly energy intensive: the production of one tonne of ceramic tiles requires 6GJ. Energy sources used in the ceramic process are natural gas and electricity.

Water is also an important raw material for tile manufacturing. The overall freshwater consumption of a medium size tile manufacturing facility amounts to approximately 75,000 m³/y and covers many uses in the ceramics process, such as washing and slip preparation.

iWAYS will enable the recovery of a substantial amount of the water – which is currently discharged through the spray dryer exhaust gases – along with the sensible and latent heat contained in the exhaust gas. The use of freshwater is expected to be cut by half as water previously discharged to the atmosphere will be reused.

The natural gas used in ceramic process is mainly required in the spray-drying process, tiles drying and firing processes. With iWAYS, the heat recovery from the exhausts of the spray drying processes will deliver 10% of thermal energy needed in a single spray-dryer.



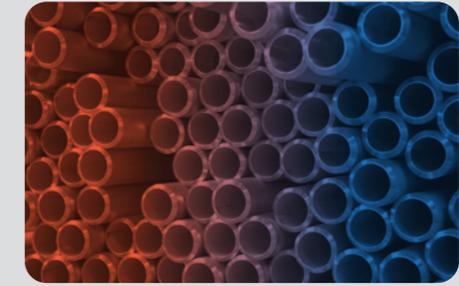
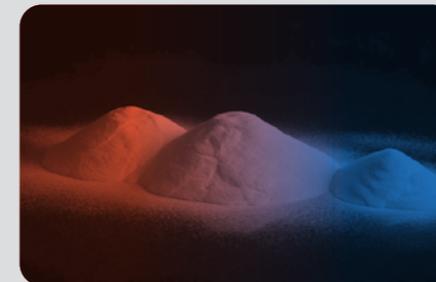
Chemical Industry

Alufluor AB – Sweden

Alufluor produces and supplies aluminium fluoride (AlF₃) used in a variety of industrial applications. It has two processes where steam is used for heating. Most of the energy usage in the Alufluor plant is thermal energy, natural gas.

Through a three-stage approach, iWAYS will substantially improve the plant's resource use and energy efficiency. The first stage involves cooling down the exhaust to the Dew point. The second stage will recover sensible and latent heat and condensation, as well as the acids. Finally, the remaining water will be condensed and recovered. With iWAYS, the heat recovered will be mainly reused in the process heating and wash water. The water recovered – after being treated and reused – from condensation will also be significant: 3,500 tonnes each year.

A very important aspect of iWAYS solutions, in the Alufluor case, is the recovery of hydrogen fluoride, calculated at 70 tonnes per year.



Steel Industry

Tubacex – Spain

Tubacex is a world leader in the production of seamless stainless-steel tubes and high nickel alloys. In the steel sector, water is used mainly in the cooling process and in degreasing procedures. During the cooling treatment of the hot pipes, a significant amount of water is evaporated and currently not used or recovered. Furthermore, the sludge from wastewater treatment is currently handled by a third party, thus the water is not recovered on site.

The solution developed – as part of the iWAYS project – will recover 30% of the evaporated water and recycle it back into the cooling process; and will recycle 95% of the water contained in the sludge. The recovered heat from the HPCE will be used to provide the thermal power, required by the treatment system, to recover water in the alkaline and acid sludge. The circuit created to recover the heat and steam, generated while the water cools the hot parts, will reduce the energy and gas requirements.

Expected Impact

iWAYS will find ways to reduce, recover and reutilize gaseous, liquid and solid waste leading to the following impacts:



Up to 60% less freshwater resources used.



Introducing water closed loop in industrial processes - recover water from the gaseous waste stream of the ceramics, chemicals and steel industries.



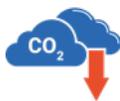
30% water and heat recovery from humid exhaust and recuperation of materials from the flue stream.



30% increase in resource and water efficiency.



Major innovation outcomes disseminated to the current and next generation of employees.



The environmental gains in absolute figures, and weighted against EU and global environmental footprints.



The planned replicability study will show that this technology can be applied to a large number of industrial processes.

The iWAYS ambition is to contribute to a future where industry is sustainable and green. This will require advances in several fields. Each one of these innovations will benefit not only European industry but also society.



Partnership



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