



Isle Utilities

15 top emerging technologies in wastewater treatment & resource recovery

Karen Clode, Asia Pac Market Leader - Industry



ABOUT ISLE

WHO WE ARE

Isle Utilities (Isle) was founded in 2010 as an **independent global technology, innovation and strategy consultancy** with a specific focus to accelerate innovation in the water sector.

WHAT WE DO

Isle supports over **250 water utilities and industrial end users** in their efforts to **drive innovation** in their organisations, by implementing innovation strategies and identifying, **evaluating and adopting emerging technologies** and **innovative best practices, programs and tools** in the most cost effective ways.

INNOVATION IS WHAT WE DO!

Experience in identifying and assessing novel technology solutions as well as qualifying and quantifying market opportunities.

RESEARCH CREDENTIALS

Experience in researching topics across the globe to determine regulatory, policy, technology and social aspects

GLOBAL NETWORK

Global network of 250 + water utilities, municipalities and industrial companies



SKILLED TEAM

Highly skilled team of scientists and engineers with experience across water and wastewater.

COLLABORATION FACILITATORS

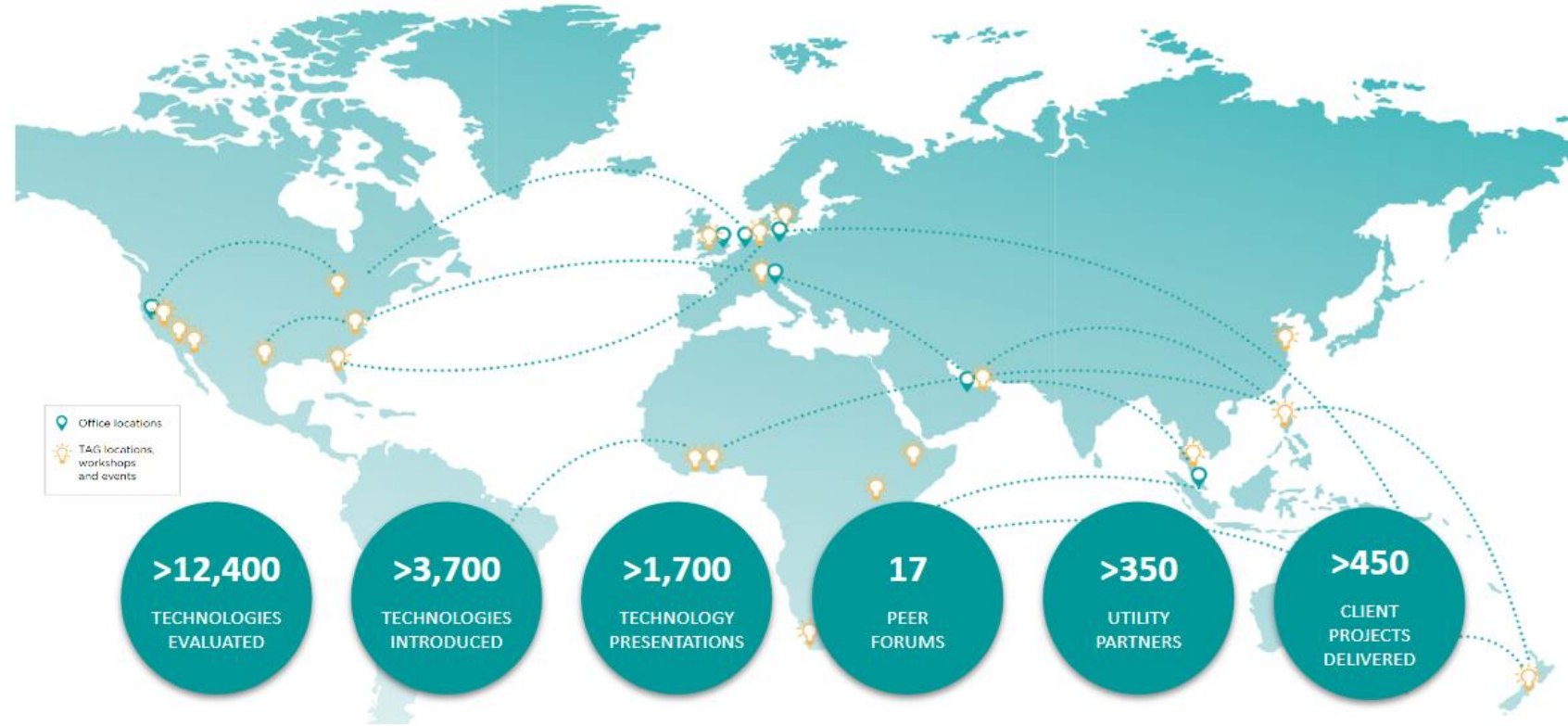
Experience in bringing together organisations with shared challenges to discuss and share experience

TEAM

Isle is a **global business** with offices in the USA, Brazil, Australia, Singapore, Abu Dhabi, Netherlands, Italy, Germany, Philippines, South Africa and the UK. We have a **skilled team of over 100 engineers and scientists** with 21 spoken languages working around the world with high technical capabilities and extensive experience in **water and wastewater fields, as well as sustainability and environmental practices.**

YOUR INNOVATION PARTNER

WE BRING TECHNOLOGIES TO LIFE



Identifying Challenges

We collaborate with the world's leading utilities and technology end users. After establishing their challenges, we find solutions through the independent sourcing of innovative technologies.



Connecting Technologies

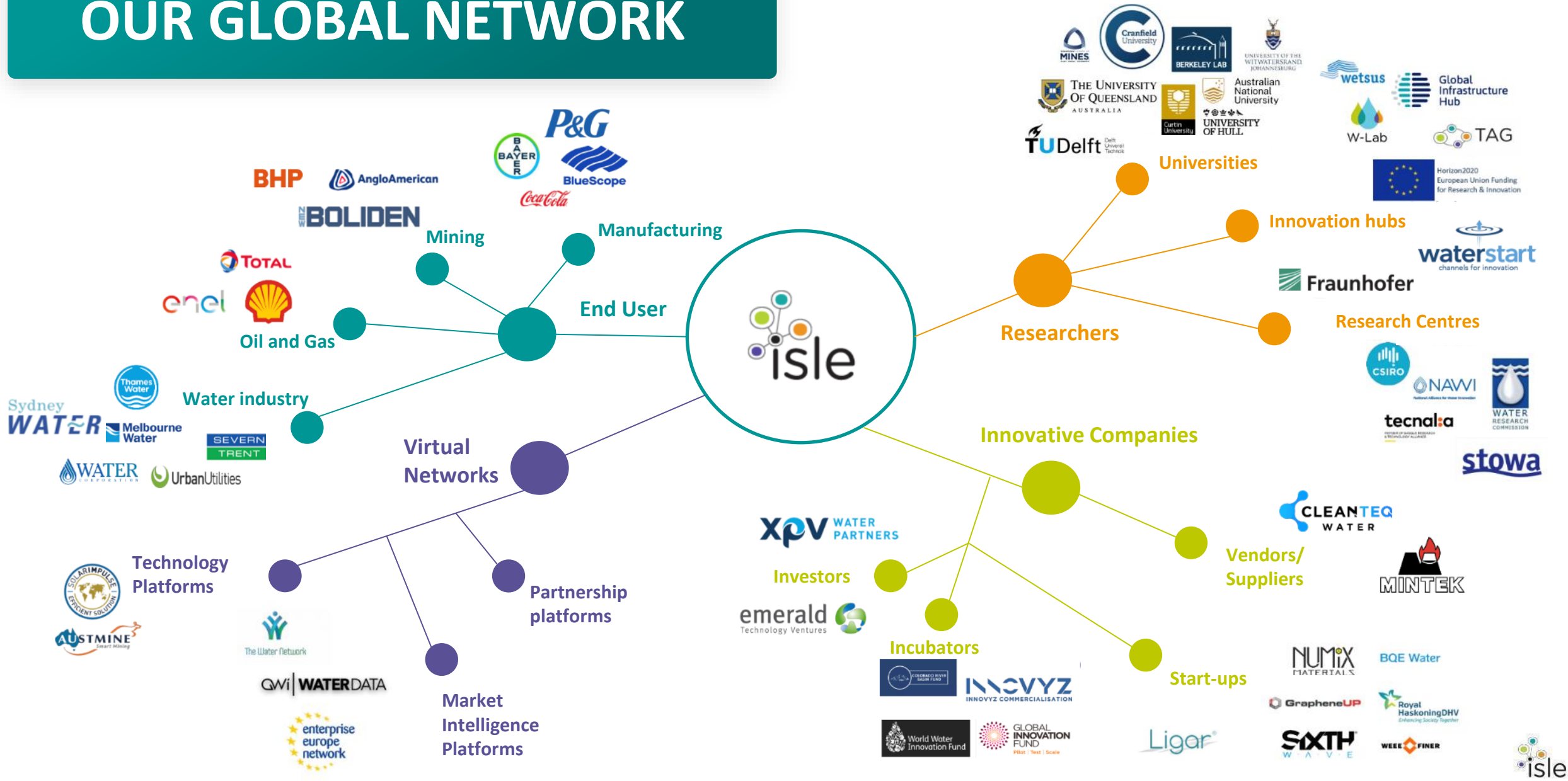
We provide market intelligence to technology providers, enhancing the commercialisation process through increased dialogue and understanding of prospective clients' needs.



Collaborative Evaluation

Our innovation forums collaboratively review emerging technologies in a peer-to-peer environment increasing opportunities for knowledge transfer and shared resources to support the uptake of technology.

OUR GLOBAL NETWORK



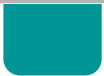
Isle's Technology Due Diligence



Dealflow – Isle’s Technology Pipeline

Dedicated water-sector technology scouting, continuously screening new innovations and solutions.

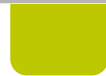
Isle’s consultants and experts conduct due diligence assessments before they are brought to clients via our various services and platforms.



8

scouts

*continuously screening
new leads for
technologies to be
assessed*



15

consultants

*providing over 30
hours of technology
assessments per week*



4,263

assessments

*of unique technologies
by consultants and
specialists to date*

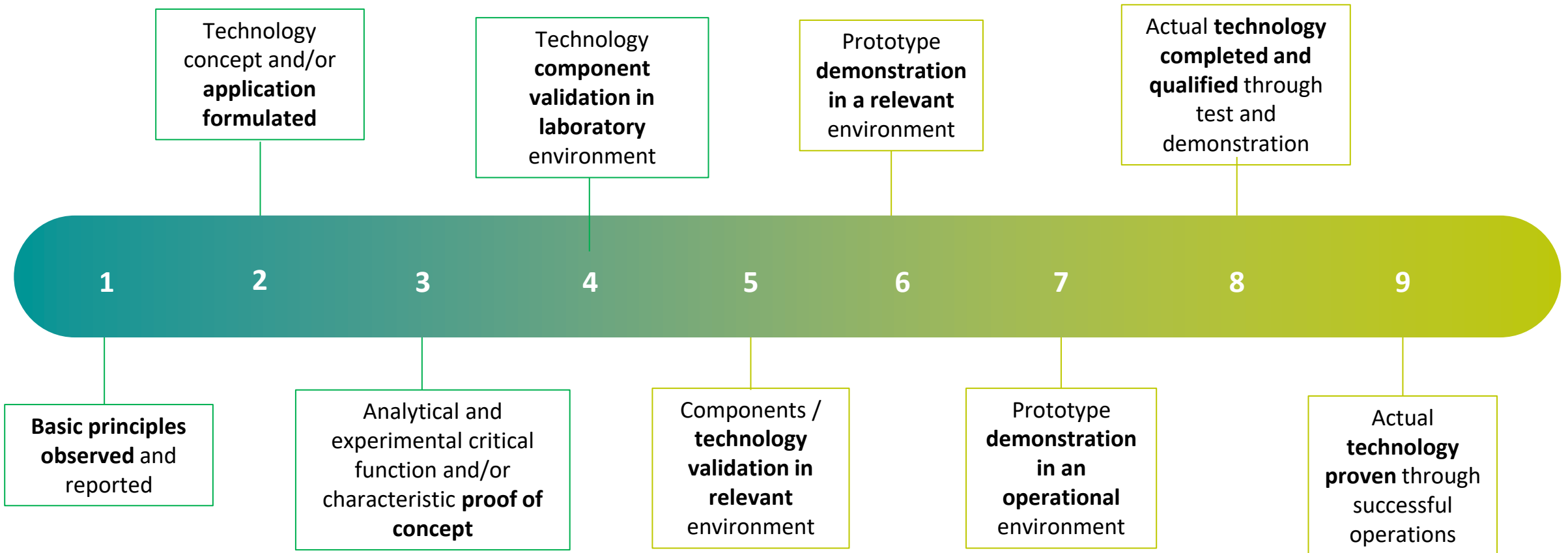


1,634

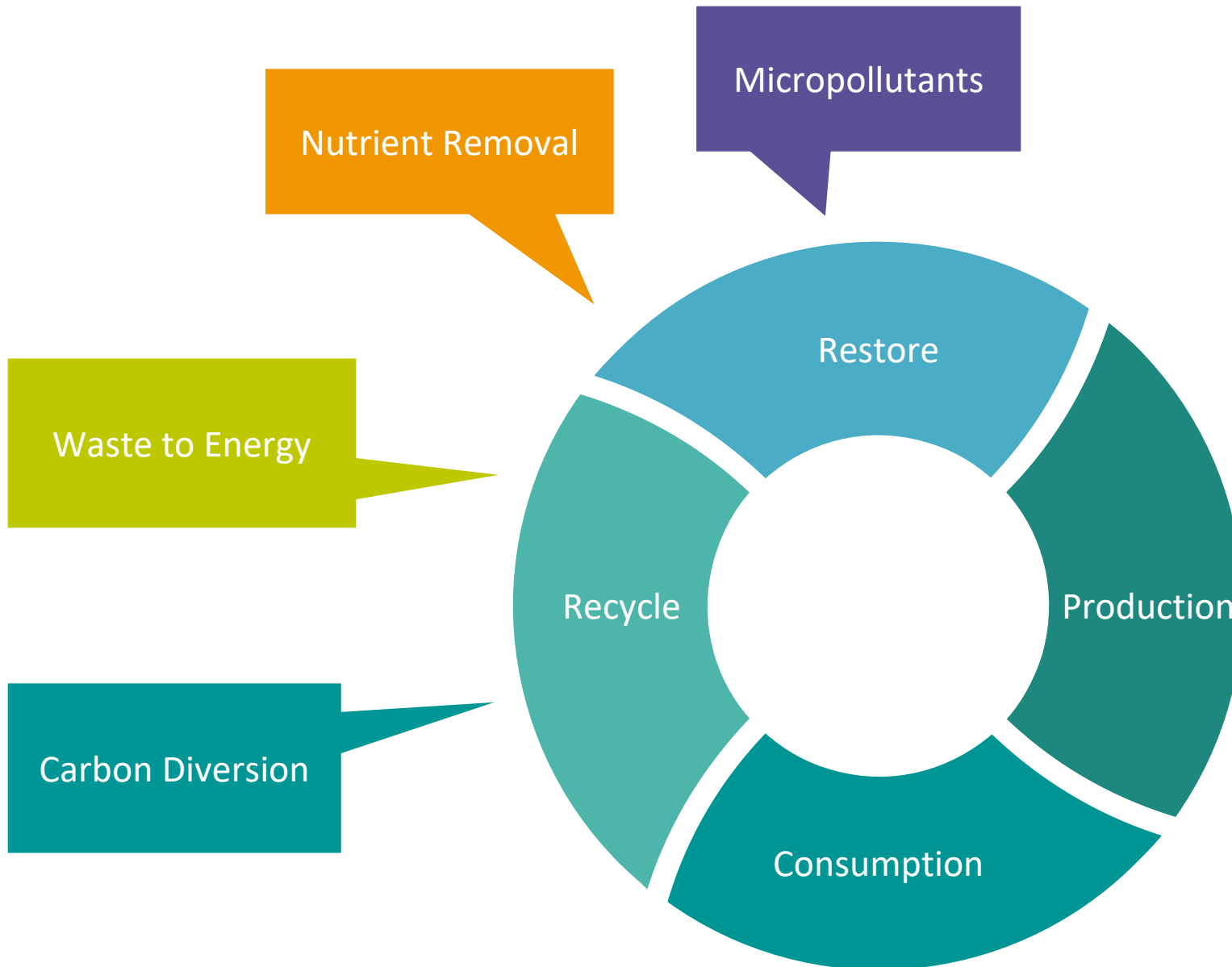
technologies

*presented to Isle
clients and accessible
to our network*

Technology Readiness Level (TRL)



Four key trends in the water cycle



Carbon Diversion



CREW CARBON

pH and alkalinity management technology that removes CO₂ from wastewater systems

Overview:

- CREW targets N₂O and CO₂ emissions in secondary treatment
- System quantifies the amount of CO₂ and controls the crushed mineral rock dosage
- Mainstream or sidestream deployment to CO₂ rich wastewater in the aeration basin

Unique selling point:

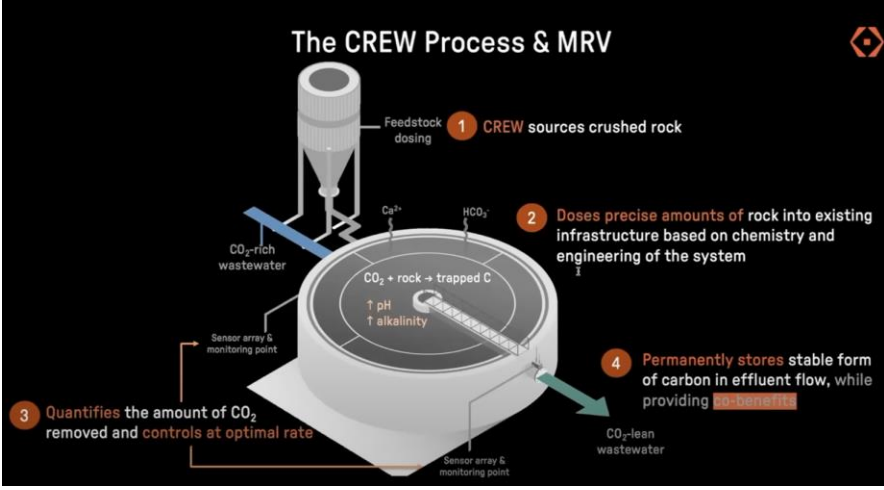
- Capturing biogenic CO₂ creates an opportunity to generate carbon credits
- Carbon negative pH adjustment



Technology Readiness Level



Country: USA



Bluemethane

Bluemethane captures methane from water and wastewater as a providing a new source of data, power and revenue

Overview:

- Turbulence generated in the system encourages the separation of methane and the rise methane bubbles in the wastewater.
- Consistent methane removal efficiencies of 70-85% have been observed at bench top scale

Unique selling point:

- The technology creates a new source of biogas that can be upgraded to natural gas or used onsite for power
- The process is designed to be energy positive, even when methane concentrations are low.

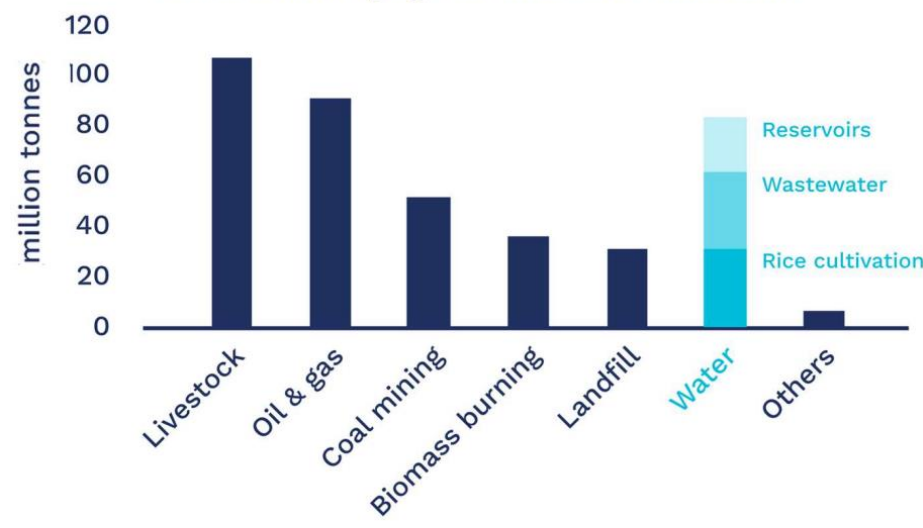


Technology Readiness Level



Country: UK

Global anthropogenic methane emissions



OTAS

Organics Thermal Ammonia Stripper (OTAS) removes ammonia from process and wastewater streams

Overview:

- Wastewater is heated to 60-70 °C (subject to wastewater composition) before air-stripping is used to remove the ammonia
- The process does not produce sludge and does not require the addition of chemicals for pH adjustment

Unique selling point:

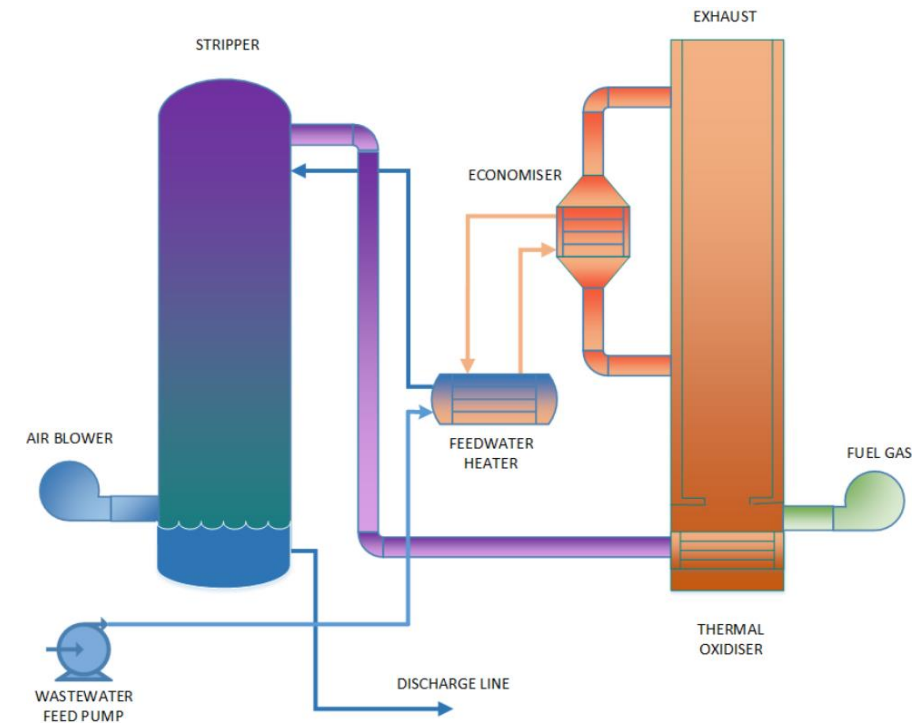
- OTAS does not require chemical pH adjustment
- Removes sufficient ammonia (up to 98.5%) to obviate the need for biological polishing
- Options to convert ammonia into nitrogen gas by thermal oxidation, recover it for sale or reuse as an ammonium ion salt, or recover it in aqueous form or as anhydrous ammonia



Technology Readiness Level



Country: USA



Waste to Energy



Indirect Dryer and Gasification Unit

Modular thermal treatment technologies for biosolids

Overview:

- Depending on the desired output, customers can opt for an IQ Indirect Drying Unit or an IQ Gasification Unit to manage biosolids
- Offsets disposal and energy costs for wastewater utilities managing dewatered sewage sludge and biosolids. Both thermal treatment systems also generate new revenue streams from resulting sustainable products for agriculture and industrial use

Unique selling point:

- Unique e-skid is also installed in each unit to manage flue gas quality and eliminate dust and other particulate matter from the system while in operation
- Compared to a hydrothermal carbonisation process, the IQ Gasification Unit doesn't require boilers
- Systems are automated and are controlled by a smart device via satellite enabling remote data support



Technology Readiness Level



Country: Canada/ Australia



Industri-WASE biocentre

Electro-Methanogenesis process for rapid organic waste treatment with energy recovery

Overview:

- Modular waste to energy system that provides accelerated treatment and increased energy recovery, compared to traditional anaerobic digestion (AD), using a patent-pending Electro-Methanogenesis (EM) process
- Each Biocentre can treat 1 - 2 tonnes of solid waste, or up to 10 m³ of wastewater per day, generating 400 - 900 kWh of energy

Unique selling point:

- Can treat solid waste at loading rates 3 x higher (6 kgVS/m³/day), and wastewater at 10x higher flow rates than AD
- IndustriWASE biogas streams contain 60 – 90% biomethane, compared to 50 – 60% for standard AD systems
- Tolerant to low pH (4.5 - 8) and high COD levels (3,000 - 25,000 mg/L) and operates at low temperatures (normally 30°C; can go lower for organic removal, but methane production is reduced)



Technology Readiness Level



Country: UK



TH4+

Double-flash, continuous, self-sufficient thermal hydrolysis for efficient AD pre-treatment

Overview:

- Uses a double-flash, which, compared to single-flash thermal hydrolysis, increases biogas yields by 5%
- Continuous process and cheaper than conventional thermal hydrolysis systems
- Best applied at sludge handling sites without existing sludge treatment before AD

Unique selling point:

- TH4+'s double-flash produces two distinct steam streams which allows for improved process heat recovery, reducing specific energy consumption and ensuring energy self-sufficiency



Technology Readiness Level



Country: Spain



Micropollutants



OXYLE

Catalytic AOP for the complete elimination of micropollutants, including PFAS, enhanced by AI-backed monitoring of micropollutant contamination

Overview:

- Advanced oxidation process (AOP) that uses a new range of catalysts for total micropollutant breakdown, including organic chemicals, PFAS and pharmaceuticals
- Suitable for micropollutant treatment in municipal water and wastewater treatment plants, environmental remediation projects and industrial applications. It can be used as a mainstream process or for the treatment of concentrated waste streams from processes such as filtration, foam fractionation, distillation, etc

Unique selling point:

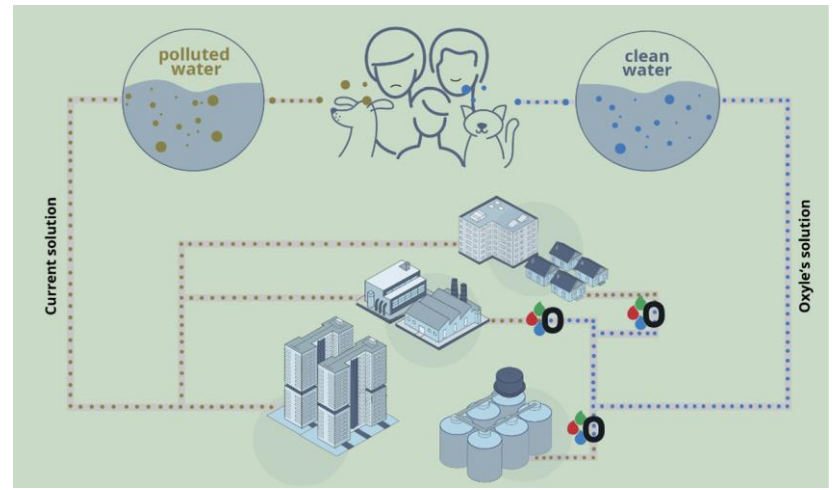
- Uses 15-50x less energy than existing micropollutant treatment processes, due to the use of nanoporous catalysts
- Combines complete micropollutant removal combined with real-time (<5-minute frequency) monitoring of micropollutant contamination, using AI-powered analytics and proprietary sensor technology



Technology Readiness Level



Country: Switzerland



PFASigator™

Onsite, skid-mounted UV-catalysed reductive defluorination reactor to permanently destroy PFAS in water

Overview:

- Uses a photoactivated reductive defluorination (PRD) process to mineralise PFAS compounds to non-toxic byproduct
- Destroys PFAS molecules even in water chemistries with pH 3-12 and aerobic or anaerobic conditions
- Can be used as a standalone system or integrated into existing water treatment systems (accepts PFAS concentrates from foam fractionation, RO and membrane filtration systems)

Unique selling point:

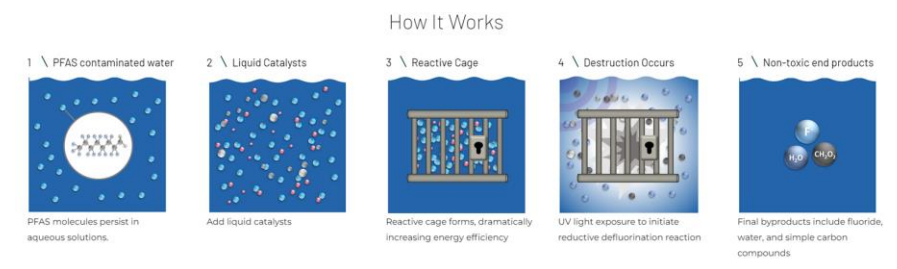
- Energy consumption is 10-40x lower than other UV systems due to the reactive mechanisms from the liquid reagents used
- The PFASigator™ is a non-thermal and non-pressurised reaction which reduces operational hazards



Technology Readiness Level



Country: USA



SuperOx[®]

Supercritical water oxidation for complete mineralisation of PFAS, pesticides, pharmaceuticals, etc.

Overview:

- Operates at SWCO conditions which creates rapid oxidation reactions, breaking down organic compounds within seconds
- Fully automated, continuous flow system that can treat wastewaters containing up to 100,000 mg/L COD and 100 mg/L PFAS
- Suitable for destruction of saturated adsorbents like resin and activated carbon from water remediation), sludge and concentrates

Unique selling point:

- Vertical SCWO reactor enhances mixing of oxygen with supercritical fluid, all without the need for multiple oxidant injection points at elevated temperatures
- Lower CO₂ footprint than equivalent incineration approaches
- No solid phase ashes/sludges are generated; any trace organics can be polished



Your water. Our business.

Technology Readiness Level



Country: Denmark



METland

Nature-based solution using a microbial electrochemical process to reduce organic pollutants, nitrogen and phosphorus in wastewater

Overview:

- Merges microbial electrochemical technologies (MET) with constructed wetlands (CW)
- An electroactive biofilter is used to treat and reuse wastewater at zero-energy cost by using natural bacteria capable of establishing a microbial community interconnected through electrical currents
- METland® has a pollutant removal efficiency of 400 g COD removed per m3 of bed per day for urban wastewater

Unique selling point:

- Uses electroconductive (EC) granular materials in place of conventional biofiltering materials
- Odourless emission, lack of solid waste production, autonomous operation and zero energy costs related to air supply
- Merges the sustainability of nature-based solutions with the low footprint-based efficiency of conventional systems



M E T f i l t e r

Technology Readiness Level



Country: Spain



High-G Separator

High performance, efficient microparticle separator without filters

Overview:

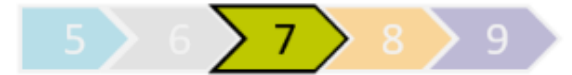
- 50-fold increase in performance and a total cost of ownership reduction of 60 - 90% compared to regular hydrocyclones
- Installed as an alternative to the 4th fourth cleaning stage in wastewater treatment plants and has a separation efficiency of more than 95 % in a single pass

Unique selling point:

- Circumvents common filtration-related drawbacks, such as the need for high feed pressure and flushing sequences, scaling, biofouling and membrane regeneration
- The novel design creates flow patterns that enable the removal of even the smallest particles, with densities only slightly different from water (e.g., microplastics)

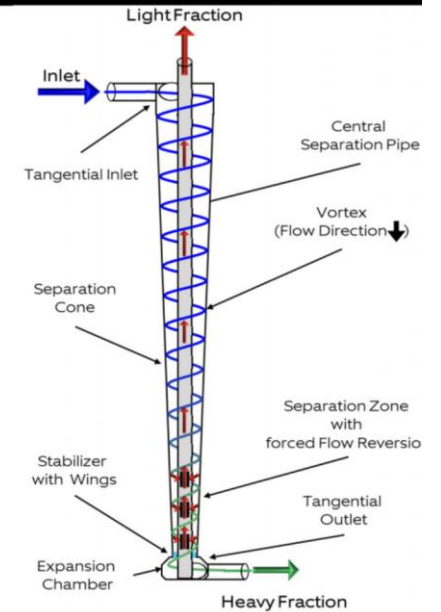


Technology Readiness Level



Country: Germany

ECOFARIO Hydrocyclone



Z-Clear Membranes

Fouling resistant and highly-selective membranes using patented zwitterionic chemistry

Overview:

- Membranes made up of zwitterionic polymers - molecular chains with equal numbers of positive and negative ions (cations and anions)
- Very hydrophilic membrane chemistry that is extremely resistant to fouling, oil and grease
- Used in the nutrient recovery process post digestion—positioned after bulk solid removal and serve as an ideal pre-treatment to reverse osmosis

Unique selling point:

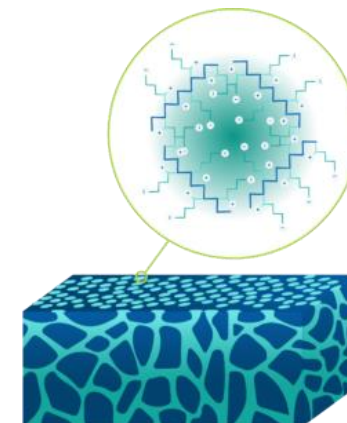
- Membranes can handle extreme concentrations (e.g. >500,000 ppm-hours) of chemicals like chlorine, peracetic acid, and aqueous ammonia, as well as a wide range of pH
- 100% flux recovery in <1 hr cleaning cycle using chlorine or caustic soda



Technology Readiness Level



Country: USA



Nutrient Removal



Aqua2[®]N

Nitrogen removal and recovery from sludge liquor, with regeneration and recycling of the precipitate

Overview:

- Two-step chemical process for removing and recovering nitrogen from liquid waste streams such as sludge liquor
- Aqua2[®]N treats waste streams with high concentrations of NH₄-N, such as sludge liquor from dewatering of digested sewage sludge or reject water from dewatering in biogas plants utilising feedstocks other than sewage sludge

Unique selling point:

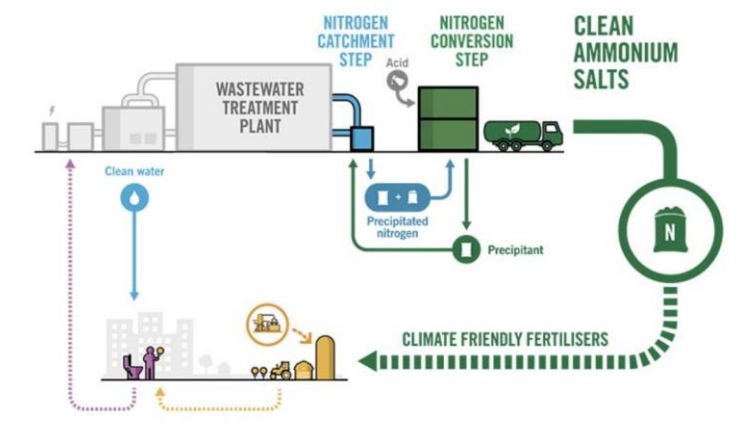
- Magnesium phosphate precipitate is regenerated and recycled unlike struvite precipitation technologies
- Removes >95% of NH₄-N, significantly reducing the total WWTP nitrogen load, without nitrous oxide emissions
- The nitrogen product from Aqua2[®]N is approved by the EU Fertiliser Product Regulation for use in conventional farming



Technology Readiness Level



Country: USA



Revolving Algal Biofilm

Vertically-oriented conveyor belt algae growth system for sustainable wastewater nutrient removal and recovery

Overview:

- Naturally occurring algae species (10-20 species) are grown on a proprietary substrate integrated into vertically-oriented conveyor belts
- Nutrient removal benefits, captures atmospheric CO₂ and uses far less energy input than aerated biological processes, reducing WWTP carbon footprints
- The RAB™ can serve as a low-energy nutrient removal system in the secondary and sidestream treatment steps, as a fixed-film tertiary treatment process and for nutrient removal in low-flow, nutrient-dense sidestreams such as AD effluent and sludge thickening supernatant

Unique selling point:

- Chemical-free, algae-based wastewater treatment technology that relies on natural photosynthetic processes to facilitate nutrient removal
- Mechanical design bypasses the need for complex algae harvesting centrifuges
- Can simultaneously remove nitrogen and phosphorus in WWTP sidestreams



Technology Readiness Level



Country: USA



AmmEL-H2

Electrochemical treatment of wastewater for ammonia removal and hydrogen production

Overview:

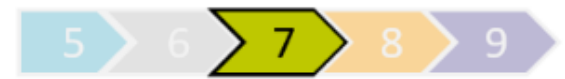
- Removes ammonia from wastewater and electrochemically converts it to nitrogen gas while producing valuable by-products (sodium hydroxide or industry-grade hypochloric acid) and pure hydrogen
- Well suited for treating municipal wastewater streams like sludge dewatering centrate, anaerobic digester centrate, and tertiary wastewater

Unique selling point:

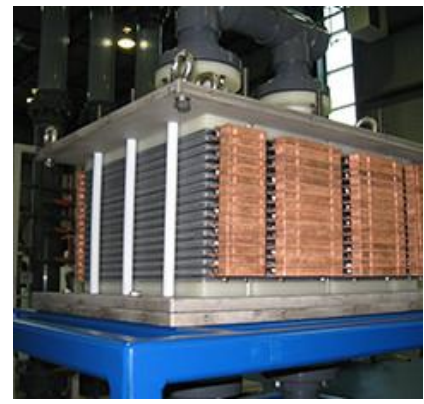
- Contrary to the operation of biological treatment systems, AmmEL-H2 does not lose efficiency in cold climates
- Does not produce environmentally harmful by-products such as nitrate, nitrite nor nitrous oxide



Technology Readiness Level



Country: Canada



Relevant Reference Projects



Partner Projects



- At Isle we constantly strive to offer innovative projects to our clients, making the most of our global network of staff, utilities and industry. We believe that **through collaboration, we can solve the shared challenges** faced by our clients.
- We are offering a number of different ‘partner projects’ to enable our clients to develop informal partnerships with one another, enabling them to **collaboratively procure research** and be an active player in our global network. **Participants learn from one another, sharing opinions and knowledge** to strengthen the outputs of each project, and have cutting edge knowledge on key topics to hand.
- Finalisation of the Partner Project scope is held in conversation with interested parties. Typically a Partner Project involves 4- 10 collaborators. **Project cost is shared between collaborators** in order to be very cost effective.
- The projects every year cover topics from resource recovery and nature-based solutions through to asset management and smart water systems **depending on the needs of the water utilities we closely collaborate with.**



Methodology

Service Description

- ✓ **Horizon Scanning** is a proven and often applied methodology applied by Isle. We screen the world for innovative technologies within a specific scope and compare the technologies using criteria relevant to the client(s).
- ✓ The technology evaluation is done through direct contact with technology providers, speaking with customers for validation of references, desktop-study assessment.
- ✓ After the initial screening and technology evaluation, Isle applies a technology scoring to prioritise the most appropriate technologies.
- ✓ The technology scoring is done through specific parameters curated to customer criteria (CAPEX, OPEX, TRL, ...) and validated with the technology providers. This allows the end-user to understand the technology options and make informed decision.



STEP 1

STEP 2

STEP 3

STEP 4



KICK-OFF
MEETING



BROAD TECHNOLOGY
SCAN SCREENING



TECHNOLOGY
PRIORITISATION &
IN-DEPTH TECHNOLOGY
ASSESSMENT



CONCLUSIONS AND
RECOMMENDATIONS

PFAS Partner Project



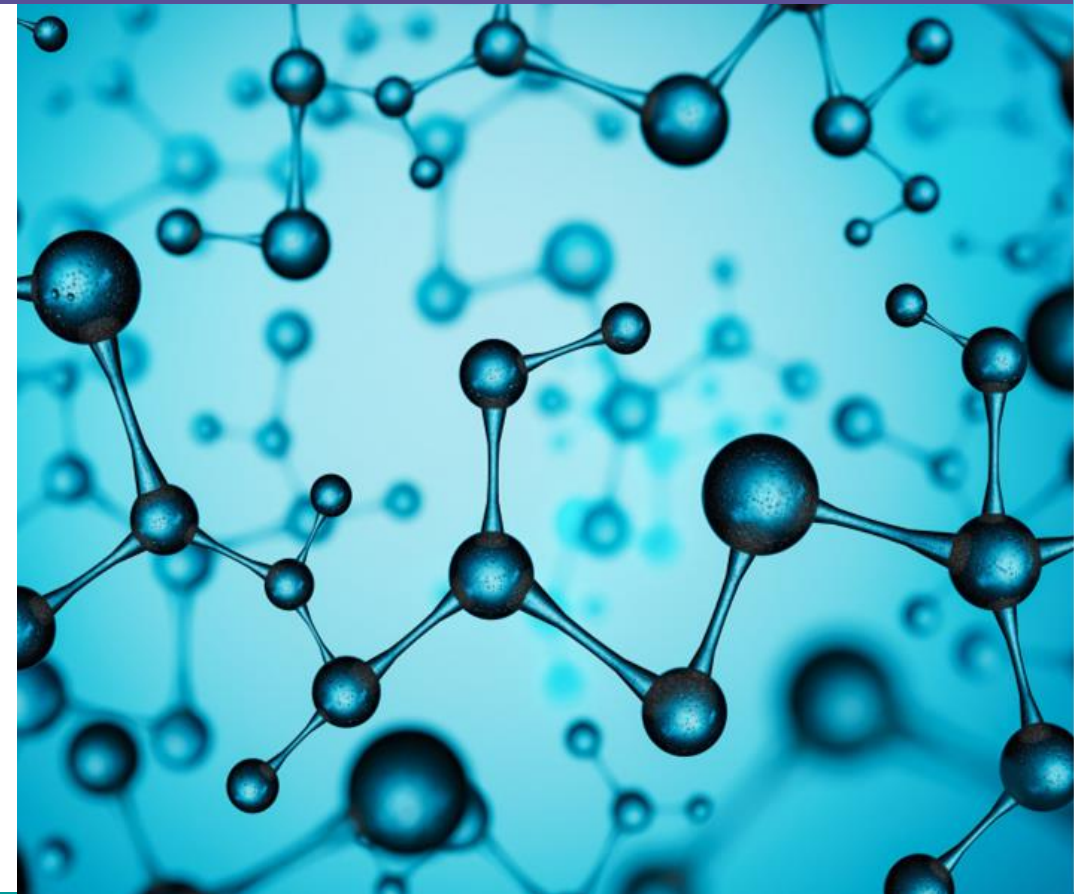
Challenge: Stricter legislation requirements in Europe for PFAS enforced in 2023.

Results: Twenty (20) state-of-the-art PFAS remediation technologies and possible treatment trains.

Customer: Multiple water utilities

Date: 2022 - Ongoing

- Per- and polyfluoroalkyl substances (PFAS) are a **group of >4,700 synthetic compounds** that are ubiquitous in the modern world.
- Water utilities in the European Union will soon be **legally required to reliably measure and remove PFAS according to stricter requirements** than ever before when the new EU Drinking Water Directive revision is enforced in 2023, and industry will be impacted as well.
- Help utilities understand the **state-of-the-art in PFAS technologies** for both drinking and wastewater, look **into emerging research and solutions**, and to **network/exchange knowledge** about PFAS management. This will enable participants to independently develop a tailored strategy in accordance with new EU regulations.



PFAS Partnership Project (EU / UK)



Quarterly Meetings



Global Intelligence



Growing TWG:

- Netherlands
- Belgium
- Sweden
- Finland
- UK

THANK YOU



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