



Wetsus 2025

combining scientific excellence with commercial relevance



Wetsus, European Centre of Excellence for Sustainable Water Technology

Oostergoweg 9 (8911 MA)
P.O. Box 1113
8900 CC LEEUWARDEN
The Netherlands

+31 (0) 58 284 30 00
info@wetsus.nl
www.wetsus.eu



Wetsus is cofunded by

- Dutch Ministry of Economic Affairs
- Dutch Ministry of Education, Culture and Science
- Dutch Ministry of Infrastructure and Water Management
- TKI-Water Technology (Topsector Water & Maritime)
- European Union (Horizon Europe, Horizon 2020, Interreg, EFRD)
- Northern Netherlands Alliance (SNN)
- Wageningen University, University of Groningen, University of Twente, NHL Stenden
- City of Leeuwarden, Province of Fryslân



Ministry of Education,
Culture and Science
Ministry of Economic Affairs
Ministry of Infrastructure
and Water Management



Introduction

Wetsus, European centre of excellence for sustainable water technology, initiates and facilitates breakthrough innovations for water treatment technology.

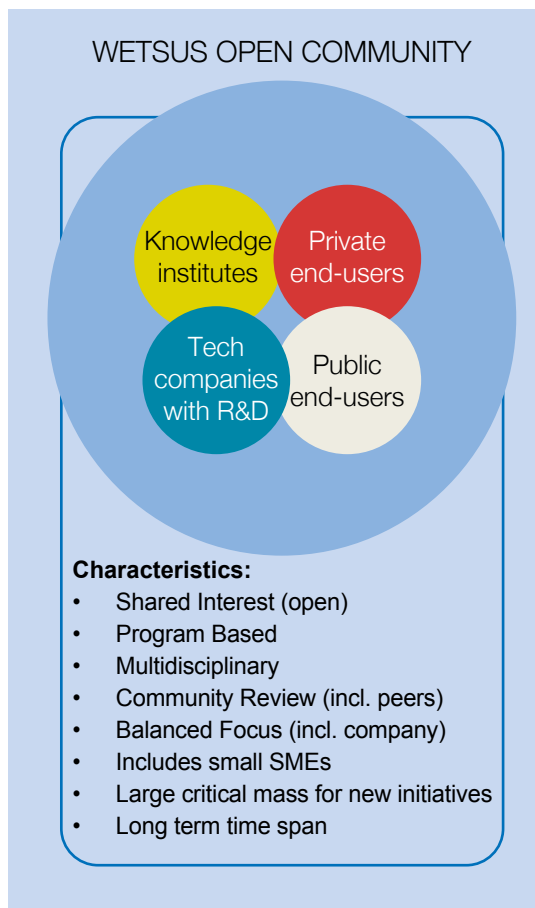
Since the start in 2003, Wetsus has aimed at combining scientific excellence with commercial relevance. For this, it has developed a unique multidisciplinary open innovation model for water technology, bringing together companies and universities. Independent scientific and economical evaluations confirm the success and added value of the Wetsus model for science, innovation, economy, sustainability and society, illustrated by Wetsus' track record of high scientific quality and production, the large number of patents used in society and the extensive network of long-term connected partners. Innovations resulting from the Wetsus program contribute significantly to the solution of global water problems.

Wetsus is organized around its aim to stimulate collaboration between the various public and private organizations that together constitute the water sector: i.e. between public companies, private companies and universities; between scientific chairs; and between regional, national and European policy makers. The Wetsus Open Community Cooperation Model (see figure) creates the synergy and momentum required to achieve major objectives. As per January 1, 2025, 110 companies annually invest some € 3.6 million in the demand driven € 16 million/year research program, with a long-term commitment. In the current Wetsus international know-how network, about 135 partners from all over the world, but with an emphasis on the EU, join forces in solving the global water problems.

Wetsus is a not-for-profit foundation located in Leeuwarden, the Netherlands. In 2022, the Dutch government has appointed Wetsus as national institute for strategically important research (Dutch: SBO-instituut). Wetsus combines a campus approach with an international know-how network strategy. At WaterCampus Leeuwarden, multidisciplinary know-how, education and talent are concentrated, valorization and commercialization are accelerated and facilities are shared.

Combining scientific excellence with commercial relevance

Companies, assembled in a Wetsus research theme, together determine the research program, which is executed in the Wetsus laboratory by the 27 involved research institutes. All research projects are performed under the scientific responsibility of the participating universities. As



Johannes Boonstra
Prof.dr.ir. Cees J.N. Buisman
Executive Board

per January 2025, 50 scientific chairs from all over Europe are involved.

Within the (inter)national scientific programs in Wetsus, research institutes and industry jointly implement market-driven, application-oriented, multidisciplinary, (pre)competitive scientific research in the field of sustainable water technology. This is typically done in four year-long research projects carried out by PhD students and their supervisors. The research goal of Wetsus is to develop innovative and sustainable water technologies. The scientific creativity required for

Wetsus Mission

Wetsus develops key enabling water technologies to foster a sustainable and fair society in a healthy and circular environment.

To achieve this, Wetsus creates an innovation community via trust-based networks of companies, universities and public bodies for generating, testing, and evolving innovative ideas and science based approaches within interdisciplinary PhD programs that shape innovations towards fruitful implementation, and where graduates become leaders in sustainable innovation.

that is to a large extent generated by the unique cooperation of 50 know-how disciplines in one physical laboratory.

A dedicated Intellectual Property Rights policy is in place, to enable optimal cooperation, innovation and the commercialization thereof. This has proven to lead to successful innovations.

Innovation, partnership, reliability, joy and cooperation are the values around which all Wetsus' activities are performed.

Wetsus' distinguishing key success factors are:

- High trust cooperation through relatively small research themes
- High commitment through long term cooperation contracts with companies and secondment agreements with universities
- Sharing of multidisciplinary knowledge from universities and companies in an idea-driven program
- Strong involvement of SME's
- Independent meeting place for scientists from all over Europe
- Valorization and commercialization acceleration by WaterCampus Leeuwarden

Regarding involvement in policy and programs for innovation, Wetsus is active on regional level (smart regional specialization in the Northern Netherlands), national level (direct involvement in national topsector Water & Maritime, TKI water technology and UPPWATER) and European level (as member of Water Europe, ERRIN and the Water4All partnership, and as coordinator or partner in Horizon Europe, Interreg and LIFE projects).

In addition to Wetsus' research role, Wetsus also fulfills two other main functions. A talent and education program is operated, in order to develop the human capital required to fulfill the innovation ambitions of the international water sector. Further, many activities in the field of stimulating spin-offs and entrepreneurship are performed to stimulate the translation of laboratory inventions into actual innovations applied in society.

Societal water challenges and solutions

Breakthrough technological developments in the field of water treatment technology are required, not only to enable the export ambitions of the water sector, but also to help solve global societal threats and challenges. Challenges that are addressed are not just in the field of water quality and availability, but also in fields like sustainable energy, agriculture, health, food security and circular economy. From Wetsus' perspective, global water problems and solutions have three aspects that need a combined approach:

- Societal needs: immense global water (and water related) problems and the social and health effects thereof have a large impact on the everyday life of people:
 - Environmental and health issues due to poor water quality and insufficient availability
 - Decreasing availability of safe, fresh water due to pollution, population growth, wealth and climate change
 - Economic instability and food insecurity due to decreasing water availability for agriculture and industry
 - Conventional water technologies are usually not circular; raw materials, water and energy are often wasted
 - Absence of safe drinking water, irrigation water and sanitation in large parts of the world is causing immense stress and tension (as described in the UN Millennium Development Goals)
- Business-market combinations: innovative companies providing sustainable enabling water technology will be leading in the highly competitive 150 billion dollar world market of water technology.
- State-of-the-art science and process technology: multidisciplinary approaches from, e.g., nano-technology, bio-sciences, separation technologies, artificial intelligence, physics and electro-chemistry are necessary to develop breakthrough solutions for the enormous water problems mankind faces.

Enabling water technology for cross-overs

Many industries and public sectors depend on water technology. Cooperation between different



Enabling water technology enables industries to keep on producing (economic value) without depleting water resources, while regenerating the environment. The development of such technology gives the water tech industry involved a competitive edge. Wetsus focuses on four impact areas where novel technology is expected to generate the biggest benefits: sustainable water, healthy environment, recovered resources and drought resilience.

sectors however, often is difficult and inefficient. Wetsus is the natural place for these sectors to join forces in the field of water technology, Wetsus has labeled this as 'enabling water technology'. Above this is graphically illustrated.

Demand driven cooperation model

The Wetsus research program is divided in themes, which essentially are Intellectual Property clusters. Typically, per theme some 4 to 8 companies and 3 to 4 universities cooperate. The program is idea-based; the ideas are ranked by the involved company participants. These companies pay an annual participation fee which gives them the right to define the program (as a group with the other theme companies) and to exercise a shared right of first refusal on the results of the research. Excellent scientific chairs are invited to execute the research and to share their know-how with the other theme participants. Regular theme meetings ensure continuous involvement of all stakeholders.

How can organizations join Wetsus?

In the Wetsus cooperation model, a distinction is made between company, platform and know-how institute participants, as described below. Specific IP rights for each participation form are part of the Wetsus IPR regulations. For the available participation forms, dedicated model agreements for cooperation in the Wetsus program are available (interested parties can contact Johannes

Boonstra, Wetsus Executive Board; johannes.boonstra@wetsus.nl).

All participants have free access to the following services offered by Wetsus:

- Early access to all Wetsus' scientific publications and other member information
- Dedicated workshops
- Admission to internal (members only) conferences and webinars
- Free access to Wetsus' public congresses
- Membership of an exclusive water technology network containing specialists from about 135 partners

Company participants

Companies participate in Wetsus per research theme. Knowledge resulting from pre-competitive research defined and co-funded by these participants, is commercially implemented by these companies and made accessible to third parties through patents and scientific publications. The participating commercial and research organizations are listed on the following pages. Wetsus' aim is to extend the number of company participants in order to further increase the commercial relevance and momentum of the scientific research. Wetsus has a collaboration policy that focuses on protecting the interests of the participants.

Cooperation in Wetsus is open to all companies. As per 2025, companies from Australia, Austria,

Belgium, Canada, Denmark, Finland, France, Germany, India, Ireland, Japan, Monaco, United Kingdom, USA, Sweden, Switzerland, China and the Netherlands participate. Much attention will be given to further internationalization, particularly in Europe.

As per January 2025, the following rates apply for theme participation (these rates are subject to inflation correction):

Company Participants: € 33,900/theme/year
 Company Participants, turnover of less than € 3 million/year: € 20,400/theme/year

For state-owned companies based outside the European Union different rates apply.

Platform participants

Further, a platform membership with network function is a participation form companies can choose for. The platform participants have no voting rights on the research program and indirect access to the intellectual property of Wetsus (to patents that are not transferred to relevant theme participants). They have a privileged position with respect to information. Each 'regular' company participant automatically is a platform participant. Platform participation is often used as a first step into Wetsus for companies who are not yet sure in which Wetsus research theme(s) they want to participate. As Platform participant companies get acquainted with Wetsus and the research program, and from that basis they can make a motivated choice to 'upgrade' to theme participant.

The 2025 annual rate for platform participation ranges from € 4,100 (company turnover < € 1.5 million/year) to € 9,600 (turnover < € 3 million/year) to € 13,600 (turnover > € 3 million/year).

Know-how institute participants

The research in Wetsus is performed by the know-how institute participants. Leading university research chairs from all over Europe are invited for this purpose. This results in a multidisciplinary and excellent scientific workforce with a clear focus. The research is mainly performed by PhD students, who are recruited from Europe and the rest of the world. Access to research facilities of 27 research institutes and a very large scientific network are important added advantages of this approach. As per 2025, 50 principle investigators and professors from 27 know-how institutes from 10 countries participate. The strategy is to maintain this network of EU chairs and to further increase its relevance and impact.

Communication

Wetsus communicates with participants and the outside world in several ways.

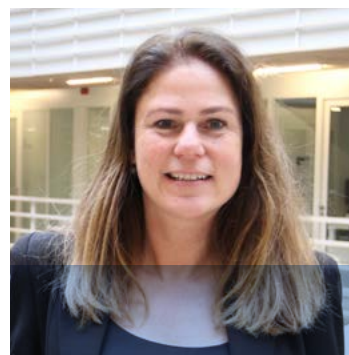
On www.wetsus.eu all up-to-date information about the organization, events and the research program can be found. Dedicated

Percentage of company participants that experience positive effects from Wetsus participation (Evaluation 2023)	
	%
Increased turnover	33
New products/technologies	40
New products/technologies within 5 years	93
Improved products/technologies	47
Expansion of own research	47

information for participating companies and universities is published on a closed section of the website, with exclusive access for participants. For (future) PhD's we offer www.phdpositions.wetsus.eu and for the master track www.masterwatertechnology.nl.

A monthly email newsletter is made available for the entire Wetsus network and is sent to some 5.000 interested individuals. A science & technology newsletter with updates on the research developments in the Wetsus program is issued regularly. Further, from time-to-time Members Only email newsletters are sent to inform the participants about meetings and developments in the program and organization. Social media (Twitter, Facebook, LinkedIn, Instagram) are used for quick news updates. Relevant movies about Wetsus can be found on the Wetsus YouTube channel.

Meetings, congresses and webinars, both Members Only and public, are used for the exchange of knowledge and to strengthen the know-how network. Annual highlight is the Wetsus Congress, with a broad variety of topics and international renowned speakers. Biannually (in even years), Wetsus co-organizes the European Water Technology Week, in which the Wetsus Congress is integrated.



Hester Henstra
 Manager communication and PR
hester.henstra@wetsus.nl

Participants (January 2025)



Platform participants (January 2025)



Know-how Institute Participants (January 2025)



International Know-How Network

Wetsus' objective to create an innovative network in the water technology sector is fulfilled through the Wetsus platform. In this platform, all activities and services for the participating companies and institutes (company participants, platform participants and know-how institute participants) are organized. In Wetsus technology providers, public water boards, drinking water companies, industrial end-users, consulting engineers, high-tech companies, financial institutes and of course the universities, know-how institutes and young talents together constitute the assembly of all relevant players in the water treatment field. Platform activities stimulate cooperation and business development around technological innovation.

To increase further strengthening of the network, Wetsus stimulates the interaction between the participants as much as possible. Wetsus offers several network events in which science meets business and talent. Several groups are targeted in dedicated events, like theme meetings, a Members Only congress and a workshop session.

Wetsus, in cooperation with its scientific partners, hosts and organizes international scientific conferences, focusing on the new field of water process technology innovations, to strengthen the EU cooperation on science and technology in water. Besides, Wetsus organizes its own annual congress. This is a well-attended networking event where science, government and business representatives meet. Companies present their progress and new products, governments share their needs and policy development. Strong scientific presentations aiming at breakthrough solutions inspire the international business and scientific community. A high number of SME's as well as multinational companies are represented. Biannually, the annual Wetsus Congress is part of the European Water Technology Week (EWTW), which is organized in close cooperation with the WaterCampus Leeuwarden partners. The following edition of the EWTW will be in 2026 (more information: www.watercampus.nl).

Legal form and Management

Wetsus is a not-for-profit foundation. Wetsus is managed by its executive board. This board is formed by a two-person executive, prof.dr.ir. Cees Buisman and Johannes Boonstra.

The participating organizations are represented in the Wetsus supervisory board. This board consists of ten members. Four members are appointed by company participants, four members are appointed by knowledge institutes and the supervisory board is completed by two independent members, the chair and vice-chair.

Funding

Wetsus derives its funding from multiple sources. Regional, national and European government funds are combined with contributions from participating companies and universities. This way, a total budget of around € 16 million per year is available.



Ed Nijpels
Chair supervisory board



Albert Bosma
Controller
albert.bosma@wetsus.nl

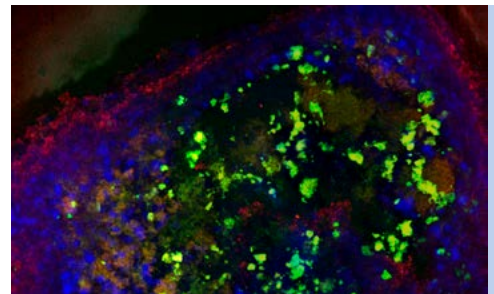
Facilities

Wetsus has moved into its landmark building early 2015. In this inspiring building, situated on WaterCampus Leeuwarden, all Wetsus activities are concentrated. The highest standards in water and energy sustainability have been applied, leading to a BREAAAM Excellent classification of the Wetsus building.

Wetsus has its own state-of-the-art research infrastructure and dedicated staff to operate these facilities. Almost the entire research program is carried out in the laboratories of Wetsus. The researchers can also use research infrastructure of the Wetsus participants. To maintain and expand the Wetsus research facilities, funding (from regional authorities) is available to continuously upgrade the equipment.

Analytical equipment

- μ -GC (biogases)
- Spectrophotometric absorbance/fluorescence/luminescence platereader
- AFM (atomic force microscopy)
- CO₂ precision analyzers
- CLSM (confocal laser scanning microscopy)
- CPD (critical point dryer for SEM microscopy)
- DSC (differential scanning calorimetry)
- Dynamic and monotonic titration systems
- EA (elemental analyzer)
- Flowcytometer (total and targeted cell enumeration)
- FT-IR (Analysis/identification of composition of solids, liquids)
- FEEM (fluorescence excitation emission matrix spectrophotometer)
- GC-FID, GC-FPD, GC-MS/MS (gaschromatography, pyrolysis & HTS autosampler)
- Gel electrophoresis (DGGE, DNA, protein)
- Gel imaging system
- High-speed camera and image acquisition
- IC (ion chromatography of anions, cations & fatty acids)
- ICP-OES (elemental analysis, option to microwave digestion)
- Triple Stage Quad LC-MS/MS
- High Resolution Accurate Mass Orbitrap LC-MS/MS (for non-targeted screening)
- LC-OCD (liquid chromatography organic carbon detection system)
- Microscopy: Brightfield, DIC, fluorescence (inverse and upright), phase contrast
- Minlon (mobile long-read sequencing)
- Nanodrop spectrophotometry (nucleic acid quality assessment)
- OCT (optical coherence tomography)
- Particle sizing 1-1000 nm asymmetric field flow fraction-MALS
- Particle sizing (50-1500 nm, including zeta potential)
- qPCR (quantitative real-time polymerase chain reaction)
- Quantus (fluorometer for nucleic acids and proteins quantification)
- Raman spectrometry system
- Rheometer
- SEM-EDS (scanning electron microscopy combined with elemental analysis)
- Spectrophotometric analyzers
- Surface area and porosity analyzer
- TGA (thermogravimetric analysis)
- Thermocycler for PCR (polymerase chain reaction)
- Carbon analyzer (TC, IC, NPOC, TOC and TN)
- UHPLC UV/VIS
- Vacuum filtration systems
- Viscosity meter



Research facilities

- -80 °C freezer
- Amplicon sequencing
- Anaerobic glove box
- Automated research fume hoods with PLC and SCADA
- Automatic film applicator
- Automated dip coater
- Ball mill
- Bead beater with cryolys cooling system (mechanical cell disruption)
- Biobench algae flatpanel reactor systems
- Biofouling monitors with and without water production
- Biological safety cabinets (HEPA filtered)
- Black water, urine and water storage tanks
- Climate unit/Indoor Plant Growth Room
- CNC mill
- Continuous and batch reactors
- Cooling and heating compartments
- Cutting plotter
- Soldering station
- Doppler echo imaging system
- Extruder for bioplastics
- Fermentation equipment
- Filament and resin 3D printers
- Flat sheet membrane production
- Freeze dryer
- Fully equipped electrotechnical station
- Fully equipped optical lab facility
- GAP fume cabinets
- Gas and sewage water distribution network
- High voltage lab
- High-speed cooled centrifuge
- Hot rolling press/calendering machine
- Knife mill
- Labopress (molding and pressing)
- Laboratory eStretching machine / membrane spinning device
- Laboratory information management system (LIMS)
- Laser cutter
- Metagenomics
- ML-II level advanced microscopy lab
- ML-II level microbiology lab
- Multi-channel potentiostats
- Nanofiltration system (pilot scale)
- Online process control
- Spirometer
- Safety precaution measurements and systems
- Safety vacuum drying oven
- Shaking incubators (hot, cold, light)
- Sonication equipment
- Temperature monitoring system (sample quality control)
- Transcriptomics (RNA sequencing)
- Tube furnace
- Ultra Turrax homogenizer
- Ultrasonic underwater inspection system
- Walk-in fume cupboards
- Welding equipment for foils and exotic metals
- Whole-genome sequencing
- Moisture analyzer



Wim Borgonje
Manager facilities
wim.borgonje@wetsus.nl



Jan Willem Schoonen
Manager analytical laboratory
janwillem.schoonen@wetsus.nl



Pieter van Veelen
Manager microbiology laboratory
pieter.vanveelen@wetsus.nl

International cooperation

Wetsus' internationalization vision is summarized in the scheme on the right.

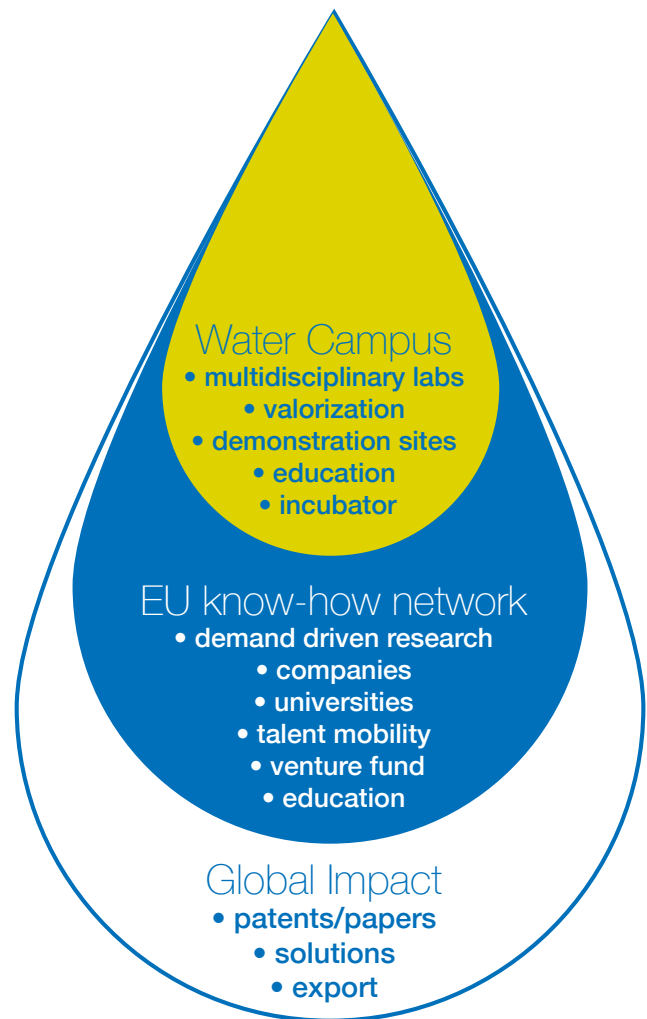
Water innovations can be applied all over the world. International cooperation is therefore essential to us and our partners. Wetsus' international activities are placed in a regional, national, European and global dimension. The physical core is formed by WaterCampus Leeuwarden, which offers facilities like a multidisciplinary laboratory, demonstration sites and an incubator. WaterCampus collaborates with a network of over 300 national and international organizations. These cooperate in the fields of research, know-how, entrepreneurship, venture capital, talent and education. With this integrated network, WaterCampus can operate effectively on European and global level. WaterCampus has become a magnet for the world's top talent. The beating heart of WaterCampus is formed by Wetsus. Today in the Wetsus laboratory, about 150 international professionals work on water technology research and innovation, connecting a global science network.

European Innovation Academy

Wetsus is the result of a very successful Research and Innovation Strategy for Smart Specialization (RIS3). It has managed to develop as a science and innovation institute in a region without a university. Wetsus has transformed from a national science institute into Europe's main spark plug for water technology innovation. The combination of a long-term focus, the concentration of the multidisciplinary core activities in a physical place and the committed connection of an international professional network, has been essential to realize this.

The number of international companies and institutes in Wetsus is increasing, currently about 25% of the partners is non-Dutch. Further Europeanisation is enhanced by participation in European research and innovation projects, under programs such as Horizon Europe, EIT, Interreg and LIFE. Wetsus and WaterCampus also actively participate in Water Europe, ERRIN and the European Partnership Water4All. All these projects and activities further enhance the critical mass and reputation of WaterCampus Leeuwarden. Wetsus fulfils the role of European Centre of Excellence with a proven capacity to generate world class knowledge, high value patents and competitive spin-offs. In this way Wetsus' research program supports the development of growth and jobs across the EU.

The European water sector, often characterized as fragmented, has found a focal point in Wetsus: time to market has been reduced, investments in



start-ups have increased, industry is long-term committed and world class research is achieved. Wetsus strives to be the most integrated innovation program for this emerging industry in the world. The impact of Wetsus is multiplied by funding synergies between local, regional, national and EU programs.

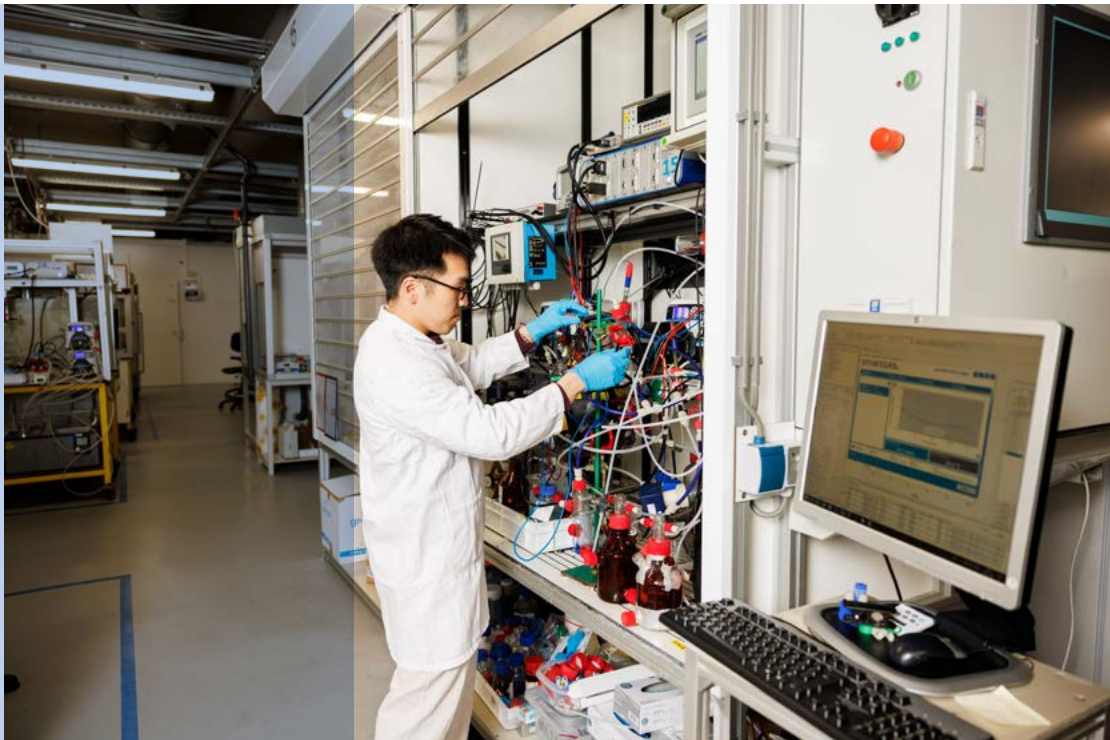
Global connections

The global water technology sector is increasingly organized in hubs. WaterCampus Leeuwarden connects these hubs and strives to create synergy between them. Biannually, during the European Water Tech Week, the global hubs are assembled in Leeuwarden. The EWTW2024 three-day program was very well received by the 500 attendees per day. Overall, more than 800 individual participants from 31 countries were present. During EWTW2026, October 5 - 8, the water tech sector will meet and inspire each other again in the innovative climate of WaterCampus Leeuwarden.

Meeting of international minds

Wetsus is a place where water technology minds meet and inspire each other. Currently, 64% of the scientific staff, researchers and students are from outside the Netherlands (from 41 different countries). In addition, on a regular basis the connected professors and the R&D managers of company members meet at Wetsus to discuss research outcomes and define future projects.

The multidisciplinary research needed to develop breakthrough water technologies depends on PhD students of various disciplines to work side-by-side on one physical location. Only by continued exposure to each other can knowledge from one discipline be applied in another. The H2020 Marie Skłodowska-Curie projects EMPOWER and ReCaP further enhance the attractiveness of Wetsus for international talent. Calls with vacancies are published on www.phdpositionswetsus.eu.



Wetsus Values

Innovation	searching actively for and the development of trendsetting technological innovations which are applicable to society
Partnership	focusing on inspiring relationships with our partners in order to create an effective network
Joy	creating a pleasant working atmosphere in which colleagues can grow professionally and personally
Cooperation	supporting and respecting each other in an open and safe environment
Reliability	our ability to keep promises and providing declared standards

Performance Indicators Wetsus

	cumulative until 2020*	2020 realized	2021 realized	2022 realized	2023 realized	2024 realized	2025**	2028
Finance and commitment								
Program Budget (mln €)		14,3	14,8	14,9	16,2	16,4	15,0	15,4
Company Contribution (mln €)		3,4	3,4	3,4	3,4	3,6	3,6	3,7
Science Progress								
Science projects started (PhD/postdoc) (cumulative)	247	6	21	51	67	85	71	110
Papers total (cumulative)	703	66	137	197	255	306	300	456
Citation Impact (-1y)		2,6	1,8	3,0	2,7	1,4	>1,5	>1,5
Competitiveness								
Number of spin-off companies (cumulative)	36	2	4	8	10	11	10	14
Number of patents generated (cumulative)	88	2	5	8	13	16	17	26
Number of patents transferred (cumulative)	37	3	3	6	6	8	14	20
Number of SME companies in program (turnover < 100 mln €)		51	57	57	55	55	55	57
Novel/Patented Technologies from idea to pilot (cumulative)	24	3	5	7	9	12	11	16
Participants using Wetsus know-how in existing products (%)		46			47			
Innovation Community								
Number of participating companies (active)		105	113	109	104	106	110	113
Number of principle investigators and professors (cumulative)	101	53	56	63	74	83	74	87
Trust & Cooperation valued by partners (grading scale 1-10)		8			8,6			
Future Innovation Leaders								
Ph.D. Graduates (cumulative)	108	12	23	33	46	60	71	110
Joint Degree Msc graduates (cumulative)	123	15	25	35	45	55	117	177
Research Students (non-PhD) (cumulative)	803	60	114	167	231	298	525	825

* The cumulative values until 2020 have been realized in the 2004-2019 Wetsus program

** Values as of 2025 are targets from businessplan 2021-2023



Innovation Ecosystem

Wetsus' main objective is to develop (pre) competitive know-how with respect to water treatment technology, by bringing scientists and entrepreneurs together.

It is crucial that this know-how is converted into successful, profitable innovations, not only to create business, but also to help solve the global water crisis. In this respect, the facilitation of start-ups and a stimulating climate and infrastructure for collaboration in the water sector are of great importance. This support is available for the entire water sector, so not just for Wetsus participants. The activities in this respect are described in this chapter.

WaterCampus Leeuwarden

In order to stimulate know-how clustering and valorization, it is important that the critical mass of the international research program of Wetsus is embedded in a dedicated innovation ecosystem. Wetsus is located in Leeuwarden, the United Nations Innovating City for water technology and capital of the Dutch province of Fryslân. This province is characterized by a relatively high density of independently owned and globally exporting water companies. Together with Water Alliance (www.wateralliance.nl) and the Centre of Expertise Water technology (CEW; www.cew.nl), Wetsus is one of the main pillars of WaterCampus Leeuwarden (www.watercampus.nl).



WaterCampus Leeuwarden is the physical core of the Dutch water technology sector and increasingly plays a sector uniting role for the rest of Europe as well. WaterCampus stimulates cooperation between (inter)national businesses, knowledge institutes and governments within the water technology sector, in order to create

synergy for world class innovation, education and entrepreneurship. This strengthens the global position of the European water technology sector. Additionally, WaterCampus offers a unique research infrastructure, and is a meeting point for scientists and companies from all over Europe and beyond.



Education and applied research

The Centre of Expertise Water Technology (CEW) has started in 2011 on WaterCampus Leeuwarden as a centre for knowledge and innovation in water technology. It is a unique collaboration between universities of applied science, SME's, large technology providers, end users and local and national governments. The focus of the centre is water technology research on higher technology readiness level (TRL 4-8). By performing applied research projects in the laboratory, at demo sites or at the location of end users, CEW supports innovation. The research is performed by students, teachers and experts, depending on the request of the customer. The CEW forms in that sense a valuable contribution in the knowledge chain from inventions to innovations. (www.cew.nl or contact Länk Vaessen; l.vaessen@cew.nl).

In addition, the 'Centrum voor Innovatief Vakmanschap Water' (CIV Water) enhances and supports vocational education and training for water-related professions. In day school, but also in part-time education and tailor-made programs, the CIV collaborates in partnership with several companies in the water sector, the manufacturing industry, service, maintenance, etc. (www.civwater.nl or contact Pieter Hoekstra: p.hoekstra@civwater.nl).



Shared Demonstration Sites and Facilities

For larger scale research and demonstration activities, it is not economically feasible to transport large quantities of specific water to a laboratory. Arranging on-site testing however, is often time and money consuming (piping, utilities, permits, etc. need to be arranged), if at all possible. To overcome this bottleneck and enhance the innovation chain, Wetsus, together with its WaterCampus Partners and other stakeholders, have realized several demonstration sites within a radius of 50 km around WaterCampus Leeuwarden. At these demosites, new concepts and technologies can be scaled up, tested and demonstrated according to the plug and play

principle. The following sites are available:

- Wetsalt, demosite for sea water desalination technologies and Blue Energy at Frisia Zout, Harlingen. Contact: j.moreno@cew.nl.
- SenTec demosite for drinking and surface water quality sensing in Glimmen. Contact: h.prummel@wln.nl.
- Demosite for sewage water treatment in Leeuwarden (renewed in 2024). Contact: sgerbens@weterskipfryslan.nl
- Test facility for hospital waste water treatment in Sneek. Contact: j.moreno@cew.nl

With these sites, companies can accelerate the introduction of new technologies considerably.



Further, companies can test their new innovations on bench scale at the Water Application Centre. This centre, abbreviated as WAC, has been developed in cooperation with Van Hall Larenstein (university of applied sciences) and local water companies. (www.waterapplicatiecentrum.nl; koos.oosterhaven@hvhl.nl or l.vaessen@cew.nl).



wac
waterapplicatiecentrum



From inventions to innovations to business

Start-up companies and SME's are a crucial vehicle for the introduction of ground-breaking innovations into the market place. The continuous strive of Wetsus and WaterCampus Leeuwarden to valorize new know-how into business has resulted in a large number of demonstration projects of new technological concepts. Further, 105 water technology companies have started their business in and around WaterCampus Leeuwarden since 2003. Of these 105 companies, 47 are spin-off companies from Wetsus. Below an overview of these spin-offs is provided.

Wetsus and the other partners in WaterCampus Leeuwarden created the right conditions and instruments to allow companies to emerge from

the ecosystem (start-ups) and to grow (start-ups and SMEs). WaterCampus helps companies to bring an invention to an innovation and successful business. The structure of this support is set-up along 5 pillars:

- Access to talent: WaterCampus offers education programs in science and entrepreneurship to increase the availability of skilled talent (new employees) on all educational levels and to train the entrepreneurs of the future;
- Access to market: the WaterCampus ecosystem gives startups and innovative companies access to the most connected water technology network in the world and, via this network and facilitation programs, to the international market for water technology;
- Access to capital: at WaterCampus startups

- and innovative companies have access to a variety of investors and funds to help them to bring their technology to the market and scale up (inter)nationally;
- Access to knowledge: WaterCampus is the gateway to all knowledge, networks and cooperation programs that are necessary for turning an innovative idea into a successful breakthrough innovation;
- Access to facilities: WaterCampus offers access to unique physical facilities (eg laboratories, demosites, incubator, etc.) that are necessary for optimally developing, scaling up and market-launching new technologies, products and services.

Wetsus spin-off companies

REDstack	Automatic Electric Europe Special Products (ended)	Salttech
HydrOwashr	Westt	Dutch Rainmaker
Aqua Explorer	Biotrack	Ynovio BV
TailTec (ended)	EasyMeasure	Capilix (now: Metrohm)
Water ProMaSys (ended)	Aiforo	Somut (ended)
Duplaco	Pure Green	Water Waves
Smart Frequencies	Wisect	High Voltage Water (ended)
Djipper	Metal Membranes (ended)	Izer
AquaBattery	NewAna	Aquacolor Sensors
Lamp-ion	NX-Filtration	Dutch Blackworms (ended)
AppSen	Evacon	Water Future
Sensor Factory	W&F Technologies	Galama Sustainable Solutions
Protodromics	Hytoxgen (ended)	Nautic Waterloo
Hulo	Aquature	VerSi Watertech
SeaO2	Aqa.earth	IonIQs
DualSoil	DeSaH	

More information about the WaterCampus entrepreneurship program and business support opportunities can be obtained at www.watercampus.nl/entrepreneurship-portal, or by contacting Ronald Wielinga (r.wielinga@watercampus.nl).

Financial Facilitation

Venture Capital, Private Equity and other financiers can stimulate entrepreneurship around water technology significantly. Many funds, water companies and other investors are actively looking to add water technology propositions to their portfolio. Wetsus plays a role as matchmaker between financiers and water technology companies in need for capital. Frequently Wetsus and other WaterCampus partners welcome visitors from all over the world with a water technology investment interest. This has led to an interesting network of funders and

technology suppliers, which has subsequently resulted in several finance successes.

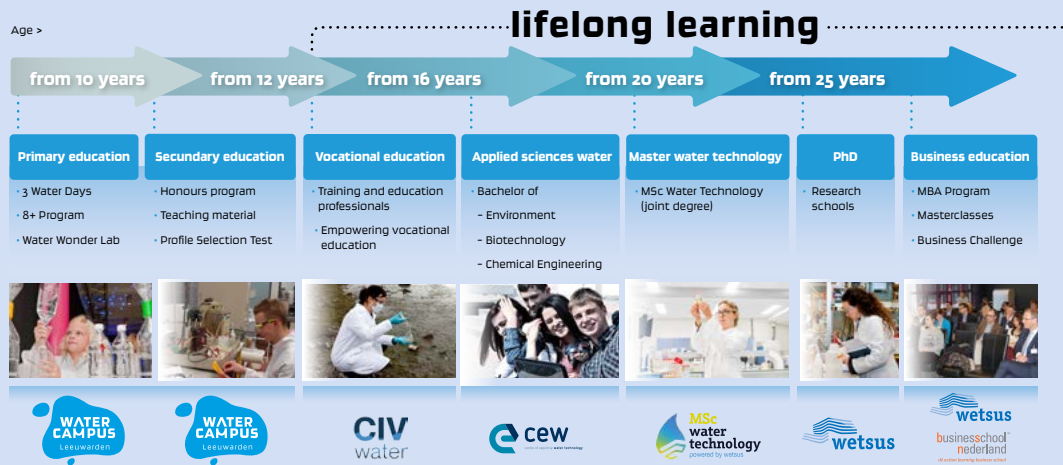
So, Wetsus and WaterCampus Leeuwarden have the ideal position to, in a neutral way, create a platform for water technology companies to showcase and demonstrate their innovation propositions to investors. This is structured in, among others, 'Financieringstafel Friesland'. Further, in 2021 we started the NEW-project together with partners Deltares, University of Groningen and the NOM. The NEW-plan offers support for early stage startups. For example with the NEW-fund that invests around 6 million euros in promising early stage startups the coming years. In addition, through Bison WaterCampus can financially support companies in the pre-seed phase. More information about financial facilitation can be found on www.bison-powered.nl (or contact albert.bosma@wetsus.nl).



Human Capital and Education

In the education and talent fields, Wetsus closely cooperates with the other actors in WaterCampus Leeuwarden and with several other national organizations. The activities in this regard are

summarized in the below scheme. All programs are characterized by an integrated science, technology, engineering, and mathematics – STEM – approach.



WaterCampus Talent Program

Together with the partners at WaterCampus Leeuwarden, Wetsus plays an important role in the inspiration of young people to choose for a scientific or entrepreneurial career in which they can help solve the global water problems.

Primary education

- **Water Professor;** Scientific research shows that very young children's learning and thinking are strikingly similar to much learning and thinking in science. Preschoolers test hypotheses against data and make causal inferences; they learn from statistics and informal experimentation, and from watching and listening to others. To stimulate this behavior, Wetsus sends 'Water Professors' to primary schools for a three-day inspiration program. One of these days the students visit a water tech site to experience real-life examples of what it looks like to solve world water problems. In the past years, more than 1000 Water Professor visits have been made to primary schools.
- **Excellence program;** a unique course that offers four lessons which are adapted to the level of highly gifted students. The kids are challenged to solve world water problems, using technology. In one of these lessons, experiments are performed in the Wetsus lab.

Secondary education

Together with teachers, researchers and companies, the Talent Program translates water technology to a level that allows youngsters to discover its impact and how it is applied in the



Rouël Gnodde
 Manager Talent Program
 rouel.gnodde@wetsus.nl

sector. The results of this cooperation have led to the development of events, competitions, teaching material and a variety of programs, such as:

- **Honors Program;** a selected group of students is invited to work on their own research project at Wetsus, supported by a team of Wetsus PhD researchers. After one year of research the young researchers qualify for participation in an international Science Fair. And if qualified, they can spend two more years on their project – teaching younger students the ins and outs of doing research.
- **Lab Experience day;** twice per month a practical course 'water technology' is organized for 2nd grade high school students, aged fourteen to fifteen. The one-day course, held at Wetsus, encourages research skills, cooperation, accuracy, out-of-the-box thinking and taking initiative.

- **Masterclasses;** Masterclasses are offered where students can receive support from PhD researchers or experts during their thesis or science projects. Furthermore, students and

teachers are encouraged to do their own research with the help of various toolkits, that allow for independent and curriculum-extending STEM programs.

BSc Water Technology

Wetsus cooperates with 4 universities of applied sciences (Dutch HBO) in the Netherlands that have a minor in water treatment: Van Hall Larenstein, NHL Stenden Hogeschool, Hogeschool Zeeland and Saxion Hogeschool. Wetsus, in close cooperation with CEW, supports these institutes and their applied research water technology professors in several ways, in order to help them to continuously improve the curriculum,

to connect them with the sector and to enable them to attract more and better students..




Dr. Luewton Lemos F. Agostinho
Applied research professor Water Technology
NHL Hogeschool
luewton.agostinho@nhlstenden.com




Dr.ir Harry Futselaar
Applied research professor International Water Technology
Saxion University of Applied Sciences
h.futselaar@saxion.nl




Dr. Michel Saakes
Applied research professor Water Technology
NHLStenden
michel.saakes@nhlstenden.com




Dr.ir Hans Cappon
Applied research professor Water Technology
HZ University of Applied Science Delta Academy
hans.cappon@hz.nl

European MSc Water Technology:


Wetsus hosts an internationally unique master program in water process technology. The curriculum is designed to create a multidisciplinary MSc program with a strong scientific and technological focus, embedded in the top-class research environment of Wetsus. The MSc water technology program aims at the education of new talents capable of addressing the growing challenges in this field. The program is grounded in multiple scientific disciplines, integral to the Wetsus research program. Students are trained to acquire a high level of (new) interdisciplinary knowledge and inquisitiveness.

The MSc Water Technology is a joint degree offered by Wageningen University, University of Twente and the University of Groningen. Students enroll at Wageningen University and are automatically registered at the other two universities. Upon successful completion of the master program, graduates receive a joint MSc degree from all three universities. The program undergoes an external evaluation every six years. In 2024, the MSc Water Technology completed the accreditation process and was positively assessed.

PhD student recruitment

Wetsus recruits new PhD students via a call system and a dedicated website

www.phdpositionswetsus.eu. Twice a year, in March and September, a call with available PhD student positions is launched. The selection and recruitment of the candidates proceeds via a 3-step selection process. The first selection is based on the application documents. The remaining candidates are interviewed by means of a video call. The final selection takes place during a recruitment challenge held at Wetsus. On average, 65 applications are received per PhD position. This recruitment approach was developed as part of two Marie Skłodowska-Curie projects coordinated by Wetsus, WaterSEED and EMPOWER, which received funding from the



Dr. Valentina Sechi
Program Director Master Water Technology
valentina.sechi@wetsus.nl

European Union's Horizon 2020 research and innovation program.

Doctorate Program for PhD students

In addition to their university's graduate school courses, the Wetsus PhD students follow the doctorate program of Wetsus. In this program, they not only learn how to work as excellent independent researchers, but also how to have impact on science and society. Personal development is a major part of this doctorate program. This is crucial as Wetsus has a challenging goal that requires not only high scientific standards, but also a high personal involvement. To work meaningful, commitment, spirit and free thinking are needed while curiosity, openness and astonishment are needed for groundbreaking accomplishments. In addition, a unique insight in innovation is experienced by the PhD students through their intensive cooperation with our company participants.

Business Education

In order for startups to emerge and develop into healthy companies, WaterCampus offers several programs to stimulate and enhance entrepreneurship.

As part of the Wetsus PhD Development Program, PhD's are offered the possibility to join the **Business Development Course**. In this 4-day training program PhD researchers take the first steps in transforming their innovative research ideas into a viable business plan and learn how to pitch this before an expert jury. For this program Wetsus has a close collaboration with the Sustainable Entrepreneurship program of the University of Groningen. The next step for PhD researchers with the ambition to develop a sustainable business, can be to join the European WaterCampus Business Challenge.

The **European WaterCampus Business Challenge** is a one-week training program on water entrepreneurship, intended for students, PhD researchers, startups and experienced professionals from all over Europe and beyond. This challenge is organized annually in close cooperation with entrepreneurs and specialists from the international water sector. During the program, participants work on their potential commercial business case that is ready for launching a (new) water product or service on (new) markets. The business challenge gives the participants an opportunity to interact with successful innovative technology providers, professional financiers and CEO's of all stakeholders in the water sector, who share their experiences with them.

Together with the University of Groningen and Deltares, Wetsus launched the **Netherlands**

Enabling Water technology (NEW) program.

The aim of this initiative is valorization of scientific research in concrete solutions to tackle international water challenges and to create impact. NEW offers, among other things, a cohesive one-year business development program for knowledge starters called VentureLab, which is the perfect link between the European WaterCampus Business Challenge and the BeStart Accelerator.



Wetsus (WaterCampus) is co-founder of the **BeStart business accelerator program** (www.bestart.nl). This program was launched in close cooperation with Omrin, Ecommunitypark and Paques and focusses on the clean tech sector. Annually 10 - 12 entrepreneurs are intensively coached and trained to make sure that the full potential of a startup company is utilized. Several spin-off companies of Wetsus have already successfully participated in this accelerator program. In addition, a dedicated program for SME's is in place since 2024, supporting SME's in their ambition to realize an innovative idea or new business model.

Together with Business School Netherlands (BSN), Wetsus launched an **Executive Water MBA program** that combines business and management issues with important water themes. The graduated MBA-candidates are especially interesting for growing companies that need more management experience. The eMBA program addresses those needs and is tailored to the water technology sector. The PhD students recruited at Wetsus under the EMPOWER project will combine their PhD research project with the eMBA training; they will graduate with the broad skillset needed to bring about innovation in the water sector. The eMBA program is open for everybody interested.



Ronald Wielinga
Manager Entrepreneurship
WaterCampus
ronald.wielinga@wetsus.nl

Wetsus Research

Water is at the heart of life, industry, and ecosystems. As the global demand for clean, accessible, and sustainable water rises, the world faces mounting challenges in ensuring its availability and quality for personal, agricultural, industrial, and environmental use. At the same time, solutions must be sustainable—saving water, requiring less energy, minimizing waste, recovering valuable resources, and eliminating harmful emissions. At Wetsus, our aim is not just to solve water challenges; we aim to redefine how, now and in the future, water is treated, reused, and valued across industries and communities.

The conventional engineering approaches that once sufficed can no longer keep up under all circumstances. New water process technologies are essential for developing integrated, innovative solutions that transform water treatment and harness alternative water sources like seawater, reclaimed wastewater, and humid air. By reducing dependence on precious groundwater and enhancing resource recovery, we move toward a sustainable and circular water economy. Our research does not particularly aim at improving state-of-the-art water technologies—it is about creating entirely new concepts and developing breakthrough technologies. We focus on efficient processes, zero-emission solutions, circular water systems, and entrepreneurial-driven innovations to enable real-world applications.

Our impact pathway is built on our effective public-private partnership (PPP) model, bringing together industry leaders, academic institutions and government bodies through initiatives like the Dutch Topsector Water (TKI Watertechnologie), the Dutch National Growth Fund program (UPPwater) and competitive EU projects. This dynamic ecosystem ensures that research is market-driven, application-focused, and multidisciplinary, addressing real-world challenges with cutting-edge solutions. Our research projects are developed through an iterative, idea-driven process within the research themes that brings together industry partners and academic experts. Each project is designed to meet clear business objectives while maintaining scientific excellence. To ensure the highest quality and relevance, every project undergoes evaluation by the Wetsus Management Board (for its strategic fit and financial feasibility) and an Independent Program Council (for its scientific and innovation potential) This rigorous process ensures that our research consistently leads to groundbreaking solutions that can be applied in the real world.

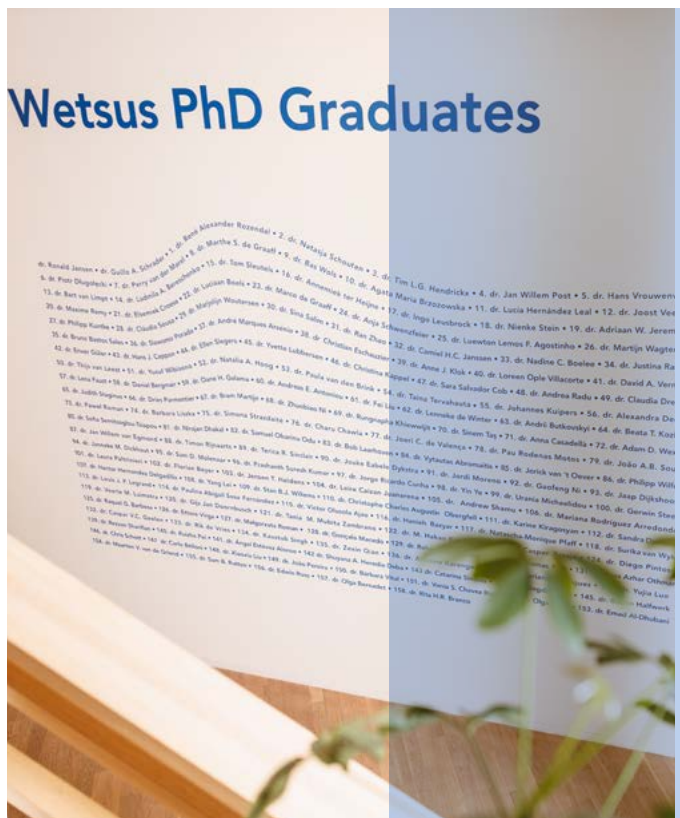


Prof. dr. ir. Bert Hamelers
Science Impact Director

Dr. ir. Jan W. Post
Program Director
bert.hamelers@wetsus.nl
jan.post@wetsus.nl

Peer review scientific evaluation 2023

Scientific quality	‘Excellent’
Societal relevance	‘Most effective academic-industry collaboration’ ‘Significant economic and societal impact’
Viability	‘The future of Wetsus is sound and very promising’





Innovation requires innovative minds. At Wetsus, we are committed to training and empowering the next generation of researchers, engineers, and industry leaders. Our PhD program offers a unique learning experience that combines scientific excellence with hands-on industry engagement. With a dedicated personal development program, we equip future water technology pioneers with the skills, knowledge, and networks they need to drive real-world impact. The four-year project duration offers the PhD researchers - supported by MSc and BSc thesis students and interns - ample time to explore and expand developments in water tech, fostering in-depth innovation. This leads to an increase in our intellectual property portfolio, with potential protection via patents that are made available for our industry partners. Simultaneously, results are published in high-quality, peer-reviewed scientific journals, contributing to global academic excellence.

Our system is designed for continuous innovation. Each year, new projects are introduced in the research program, accounting for 25% of the portfolio since PhD projects span four years. This ongoing programming ensures that Wetsus remains at the forefront of water technology advancements.

Research areas and scientific focus

In addition to strong partnerships between companies and utilities, Wetsus fosters a unique form of scientific collaboration with universities and institutes. Over 60 scientific chairs from multiple disciplines cooperate within our research program through the supervision of ~60 PhD researchers. What sets Wetsus apart is that PhD researchers from different universities, various disciplines, and connected with diverse industry partners, work side by side in the Wetsus laboratory. This creates a truly multidisciplinary environment where leading researchers from

Research proposal evaluation

After pre-selection by the relevant company participants, research proposals are evaluated on the following criteria:

- Scientific quality
- Innovation potential
- Composition of the research team



academia, research institutes, and industry collaborate closely, generating synergy and accelerating innovation.

Wetsus connects a variety of disciplines to water technology, opening new avenues for discovery and application. Our research is built around (bio)chemical engineering, environmental engineering, and membrane technology, which serve as a foundation for developing cutting-edge water solutions. We also leverage genomics, microbiology, organic chemistry, electrochemistry, photonics and AI to push the boundaries of innovation. To maximize the impact of our advancements, we recently have also integrated social sciences into our research, ensuring that technology aligns with societal needs and policy frameworks.

By strategically focusing on these key disciplines, Wetsus ensures scientific excellence while maintaining international leadership in sustainable water technology. Our approach ensures that scientific advancements, industry-driven innovations, and societal needs reinforce each other—leading to real-world impact.

This unique collaboration brings synergy and new creativity to the search for new sustainable water treatment technology. At Wetsus, our research focuses on four core themes that address the most pressing water challenges of our time:

- 1. Sustainable Water:** Developing chemical-free and nature-based treatment solutions to ensure safe, sufficient, and sustainable water supplies while drastically reducing chemical and energy use.
- 2. Healthy Environment:** Protecting both human

health and ecosystems by advancing (bio) sensors, AI-driven monitoring networks, and intelligent water management systems. These innovations enable early detection, real-time response, and predictive maintenance for water quality control.

- 3. Recovered Resources:** Turning wastewater into a valuable resource by enabling the recovery of polymers, nutrients, energy, and metals. By closing the loop, we transform waste streams into economic opportunities.
- 4. Drought resilience:** Developing technological interventions to restore water cycles, rehabilitate degraded lands, and balance regional water use, ensuring resilience in the face of changing environmental conditions.

Research program

The research program is currently defined in 20 research themes.



Sustainable water

1 | Advanced water treatment

Advanced water treatment plays a vital role in developing sustainable purification technologies to remove inorganic and organic priority compounds like PFAS, pharmaceuticals, and personal care products, aligning with the Water Framework Directive. This is achieved by investigating new methods based on physical, electrical, and electrochemical principles. Techniques include selective membrane transport for organic micropollutants and salt ions, driven by electricity or pressure, hydrophobic interactions for adsorption and biological degradation of organic compounds. These processes enhance the efficiency and effectiveness of water purification. Current research focuses on technologies such as multilayer nanofiltration membranes, foam fractionation, and biologically activated carbon-based filtration and conversion, offering innovative solutions for producing cleaner, safer water while promoting environmental sustainability. The theme started in 2007.

2 | Source separated sanitation

As urban populations grow and centralized water and sewer systems reach capacity, and as rural communities remain disconnected from such infrastructure, Source Separated Sanitation (SSS) systems are becoming essential. SSS is an emerging and scalable concept that addresses

these challenges by collecting, transporting, and treating waste streams – such as greywater, urine, and feces – separately at the source. This approach enhances water savings, enables the safe reuse of greywater, and supports the recovery of nutrients and organics from human waste (urine and feces). By preventing the dilution of waste streams, SSS facilitates more efficient treatment processes, allowing for targeted resource recovery and improved environmental outcomes. The elevated temperatures of these concentrated streams also enable efficient heat recovery and the use of thermophilic processes, contributing to energy savings. Moreover, by isolating waste streams, SSS can help mitigate the spread of antibiotic-resistant bacteria, a growing concern in conventional wastewater systems. These technologies are crucial in providing sustainable sanitation solutions while reducing the strain on existing centralized systems. The theme started in 2004.

3 | Priority compounds & Virus control

The Priority compounds & Virus control theme focuses on the chemical-free degradation and inactivation of human-originated trace contaminants, transforming them into harmless products. We explore two key areas: First, we develop efficient, UV-based advanced oxidation processes (AOPs) to ensure safe drinking water from impaired sources. Second, we aim to create



rapid, simple validation methods to measure log removal and inactivation values, crucial for maintaining high safety standards. Without sensitive operational monitoring, valuable log credits may be lost. Additionally, we address the formation of transformation products (TPs) during AOPs. While AOPs effectively degrade micropollutants like pharmaceuticals and pesticides, some TPs may remain biologically active and go undetected by conventional methods. To tackle this, we combine high-resolution mass spectrometry (HRMS), effect-directed analysis (EDA), and machine learning to identify and assess TPs' potential toxicity, enhancing both treatment safety and effectiveness.

The theme started in 2009.

4 | Desalination & Concentrates

Meeting the growing demand for freshwater and water reuse requires sustainable solutions for desalinating seawater, groundwater, and wastewater. The Desalination & Concentrates theme leads the way in developing innovative, eco-friendly, and cost-effective desalination technologies that either enhance or replace traditional thermal and membrane methods. These cutting-edge approaches can be integrated into closed-loop water treatment systems or used for mineral extraction. The projects focus on reducing energy and chemical use, targeting specific ions that hinder further processing, recovering valuable materials from brines, and eventually achieving zero liquid discharge. The theme explores diverse, interdisciplinary methods, blending expertise from electrochemistry, crystallization, membrane separation, extraction, and adsorption. Technologies under development include capacitive deionization, electrodialysis metathesis, bipolar membrane electrodialysis, nanofiltration, and crystallization, pushing the boundaries of sustainable water treatment.

The theme started In 2004.

5 | Applied water physics

The emphasis of the Applied Water Physics Theme lies in the exploration of these basic properties of water, especially its interactions with electric, magnetic and electromagnetic fields, vortical flow fields, and the effect of such interactions on living organisms like bacteria. Based upon deeper insights into the fundamentals of water, the Theme furthermore focuses on screening commercially available water treatment

concepts based upon such interaction. Thereby, breakthrough discoveries through fundamental research and pioneering screening experiments with physical, chemical and biological model systems are combined to pave the way for the development of seminal, epoch making water treatment technologies. The theme started in 2007.

6 | Natural flocculants

In this theme, the focus is on developing natural alternatives for synthetic organic polymeric flocculants for the treatment of surface water or wastewater. These alternative flocculants should overcome the disadvantages of synthetic polymers: produced from scarce fossil sources, non-specific, non-biodegradable, and produce large amounts of (toxic) waste that cannot be reused in, e.g., agriculture. Mixed extracellular polymers produced by micro-organisms during biological wastewater treatment are more sustainable than synthetic polymers, and indications are that they can also give a better flocculation performance. Moreover, possibly in combination with physical separation technology such as membrane treatment, natural flocculants have a potential application to remove particles in drinking water, to produce industrial process water from fresh or saline surface and waste waters, to treat oil-containing wastewaters, to separate algae from their medium in algae cultivation systems, to assist in the retention of valuable biomass in biological wastewater treatment processes, etc. The theme started in 2004.

7 | Biofilms

Biofilms consist of cells embedded in a polymeric extracellular matrix, produced mainly by the organisms, forming the scaffold for a three-dimensional architecture that protects the microbial community from environmental and shear stresses. Biofilms are found in several environments and play both beneficial and detrimental roles depending on whether their formation is controlled or occurs naturally.

Biofilm formation is a multi-stage process resulting from the balance of several physical, chemical, and biological factors. At Wetsus, the Biofilms Theme focuses on a multi-level research approach to examine all these factors and the various technologies to characterize, monitor, and control biofilm growth. In this way, we aim to find practical solutions for industries

and a better understanding of both beneficial and detrimental forms of biofilms. In particular, elucidation of biofilm structure is a prerequisite to understanding and modeling cell mass transfer and growth within the sheltering extracellular matrix. The theme started in 2004.

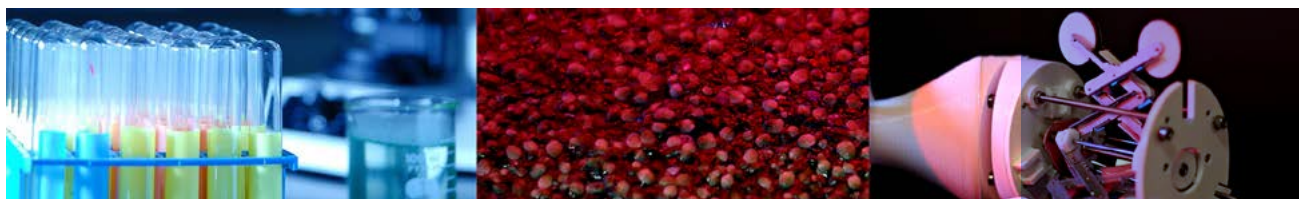
8 | Advanced coagulation for nanoparticles

Conventional water treatment processes are very well suited to remove particles. However, the smaller particles get (micro- and nanometer-sized), the harder they are to remove. Still, a significant part ends up in effluent and eventually in the environment. The chemical composition (e.g. plastic particles) and size cause these particles to be unwanted in the environment. Their small size allows uptake and accumulation in aquatic life, eventually posing a risk to human health. New technologies are urgently required to address the problem of nanoparticles and to remove them from water effectively. This theme focuses on a more sustainable approach in conventional water treatment techniques, such as coagulation/flocculation, to remove nanoparticles. We will develop enhanced

coagulation approaches to aggregate, especially the fraction of the smallest nanoparticles, allowing their effective removal through standard flocculation and floatation approaches. The theme started in 2022.

9 | Integrated PFAS treatment

Perfluoroalkyl and polyfluoroalkyl substances (PFAS) are increasingly showing up in waste streams, sparking serious concerns about their harmful effects on human health and the environment. Known for their extreme stability and resistance to biodegradation, PFAS are notoriously difficult to remove or break down in water treatment processes. This persistence makes them a major challenge, as both adsorption and degradation methods struggle to keep up. To tackle this, we're developing an innovative treatment system using novel adsorbent materials in high-throughput filters. These filters will be regenerable before PFAS breakthrough, followed by a thermal reductive process to fully mineralize the concentrated waste solution. The theme started in 2024.



Healthy environment

10 | Groundwater technology

In the Netherlands, approximately two-thirds of the drinking water is produced from groundwater. Due to the filtering capacity of the underground, the quality of groundwater is high compared to surface water. However, the quality and availability of groundwater are threatened by the emission of highly mobile organic micropollutants such as pesticides and pharmaceuticals. Additionally, freshwater aquifers near the coast face pressure from saltwater intrusion, while increased drainage and prolonged droughts reduce natural aquifer recharge.

The Groundwater technology theme develops tools to address these challenges. These include enhancing natural pollutant attenuation, distributed groundwater flow & quality sensing, and underground infrastructure such as wells and dams. The theme started in 2008.

11 | Smart water grids

The Dutch water supply network ensures high-quality drinking water through an extensive system of water mains, ranging in age from newly installed to over a century old. With a replacement value exceeding €13 billion, managing and

maintaining the network is crucial. The condition of the water mains varies significantly, with some sections leaking while others remain in excellent condition, making it difficult to assess their state accurately. Timely replacement of aging parts is essential to maintain water quality, minimize downtime, and optimize resource use.

Innovative solutions are needed to improve inspection and prediction methods. The Wetsus Smart Water Grids research focuses on developing advanced inspection technologies, such as in-line and on-line inspection methods, autonomous inspection robots, and intelligent pipes with integrated sensors. Significant progress has been made in PVC material characterization, leak detection, and data-driven insights. These advancements help predict the condition of water mains and guide maintenance decisions.

Collaboration with partners has resulted in scientifically relevant innovations, with companies like Acquaint BV and HULO BV emerging as spinoffs, ensuring practical applications in the water supply industry. The theme started in 2009.

12 | Monitoring & Quality

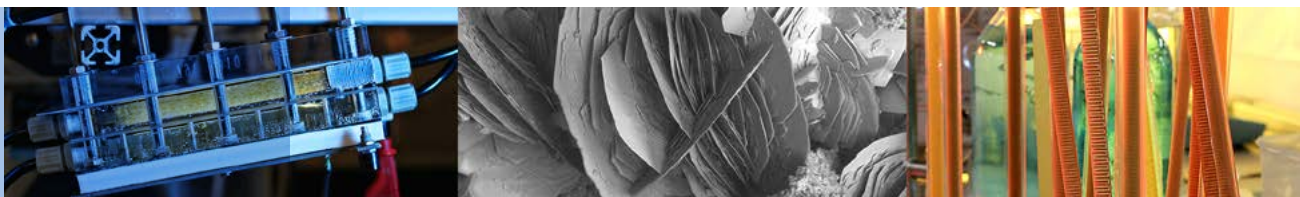
Guaranteeing the availability of clean water is crucial for human health. Continuous threats to both water quality and quantity require ongoing monitoring. Since no single method or sensor can assess all aspects of water quality, combining various sensor technologies and data integration from different sources is crucial.

A complex interplay of chemistry, biology, and physics influences water quality. While we can individually measure chemical concentration levels or biological activity, we often do not fully understand the sources or how these factors are interrelated. An integrated approach is needed to synergistically use chemical, biological, and physical water properties to comprehend

the system's complexity. Innovations in (bio) sensing technology and data fusion allow future-proof water quality assessment without an unconstrained growth in cost and data complexity. These tools are instrumental in simplifying the system's complexity.

This theme builds on previous advancements in sensor development and genomics for water quality monitoring, covering aspects like chemical and microbial composition. It focuses on various water types, including drinking water, wastewater, and surface water, while involving chemical, physical, and biological sensors, as well as data networks to enhance process control and accuracy.

The theme started in 2006.



Recovered Resources

13 | Sulfur

This theme focuses on integrated processes for removing and converting volatile sulfur compounds from aqueous solutions. These solutions are used to scrub volatile sulfur compounds from oil and gas and have a high pH and salt concentration. The process scheme consists of scrubbers and bioreactors and aims to remove all volatile sulfur compounds like sulfide and thiols (e.g., methanethiol). The water consumption of this process can become zero by treating the bleed stream, enabling the recycling of all water. The scientific disciplines needed to develop such an integrated process are chemistry, microbiology, biotechnology, and modeling. The theme started in 2011.

14 | Phosphate recovery

Phosphate is an important fertilizer needed for food production. The sources are finite, and mining and processing the ore is energy intensive and polluting. An appreciable part of the phosphate in food ends up in wastewater and manure. Currently, chemicals and energy are used to remove the phosphate from the wastewater as emissions from phosphate to the surface water is unwanted. This theme focuses on technologies to remove phosphate from wastewater in such a manner that the phosphate becomes available as fertilizer and the water will be clean. The theme will focus on expanding and improving current technology to produce more phosphate at lower costs while producing high-value products. The theme started in 2013.

15 | Resource recovery

In the Resource Recovery theme, new electrochemical technologies are developed to harvest resources from water. An example is the recovery of nitrogen from waste streams like urine and industrial wastewater in the form of ammonia converted to, e.g., ammonium sulphate. Another focus is the electrochemical harvesting of phosphate from waste streams from the dairy industry, in the form of hydroxyapatite. As a continuation of studies on microbial fuel cells and microbial electrolysis cells, the bio-anode is studied in case of intermittent control to improve the storage of energy in the biofilm. Bio-anodes can also be used for a biological cell for harvesting of ammonia.

The theme started in 2004.

16 | Biopolymers from water

Wastewater treatment most often involves using biological processes to reach effluent water quality objectives. The by-product of biological treatment is surplus biomass rich in microbial activity. Research has shown that it is possible to engineer biological treatment processes for municipal and industrial wastewater to be naturally enriched with bacteria that can store excess biopolymers. The biopolymers are from the family of polyhydroxyalkanoates (PHAs). PHAs are biodegradable thermoplastic materials that are attractive ingredients for bioplastics. The status of current know-how provides an interesting opportunity for synergy to combine water quality management services with resource

recovery and the realization of new biopolymer value chains in regional circular economies. Research in this theme is to build on and bridge fundamental bioprocess engineering and materials science with downstream commercial opportunities for platform chemicals and bioplastics. The theme is an incubator to reach optimal insights and strategies to produce value-added biopolymers for the industry in combination with the ongoing demands for increasingly more effective wastewater treatment methods. The theme started in 2017.

17 | Sustainable carbon cycle

Interest in Carbon Capture and Utilization (CCU) has been growing recently, i.e. the development

of technologies to remove CO₂ from flue gas and the atmosphere, and use the captured CO₂ as a working fluid or source of carbon. At Wetsus, the Sustainable carbon cycle theme aims to develop energy-efficient technologies to capture CO₂ from the atmosphere and from renewable sources, and convert the captured CO₂ into valuable chemicals. Our research focuses on electrochemical methods based on new electrode materials, ion exchange membranes, and new reactor designs. The SCC theme builds on the long research experience at Wetsus in the field of applied electrochemistry for salinity gradients, capacitive deionization (CDI), and energy recovery from flue gas (CO₂ energy). The theme started in 2015.



Drought Resilience

18 | Soil

Soil fertility is a central parameter in the global ecosystem, linking water, food, and nutrient flows. Soil erosion and declining soil fertility pose a significant threat to food production, freshwater availability, and carbon storage. Soil organic matter plays a vital role in the buildup of healthy soil in terms of soil structure and biological activity. To strengthen the circular economy approach, organic streams such as sewage sludge, animal manures and agricultural plant residues can recycle organic matter and nutrients back to the soil. Organic matter treatment is required to reach appropriate biochemical conditions for soil application. The scope of this theme is to define

the most suitable form of organic matter addition, the treatment necessary and the interactions between the organic matter and soil components concerning micro-organisms, organic carbon, and nutrients/minerals. The theme started in 2016.

19 | Natural water production

The theme natural water production aims to enhance precipitation and make more freshwater available. The key to enhancing precipitation is to increase evaporation and water recycling in a watershed. To make this vision a reality, a strong interdisciplinary approach is taken, including disciplines like meteorology, hydrology, forestry, and water technology. The theme started in 2019.

Social Sciences

20 | Sustainability in the making

Wetsus aims for responsible water technology innovations that strengthen a fair, sustainable and productive society. To get ahead, it is necessary to have both an excellent technological innovation base and a clear insight into the road towards these responsible innovations. This theme focuses on studying such responsible innovation roads using state-of-the-art social sciences

theories, concepts and models. Projects will focus on specific Wetsus innovations and will be tightly embedded within the Wetsus network. In this way, social sciences and public companies, end users, technology companies, and technological sciences will cooperate in providing a framework for analyzing and strengthening the responsible innovation process of Wetsus and its partners. The theme started in 2022.

Research staff of Wetsus

Research Management team



Prof.dr.ir. Cees J.N. Buisman
Member executive board
cees.buisman@wetsus.nl



Dr.ir. Jan W. Post
Program director, theme
coordinator Desalination
& Concentrates, Priority
compounds & Virus control
Drinking water technology
jan.post@wetsus.nl



Prof.dr.ir. Bert Hamelers
Science impact director
bert.hamelers@wetsus.nl



Dr. Inez Dinkla
Program manager, theme
coordinator Monitoring &
Quality
Environmental microbiology
and molecular biology
inez.dinkla@wetsus.nl



Dipl.-Ing. Dr. Elmar C. Fuchs
Program manager, theme
coordinator applied water
physics
Physical and theoretical
chemistry, experimental
physics
elmar.fuchs@wetsus.nl



Dr.ir. Roel Meulepas
Director europe, theme
coordinator groundwater
technology
Environmental biotechnology
roel.meulepas@wetsus.nl

Theme coordinators



Joris Bergman MSc
Sulfur
Biological desulfurization,
process modeling, system
identification & control
joris.bergman@wetsus.nl



Dr.ir. Maarten Biesheuvel
Advanced water treatment
Electrochemical processes,
Aquatic and physical chemistry,
Membrane transport
maarten.biesheuvel@wetsus.nl



Dr. Carlos Contreras-Davila
Natural flocculants
Resource biorecovery,
(an)aerobic fermentation
carlos.contrerasdavila@wetsus.nl



Dr. Cristina Gagliano
Biofilms
Environmental anaerobic
microbiology, fluorescence
microscopy, extracellular
polymeric substances
cristina.gagliano@wetsus.nl



Dr. Lucía Hernández Leal
Source separated sanitation
 Environmental engineering,
 decentral sanitation
lucia.hernandez@wetsus.nl



Ir. Leon Korving
Phosphate recovery
 Phosphate
leon.korving@wetsus.nl



Dr. Amanda Larasati
Integrated PFAS treatment
 Granular activated carbon
 adsorption-desorption, micro-
 pollutant removal, drinking
 water treatment
amanda.larasati@wetsus.nl



Dr. Xiaoxia Liu
Sustainability in the making
 Microbial ecology, biophysics,
 environmental engineering
xiaoxia.liu@wetsus.nl



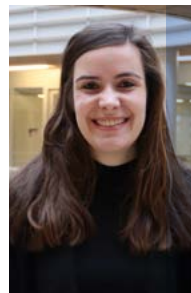
Dr.ir. Sam Rutten
*Advanced coagulation for nano
 particles*
 (Waste)water treatment,
 membrane technology,
 emerging contaminants
sam.rutten@wetsus.nl



Dr. Michel Saakes
*Resource recovery, Sustainable
 carbon cycle*
 Electrochemistry, bio-
 electrochemistry, fuel cells,
 batteries
michel.saakes@wetsus.nl



Dr.ir. Valentina Sechi
Soil
 Soil ecology, trophic
 interactions and functional
 traits
valentina.sechi@wetsus.nl



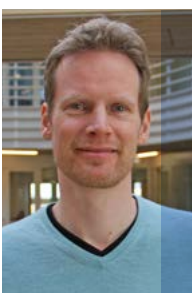
Jolanda Theeuwen MSc
Natural Water Production
 Ecohydrology, Land-
 atmosphere interactions
jolanda.theeuwen@wetsus.nl



Dr.ir. Martijn Wagterveld
Monitoring & Quality
 Crystallization, micro fluidics,
 electronics, acoustics
martijn.wagterveld@wetsus.nl

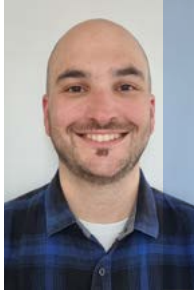


Dr. Alan Werker
Biopolymers from water
 Bioprocess and environmental
 engineering, water quality,
 mixed microbial cultures,
 polyhydroxyalkanoates,
 material science
alan.werker@wetsus.nl



Dr.ir. Doekle Yntema
Smart water grids
 Electronics, acoustics, optics,
 physics, data processing, water
 technology
doekle.yntema@wetsus.nl

Scientific project managers



Dr. Carlo Belloni
Adsorption-desorption,
phosphorus recovery, iron
oxides nanoparticles, material
science
carlo.belloni@wetsus.nl



Dr. Raquel Goncalves Barbosa
Patent coordinator
Microbial cleantech, microbial
reuse technology, nutrient
removal/recovery
raquel.barbosa@wetsus.nl



Dr. Ruben Halfwerk
Crystallization, eutectic
freeze crystallization, freeze
concentration, particle analysis
ruben.halfwerk@wetsus.nl



Dr. Philipp Kuntke
Urine treatment, nutrient
recovery, bioelectrochemical
systems
philipp.kuntke@wetsus.nl



Dr. Henk Miedema
(Biological) membrane
transport, separation
technologies
henk.miedema@wetsus.nl



Ragne Pärnamäe MSc
Ion exchange membrane
processes, water electrolysis
ragne.parnamae@wetsus.nl



Dr. Thomas Prot
Horizon Europe manager
Wastewater treatment,
phosphorus recovery, sewage
sludge
thomas.prot@wetsus.nl



Dr.ir. Chris Schott
Crystallization, nutrient
recovery, biological treatments,
anaerobic digestion, manure
treatment, water technology
in agriculture, circular use of
resources
chris.schott@wetsus.nl



Dr.ir. Tom Sleutels
Bioprocess technology, (bio-)
electrochemistry
tom.sleutels@wetsus.nl



Dr. Sara Vallejo Castaño
Chemical engineering,
up-scaling
sara.vallejocastano@wetsus.nl



Ir. Wokke Wijdeveld
Mineral processing and urban
mining
wokke.wijdeveld@wetsus.nl

Senior advisors



Dr. Angeliki Balayannis
Public participation,
transdisciplinary
methodologies, human
geography
angeliki.balayannis@wetsus.nl



Prof.dr.ir. Martijn Bezemer
Soils, microbiomes, healthy
crops, aboveground-
belowground interactions
martijn.bezemer@wetsus.nl



Ir. Robert de Kler
Energy conversion, energy
systems, dynamic system
analysis
robert.dekler@wetsus.nl



Prof.dr.ir. Louis de Smet
Organic chemistry, selective
materials
louis.desmet@wetsus.nl



Prof.dr.ir. Karel Keesman
System identification,
modelling, control, water
treatment
karel.keesman@wetsus.nl



Dr.ir. Antoine Kemperman
Membrane fouling, membrane
water treatment, membrane
bioreactors
antoine.kemperman@wetsus.nl



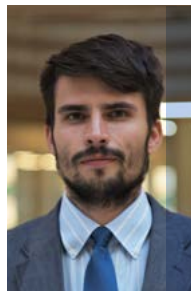
Dr. Mohamed Zakaria Hatim
Ecological modeling,
vegetation science, dryland
ecology, ecosystem restoration
zakaria.hatim@wetsus.nl



Dr. Luewton Lemos
Electrohydrodynamics,
desalination
luewton.lemos@wetsus.nl



Dr. Caroline Plugge
General and applied
microbiology of aquatic
ecosystems
caroline.plugge@wetsus.nl



Dr. Sławomir Porada
Material science,
electrochemical processes,
membranes
slawomir.porada@wetsus.nl



Prof.dr. Heike Schmitt
Antibiotic resistance
in the environment
heike.schmitt@wetsus.nl



Dr.ir. Bas Wols
UV-technology, modelling
bas.wols@wetsus.nl

Postdoctoral researchers

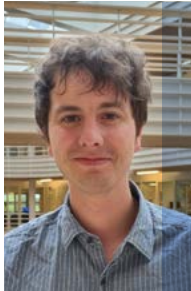


Dr. Alexander Finnegan
Microplastics and other novel
environmental pollutants,
chemical analysis, plastic
recycling
alexander.finnegan@wetsus.nl



Dr. Ahmed Mahmoud
Groundwater quality,
Micropollutant removal, nature
based water treatment, drinking
water treatment
ahmed.mahmoud@wetsus.nl

Scientific project coordinators



Dr. Ángel Velasco Sánchez
Soil health, soil bio-geo-
chemical cycles, sustainable
agriculture, phosphorus,
enzymatic activities
angel.velascosanchez@wetsus.nl



Wetsus, European centre of excellence for sustainable water technology is a facilitating intermediary for trend-setting know-how development. Wetsus creates a unique environment and strategic cooperation for development of profitable and sustainable state of the art water treatment technology. The inspiring and multidisciplinary collaboration between companies and research institutes in Wetsus results in innovations that contribute significantly to the solution of the global water problems.