wetsus

european centre of **excellence**
for sustainable **water technology**

# Businessplan 2016-2020

**combining scientific excellence with commercial relevance**

# Business Plan
# 2016-2020
(April 2016)


**Wetsus, European Centre of Excellence for Sustainable Water Technology**

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

phone: +31 (0) 58 284 30 00
e-mail: info@wetsus.nl
web: www.wetsus.eu

@wetsus  Wetsus



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- the Dutch Ministry of Infrastructure and the Environment
- the European Union (Horizon 2020 and Seventh Framework Programme)
- Northern Netherlands Provinces (REP-SNN)
- the City of Leeuwarden, the Province of Fryslân
- The Netherlands Organisation for Scientific Research (from 2017 onwards)

# 1. Executive Summary and Introduction

Wetsus, European centre of excellence for sustainable water technology facilitates breakthrough innovations for water treatment technology. This business plan describes Wetsus' strategy for the 2016-2020 period, and is the successor of the Wetsus 20013-2017 business plan. The starting points, strategy and structure of this new plan are in line with the former business plan.

This business plan is aligned with the water technology innovation contract of the Dutch Water Topsector and with the RIS3 strategy of the Northern Netherlands EU region. The research program 2016-2020 is part of the scope of the Topsector's Topconsortium for Knowhow and Innovation (TKI water technology), and has clear links with several other regional, Dutch and European policies. These policies address issues related to water availability, environment, innovation, economic development, science, inclusive growth and talent development and mobility.

## 1.1. General introduction

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, such as:

- Decrease of biodiversity (by waste water discharge, hormone disrupting substances, salination, water depletion)
- Growing shortage of water (water reuse and desalination required)
- Emission of greenhouse gasses, need for sustainable energy and energy efficiency
- Millennium Development Goals (global water and sanitation availability)
- Growing antibiotics resistance (treatment of hospital water)
- Depletion of raw materials (recycling of metals and minerals from water required)

### Wetsus approach

Wetsus is a facilitating intermediary for trend-setting know-how development and acts as the EU centre of excellence for water treatment technology. Wetsus creates a unique environment and strategic cooperation for development of profitable and sustainable state of the art water treatment technology. Wetsus' main activity is the coordination of a world leading research program. 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. At this moment (2016), more than 100 companies annually invest some € 3.3 million in the demand driven € 14 million/year research program, with a long term commitment.

Wetsus, a not-for-profit foundation, acts as Technological Top Institute for Water Technology and is located in Leeuwarden, The Netherlands. Innovation, partnership, reliability, joy and cooperation are the values around which all Wetsus' activities are performed. Wetsus acts as an open consortium for companies and research institutes. Wetsus' scientific research program is defined by the private and public water sector and conducted by leading universities. A dedicated Intellectual Property Rights policy is in place, to enable optimal innovation, cooperation and the commercialization thereof.

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
- Pooling of multidisciplinary knowledge from universities and companies
- Strong involvement of SME's from all over Europe
- Independent meeting place for scientists from all over Europe

In addition to Wetsus' research role, Wetsus also fulfills several other 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. 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. The Wetsus approach is described in more detail in chapter 2.

## 1.2. Business plan 2016-2020

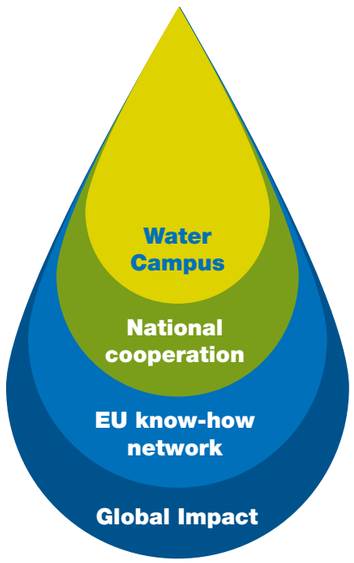
The success, promise and structure of Wetsus' activities performed in the years since its start in 2003 and, more particularly, the 2013-2017 business plan are the basis for the continuation for the 2016-2020 period. The ambition is to continue with the existing strategy, structure and approach in order to expand the international know-how network and to further extend the global impact of the the research program.

In this business plan the structure and strategy of the new research program and related activities, which together will form the basis of the EU water technology knowledge network, are described.

### Activities

The heart of Wetsus' activities is the execution of the TTI research program. This demand driven scientific program is part of the water technology innovation contract of the Dutch Water Topsector. Besides its role in this national innovation strategy, Wetsus is active in several international programs (Horizon2020, EIT, COSME, Interreg, European Fund for Regional Development) for international research cooperation.
As described in chapter 5, the research program is split up in 22 themes in which the participating companies determine the focus.

To a lesser extent, programs to stimulate clustering and economical development (European Fund for Regional Development, Regional spatial Economical Program REP) are used by Wetsus for stimulation of the growth and effectiveness of a water technology knowledge focal point around its Leeuwarden premises, WaterCampus Leeuwarden. Wetsus combines a campus approach with an international know-how network strategy (see figure). This way, Wetsus creates synergy in regional, national and EU policy on innovation and economical development.




### International commitment

Wetsus' current 101 company participants and 21 know-how institute participants (status March 2016) all have signed contracts with running commitments and will also participate in the continued research program. This way, the required company funding for the new program is already committed. Further, the intention is to increase this network, especially with participants from the international business and scientific community. As described in chapter 6, together with its participants Wetsus is increasingly active in EU research programs. These EU projects are the basis of Wetsus' recognition as the EU centre of excellence in water treatment technology, both as knowledge network and as know-how campus.

The envisaged funding of Wetsus for the 2016-2020 period is summarized in the below table. Chapter 7 provides further insight in the financial and organisational aspects of this business plan.

### Wetsus funding 2016–2020 (in million €)

| | average per year | total 2016–2020 |
|---|---|---|
| Companies and universities | 5,75 | 28,75 |
| Ministry of Infrastructure and Environment | 0,5 | 2,5 |
| Ministry of Economical Affairs | 1,05 | 5,25 |
| REP subsidy (research, through Northern Netherlands) | 4,75 | 23,75 |
| Regional authorities (research infrastructure) | 1 | 5 |
| European Union (FP7, Horizon 20) | 1,75 | 8,75 |
| NWO (from 2017 onwards) | 0,5 | 2 |
| **total** | **15,3** | **76** |

### Outcome and impact

The return on investment from this business plan will be a world leading position for the EU in water treatment technology, both for the know-how institutes and for the companies (chapter 8). Parties will cooperate in a unique high trust and high commitment know-how network. At the same time, the resulting technologies will constitute a significant contribution to the solution of the global water crisis.

The worldwide water technology business is estimated at € 500 billion per year, with a growth of more than 10% per year. The developed know-how in Wetsus will put the involved part of the water sector in a very competitive position on the global market place.

The envisaged Wetsus program will lead to 90 patents, 25 new technologies and 35 new companies in 2020. More than € 75 million will directly be invested in research at Wetsus. A multiplier of this amount is expected to be invested in research and development at the participating companies for the valorization of the results. Also a significant venture capital investment is envisaged. All this will lead to new and sustainable solutions for the global societal water problems. This will not only lead to improved quality and availability of water resources, but also to significant new business for the water sector.

Multidisciplinary research is difficult to organize. Wetsus invites researchers (for PhD projects of 4 years) from different disciplines to work together in one geographical location, WaterCampus Leeuwarden. This way, people from different backgrounds learn to work multidisciplinary. The graduated Wetsus PhD's will therefore be among the most multidisciplinary scientists in the world. Further, due to the fact that companies are well integrated in the research program, the graduated PhD's will also have a clear industry orientation.

By working with leading chairs in Europe, this multidisciplinary approach will lead to top research. The citation impact of the Wetsus program until 2015 was 2.4 which is of world class level. Wetsus aims for a very high scientific impact and therefore the citation impact objective of the new program is at least 1.5 times better than the world average, based on more than 700 produced scientific papers.

Wetsus' initiative will liberate enough impact, connectedness, synergy, talent and research investments to become the world's number 1 in water technology.

# 2. The Wetsus Approach

## 2.1. Introduction

In line with the EU's RIS3 strategy, Wetsus combines a campus approach with an international know-how network strategy. In the campus, multidisciplinary know-how and talent are concentrated and facilities are shared. In the Wetsus international know-how network, 150 partners from all over the world, but with an emphasis on the EU, join forces on solving the global water problems.

As part of the Dutch Topsector Water approach, within 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 application-oriented, four-year-long research projects carried out by PhD students and their supervisors. Wetsus is a not-for-profit foundation and is formed after the model for Technological Top Institutes of the Dutch Ministry of Economic Affairs. Wetsus combines scientific excellence with commercial relevance, which ultimately results in successful innovations.

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
- Pooling of multidisciplinary knowledge from universities and companies
- Strong involvement of SME's from all over Europe
- Independent meeting place for scientists from all over Europe

Cooperation is the key word in Wetsus. Wetsus acts as an open consortium for companies and research institutes. Companies and scientific institutes together constitute the participant network that Wetsus actually is. Companies, assembled in a research theme, together determine a research program, which is executed by the involved research institutes.


To increase multidisciplinary cooperation, the research is done in Wetsus' dedicated laboratory at WaterCampus Leeuwarden. A dedicated IPR policy, in which the interests of all involved parties are respected and which encourages commercial application of the inventions in society, is already successfully applied in Wetsus' current program and will also be used for the new activities.

While societal problems inspire research institutes to new insights, Wetsus' vision is that entrepreneurship will introduce new technologies into society in the most efficient way.

Wetsus' activities are split up in 3 fields of attention, as summarized in the below figure. In the following paragraphs the strategy around these functions is described.



## 2.2. Research

### Research approach

At the World Economic Forum in Davos (2006), water scarcity was recognized as the most threatening problem for mankind. The world requires solutions for new and growing existing problems in the availability and quality of water for personal, agricultural, industrial use and nature. At the same time, the focus must be on sustainable solutions for these problems requiring less energy, reuse of valuable minerals and metals and low or no production of greenhouse gasses. So, more available water with a lower environmental footprint.

Traditional civil engineering solutions will not be able to provide solutions for these challenges that our society faces now and in the future. New water process technology will be necessary to develop new concepts to treat waste water and to produce clean water from alternative sources like salt (sea) water, waste water or humid air to minimize the use of precious groundwater.

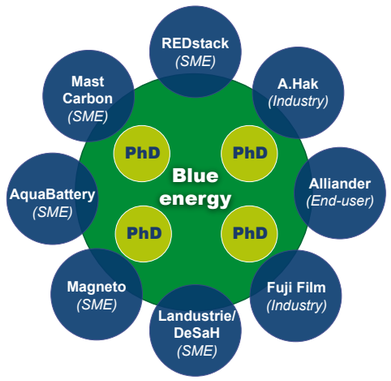
The research objective of Wetsus is to develop sustainable water technology. In our vision, this technology must be:
- Based on process technology
- A potential breakthrough solution
- Emission free
- Part of an endless cycle (natural technology, cradle to cradle)
- Introduced into society by entrepreneurs

The combination of biological and chemical conversion technology with separation technology, high tech systems and new materials has high potential to develop important innovations in water technology, especially if researchers work in close collaboration, preferably at a single location. In Wetsus, scientific expertise from different knowledge institutes in Europe is combined, leading to a bundling of monodisciplinary science into a world leading multidisciplinary research program on water technology. The critical mass of this program is concentrated in Wetsus' multidisciplinary laboratory.

### Demand driven cooperation model and participation forms

Since its start in 2003, Wetsus has shown that its strategy to operate as a demand driven organization in which scientific excellence is combined with commercial relevance is successful. The research program will continue to be defined by the involved industrial partners, in consultation with, and carried out by excellent academic groups. This set-up guarantees an industrially relevant, multidisciplinary scientific research program focused on breakthroughs.

The research program is divided in themes, which essentially are Intellectual Property-clusters. Typically, per theme some 8 companies and 4 universities cooperate. The program is idea-based; the ideas are ranked by the involved companies. 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.




*Example of company involvement in a Wetsus research theme: Blue energy*

In the Wetsus cooperation model, a distinction is made between company and know-how institute participants, as described below. For the available participation forms dedicated model agreements for cooperation in the Wetsus program are available.
All participants have free access to the following services offered by Wetsus:

- Early access to all Wetsus' scientific publications
- Membership of an exclusive water technology network containing specialists from 125 partners (2016 status; in 2017 150 partners)
- Dedicated workshops
- Admission to internal (closed) conferences
- Free access to Wetsus' public congresses

Specific IP rights for each participation form are part of the Wetsus IPR regulations (see below).

### *Company participants*

Companies participate in Wetsus per research theme. Knowledge, which results from pre-competitive research funded by these participants, is implemented commercially by the participants and is made accessible to third parties through patents and scientific publications.

The participating commercial and research organizations (status March 2016) are listed in appendix 1. 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 emphatically not limited to Dutch companies. As per 2016, companies from Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Israel, Japan, Monaco, Norway, Saudi Arabia, Spain, UK, USA and the Netherlands participate. Some 26% of the participants are from outside the Netherlands (March 2016). Much attention will be given to further internationalization, particularly in Europe, in the coming years (chapter 6).

As per 2016, the following rates apply for participation (these rates are subject to inflation correction):
Company Participants: € 27,500/theme/year
Company Participants, turnover of less than € 3 million/year: € 16,500/theme/year

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. They have indirect access to the intellectual property of Wetsus (to patents that are not transferred to relevant theme participants) and a privileged position with respect to information. Each 'regular' company participant automatically is a platform participant. The 2016 annual rate (subject to inflation correction) for platform participation ranges from € 3,300 (company turnover < € 1.5 million/year) to € 7,700 (turnover < € 3 million) to € 11,000 (turnover > € 3 million).

### *Know-how institute participants*

The involved know-how institutes conduct the actual research. Leading research chairs from various European universities are invited for this purpose. This results in a very multidisciplinary and excellent scientific workforce with a clear focus. The research is mainly performed by PhD students, who are recruited from all over Europe. Access to research facilities of 21 research institutes and a very large scientific network are important added advantages of this approach.

As per 2016, 55 scientific chairs from 21 know-how institutes from 9 countries participate. The strategy is to maintain this network of EU chairs and to further increase its relevance and impact.

## Intellectual Property policy

The Wetsus research program is divided in themes, which essentially are Intellectual Property clusters. Companies pay an annual participation fee per theme, which gives them the right to define the program (as a group with the other theme companies) and to use a shared right of first refusal on the results of the research.

## IP-starting points

The Intellectual Property regulations of Wetsus aim to effectively transfer the developed know-how to the involved companies and to let the involved know-how institutes benefit from that in a reasonable manner. An equilibrium between the interests of companies, entrepreneurs, know-how institutes and governmental bodies has been found. The IP-regulations are based upon the following starting points:

- All inventions are done by know-how institutes.
- Patents will be filed by and paid for by Wetsus, as intermediary between the companies and know-how institutes.
- Wetsus hence offers the patents to the involved company participants. For commercial use, a capped success fee (or royalty), related to the market value of the invention, is paid to Wetsus.
- If none of the entitled company participants is interested, the patent can be offered by Wetsus to third parties.
- Earned success fees will be divided 50/50 between Wetsus and the know-how institute that did the actual invention. The know-how institutes can transfer (part of) their earnings to the inventing scientist(s). Wetsus' revenues in this regard are reinvested in the research program.
- For participating public companies, such as water boards and drinking water companies, a 'group-participation' cooperation form is offered. Members of these groups cannot obtain commercialization rights on patents, but can apply the inventions in-house royalty-free.
- All developed know-how will be made public, either through scientific publications or through patenting.

## IP regulations

Based on these principles, IP-Regulations have been set up. The regulations have been approved by the Dutch ministry of Economic Affairs and comply with the Dutch VSNU-code (for universities) and with the fair competition rules of the EU. In these regulations, validated by Professor Dick van Engelen (a law professor in Technology Transfer at the University of Utrecht) appointments and procedures are laid down between all involved parties in Wetsus for the following fields:

- Patenting procedures
- Rights and ownership of research results
- Use and commercial exploitation of research results
- Acquiring and licensing of patents
- Patent validation
- Publication of research results
- Background know-how
- Entry/exit rules for partners
- Confidentiality
- Dispute resolution board

The Wetsus executive board is responsible for proper implementation of the above regulations and acts as IP-Board. In case of a dispute between a partner and the executive board, a dispute resolution board can be installed by the Wetsus supervisory board.

## 2.3. Entrepreneurship and Valorization

A stimulating climate for collaboration and innovation in the water sector is created around the research program. 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. In this respect, much attention is given to the stimulation of international networks, business development support, the proximity of test facilities, proper business education, availability of venture capital and other facilitation of start-ups. The Innovation Ecosystem around Wetsus is described in more detail in chapter 3.

### Involvement of SME's

To optimize the innovation chain efficiency, Wetsus strives for involvement of multinationals, public companies (typically end users), start-up companies, and SME's (typically technology launchers) in the research themes. Together with the variety of excellent scientific chairs involved, this results in a unique know-how network.

Public companies for drinking water and waste water play a crucial role in the innovation chain. In the IPR rules special provisions for public companies stimulate these parties to join the collaboration.

To stimulate the involvement of smaller companies, several measures are in place:

- Companies with a turn-over of € 3 million and less get a discount on the participation fee.
- In a theme, each company participant, large or small, has an equal vote. This creates equality, trust and respect.
- Demonstration sites and other test facilities in the vicinity of the Wetsus research laboratory on WaterCampus Leeuwarden have been realized. Here, technologies can be tested, scaled up and demonstrated to potential customers. This is a significant facilitation of the SME's in this crucial phase of innovation.

As a result, in 2016 57% of the companies that have joined the collaboration with a rolling financial commitment can be qualified as SME. The entrepreneurial climate in the research has and will lead to many market introductions of new technology, but also to the formation of spin-off companies and joint ventures between theme participants.

## 2.4. Human Capital and Education

Human capital is a basic condition to guarantee the success and continuity of the development of sustainable technologies and a European know-how economy in water technology. In many EU countries the lack of talented technological professionals is becoming an increasingly limiting factor, also for the water technology sector.

The Wetsus strategy is to perform a series of interlinked activities that will contribute to the growth of the number of young professionals for the international community and a strong mobility of knowledge-workers for the European labour market. These activities will make the WaterCampus a meeting place for master and PhD-students and their professors from all over the European Union. A place where water technology minds meet and inspire each other.

Activities in the field of education are the dedicated support of professional BSc schools ('Dutch HBO', with lectors and support of demand driven applied research projects), the Wetsus Academy (MSc water process technology) and the education of multidisciplinary PhD's.
To make youngsters enthusiastic about a water technology career, dedicated talent programs are carried out at primary and secondary schools. These programs are run in close cooperation with the companies and universities participating in Wetsus.

The above activities are further described in chapter 4.

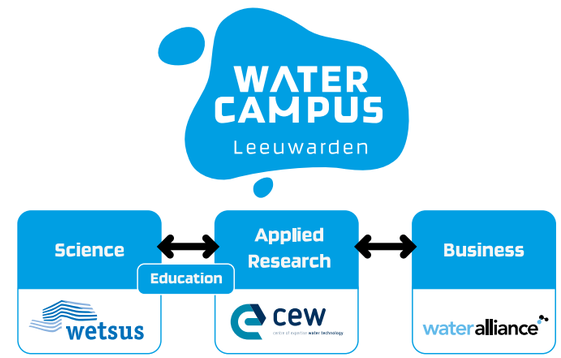


# 3. Innovation Ecosystem: Entrepreneurship and Valorization

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.

## 3.1. 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 capital of the Dutch province Fryslân. This province is characterized by a relatively high density of independently owned and globally exporting water companies. Together with the relevant commercial, educational and governmental organizations, in particular Water Alliance (www.wateralliance.nl) and the Centre of Expertise Water technology (CEW), Wetsus drives the development of WaterCampus Leeuwarden (www.WaterCampus.nl). This campus increasingly acts as the European hub for water technology and hosts a concentration of commercial, educational and scientific activities in the field of water technology, providing synergy in the shape of natural joint ventures, new creativity and facility sharing.




## 3.2. Education, applied research and SME collaboration

The Centre of Expertise Watertechnology (CEW; www.cew-leeuwarden.nl) has started in 2011 on WaterCampus Leeuwarden as a centre for knowledge and innovation in water technology. CEW is a unique collaboration between the Dutch government (Ministries of Education and Economical Affairs), education (Van Hall Larenstein and NHL, Leeuwarden based BSc universities of applied sciences) and business in the water sector. CEW is specially intended to increase the research cooperation between SME's and Universities of Applied Sciences with an emphasis on valorization research. CEW forms in that sense a valuable contribution in the knowledge chain from inventions to innovations (www.cew-leeuwarden.nl; or contact Gerard Adema: q.g.adema@cew-leeuwarden.nl).

In addition, the 'Centrum voor Innovatief Vakmanschap Water–CIV Water' (www.civ-water.nl) 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.

## 3.3. Shared Demonstration Sites and Facilities

For larger scale research and demonstration activities, it is economically not feasible to transport large quantities of specific water to a laboratory. To arrange 'On site' testing at the location where the water is available however, is often time- and money consuming (foundation and piping must be prepared, permits have to be arranged, etc.), if at all possible.

To overcome this bottleneck in the innovation chain, Wetsus, together with Water Alliance, facilitates the realization of unique demonstration sites where new concepts can be scaled up, tested and demonstrated. The sites have been and will be realized in a radius of 50 km around the Wetsus laboratory. The possibility for companies to test and demonstrate new technology at specially prepared sites in the immediate vicinity of Wetsus and its researchers accelerates the introduction of new technology considerably and is a good example of the synergy that is created by geographic clustering.
Some examples:

- 'Wetsalt' demosite sea water desalination and blue energy at Frisia Zout, Harlingen (2007). Contact: www.wetsalt.nl or heleen.sombekke@wetsus.nl
- Vitens Innovation Playground in Noardburgum for research on water distribution systems (2011; contact: erik.driessen@vitens.nl) and drinking water technology (2010; contact: bas.rietman@vitens.nl)
- 'Sentec' demonstration site water quality sensoring in Glimmen (2010). Contact: h.prummel@wln.nl
- Demonstration site sewage water in Leeuwarden (2010). Contact: yvanderkooij@wetterskipfryslan.nl
- Demonstration site hospital waste water in Sneek (2014). Contact: a.vanscheltinga@gemeenteswf.nl




Further, the Water Application Centre for bench scale testing, available for commercial companies, has been developed in cooperation with van Hall Larenstein (university of applied sciences) and local water companies (www.waterapplicatiecentrum.nl). This centre, WAC, has opened its doors in 2013.

wac water application centre

### 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. Wetsus and WaterCampus have proven to be a magnet for new watercompanies. The continuous strive of Wetsus and WaterCampus Leeuwarden to stimulate the translation of know-how into business has resulted in the start of 27 spin-off companies and in various scale-up and demonstration projects for breakthrough technological concepts. Below an overview of these spin-offs is provided.
In the Netherlands as a whole, 110 new water technology companies have started their business in the 2000- 2015 period. Of those 110 companies, 27 are Wetsus spin-offs, and 66 have direct ties with Wetsus and/or WaterCampus Leeuwarden.



Wetsus and WaterCampus Leeuwarden enable start-ups and SME's in several ways:

- Matchmaking and access to the Wetsus know-how network (with partners, end users and universities)
- Creating an innovative and entrepreneurial environment
- Facilitation the access to seed and venture capital in a dedicated way for the water sector
- Working closely with organizations like Bison, BeStart, NWP, Water Alliance and Syntens. Entrepreneurs or inventors with early business ideas can be supported by these organizations. Bison supplies coaching and pre-seed capital
- Organizing business education (MBA and business challenge, as described in next chapter) and co-offering the BeStart business accelerator program
- Supporting an incubator for spin-off's from Wetsus and universities and for other small water technology companies. This incubator, located in the direct vicinity of the Wetsus laboratories, has opened its doors in 2009
- Facilitation of research infrastructure; access to demo sites
- By stimulating the creation of joint-ventures for the further development, scale-up and commercial implementation of new technology

BeStart BOOSTING CLEANTECH

### Wetsus spin-off companies

| | |
|---|---|
| • REDstack | • Automatic Electric Europe Special Products |
| • DeSaH | • HydrOwashr |
| • Westt | • Salttech |
| • Aqua Explorer | • Biotrack |
| • Dutch Rainmaker | • TailTec |
| • EasyMeasure | • ExtIns Technologies |
| • Water ProMaSys | • Aiforo |
| • Capilix | • Duplaco |
| • Pure Green | • Somut |
| • Smart Frequencies | • Wisect |
| • Water Waves | • Djipper |
| • Metal Membranes | • High Voltage Water |
| • AquaBattery | • NewAna |
| • Izer | |

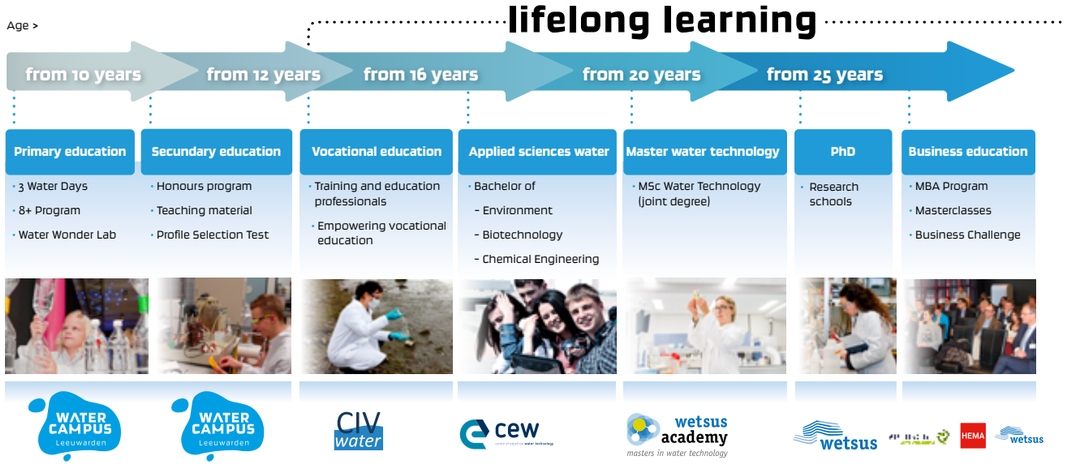
## 3.4. Financial Facilitation

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. 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 innovate propositions.
Frequently Wetsus and other WaterCampus partners welcome visitors from all over the world with a water technology investment interest. This has led and will continue to lead to an interesting network of financiers and technology suppliers, which subsequently results in several real finance successes.

# 4. Human Capital and Education

In the field of human capital and education, Wetsus performs several activities that will result in a meeting place for master and PhD-students and their professors from all over the European Union. A place where water technology minds meet and inspire each other. The activities are split up in 4 main fields of attention: WaterCampus Talent program, BSc-school support, Wetsus Academy and Business Education, which are described below.

In the education and talent fields, Wetsus closely cooperates with the other actors in WaterCampus Leeuwarden and with national organisations. Our activities in this regard are summarized in the below scheme.




## 4.1. WaterCampus Talent Program

Together with its partners in WaterCampus Leeuwarden, Wetsus is dedicated to play an important role in the inspiration of young people to choose for an innovative or entrepreneurial career in which they can help solve the global water problems.

### Primary education

- **Water professor**; new theoretical ideas and empirical research show 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. More than 700 schools have already been visited by the 'Water Professor'.
- **Excellent program**; a unique course that offers 4 lessons which are adapted to the level of highly gifted students. The kids are challenged to solve world water problems, using technology.

### Secondary education

Together with teachers, researchers and companies, the Talent Program translates water technology to a level that allows young people to discover its impact and how it is applied in the sector. The result of this cooperation has led to the development of teaching material and a variety of programs, such as:

- **Honors Program**; a selected group of students is invited to work on their own research at Wetsus, supported by a team of Wetsus researchers. The young researchers qualify for participation in an international Science Fair.
- **Practical courses water**; each month a practical course 'water technology' is organized for 2nd grade students. The courses encourages research skills, cooperation, accuracy, 'out of the box thinking' and taking initiative.

## 4.2. BSc Water Technology

Wetsus cooperates with 5 BSc schools (Dutch HBO) in the Netherlands that have a major in water treatment: Van Hall Larenstein, HAS Den Bosch, Hogeschool Zeeland, Noordelijke Hogeschool Leeuwarden and Saxion Hogeschool. Wetsus supports these BSc-schools and their water technology lectors in several ways, in order to help them continuously improve the curriculum, to connect them with the sector and to enable them to attract more and better students.

**Paul van Eijk**
*Lector Sustainable Water Systems*
*Hogeschool VHL*
paul.vaneijk@wur.nl

**Harry Futselaar**
*Lector International Water Technology*
*Saxion University of Applied Sciences*
h.futselaar@saxion.nl

**Luewton Lemos F. Agostinho**
*Lector Water Technology*
*NHL Hogeschool*
luewton.agostinho@wur.nl

**Niels Groot**
*Lector Water Technology HZ University of Applied Science Delta Academy*
niels.groot@hz.nl

## 4.3. European MSc Water Technology: Wetsus Academy

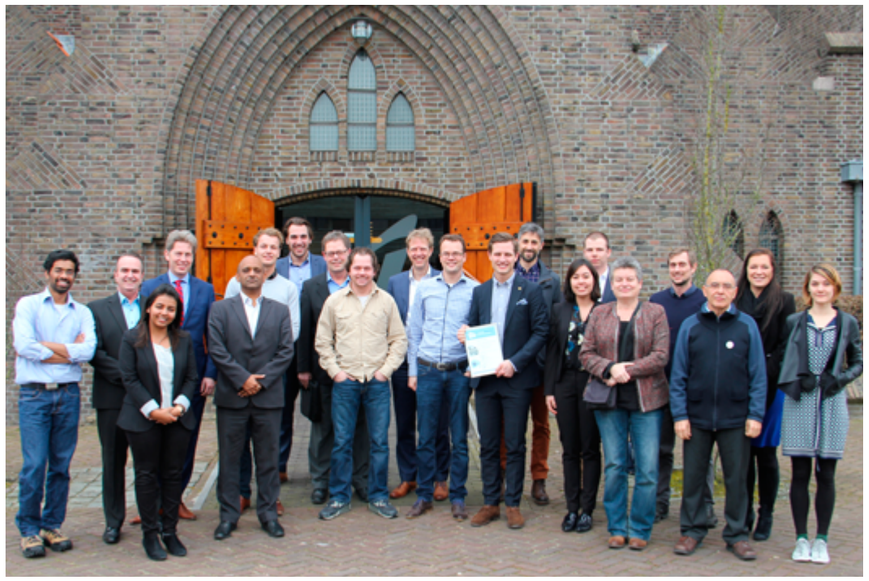
Wetsus offers an internationally unique master program in water treatment technology. Wageningen University, University of Twente and the University of Groningen started in 2008, in co-operation with Wetsus, a new master track Water Technology in order to combine research and education. In 2013 the involved universities and Wetsus have formally changed the mastertrack into a master program Water Technology with a joint degree. This way, Wetsus' research program is used simultaneously to educate new talents in the field of water technology.

Typically, the attended bachelor programs of the participating students are based on one discipline. The master program is based on multiple disciplines and thus requires a high level of (new) interdisciplinary knowledge assimilation and inquisitiveness from the student. Therefore, student recruitment emphasizes on quality (talent) more than quantity (number). Students register at Wageningen University, and will hence automatically be registered at the two other universities. After successful completion of the master program, students receive a joint MSc degree from the three universities.

## 4.4. Business Education

Together with Empower People, SkillsTown and Lemniscaat School of Management, Wetsus launched an Executive Water MBA program and a series of masterclasses that combines management issues with important water themes.
The international water sector is facing several technical and societal challenges, such as climate change, water scarcity, environmental pollution, aging population, aging infrastructure and urbanization / mega cities. These challenges require multidisciplinary solutions. The future water managers therefore require more than just technical skills. The eMBA program addresses those needs and is tailored to the water technology sector.

The European WaterCampus Business Challenge is a training program on water entrepreneurship, intended for students and experienced professionals. This challenge is organized annually in close cooperation with entrepreneurs and specialist from the international water sector (partners include Deloitte and O2 Environmental). During 5 days, participants workout their draft business plan into a potential commercial one, ready for launching a (new)water product or service on (new) markets. Participants interact with successful innovative technology providers, professional financiers and CEO's of water technology companies, who share their experiences with them.



*The European WaterCampus Business Challenge 2016 participants*



# 5. Research

Wetsus focuses on research and development of entirely new concepts and on breakthrough improvements of existing technology. In both cases, an entirely new approach has been chosen whereby the basic principle is always the integration of various knowledge disciplines. In addition to collaboration between industry and universities, there is also unique scientific collaboration within Wetsus. Many scientific chairs from multiple scientific disciplines cooperate in the program. Leading researchers from various universities and other research institutes can physically work side-by-side in the Wetsus laboratory. This unique collaboration brings synergy and new creativity to the search for new sustainable water treatment technology.

## 5.1. Research area and scientific focus

The research goal of Wetsus is to develop innovative and sustainable water technologies. Combining biological and chemical conversion technology with separation technology and new materials has high potential to develop important innovations in water technology especially if researchers work in close collaboration in one laboratory.

Despite the enormous importance of water technology for society it is not a focal point of most academic research groups. The expertise in various research groups is usually used for other processes and only later adapted for water treatment in spin-off projects. Within Wetsus the scientific expertise of different European knowledge institutes is pooled, leading to a bundling of monodisciplinary science and resulting in a world-leading multidisciplinary research program on water technology.

In the program, in which 55 professors are connected (2016 status), the focus is on the following five main research areas in clean water production and waste water treatment:

1. New water sources
2. Sustainable water supply
3. Waste water treatment and reuse
4. Reuse and production of components and energy from water
5. Detection of pathogens and micro/nano pollutants

The program is further organized in and defined by 22 research themes (2016 status). These themes are clusters of participating companies and knowledge institutes, which together define and closely follow the research program. The research themes meet several times per year. On average, one new research theme is started each year, and also annually one research theme is ended.

## 5.2. Research theme organization

Research is performed within the research themes where participating companies determine the focus of the research projects. A company is contractually linked to one or more themes. Only in these themes, the companies have influence on the research program and access to the intellectual property. Knowledge institutes are invited within these research themes to execute the research. Together, the companies and universities comprise the theme team.

Wetsus takes care of a balanced research program within the themes and ensures the scientific excellence of the research projects.

A theme manager, from industry, is appointed for each research theme. Wetsus appoints a theme coordinator for each theme, typically taking care of the theme organization, communication with the theme participants and supervision on research.  The organization is schematically depicted in figure 5.1.

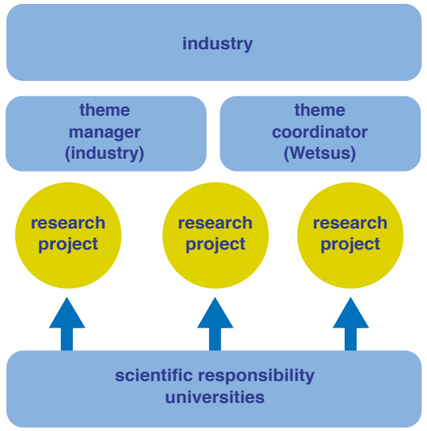



*Figure 5.1: Structure of a research theme*

The PhD-researchers executing the research projects are in principle employed by the involved know-how institutes and full time seconded in the multidisciplinary Wetsus laboratory in Leeuwarden. All PhD-students are supervised by their professor and other relevant university staff. To each PhD researcher active in the Wetsus laboratory, a daily supervisor (PhD mentor, or PhD coach) is assigned from the Wetsus scientific staff. Often this is the same person as the theme coordinator of the theme where the PhD researcher performs his research in.

All themes meet at least three times a year. In these theme meetings the progress of the research is discussed with all the participating companies and knowledge institutes. In these meetings, PhD-students and postdoctoral researchers present their results.

## Project definition

Research projects are defined within a research theme during an idea driven iterative process between the participating commercial parties and invited academic researchers. This leads to a clear business orientation combined with excellent academic quality of the research activities. The company members of the relevant research theme evaluate and rank the generated ideas on their commercial and scientific relevance. For high ranked ideas, a project proposal will be written by the knowledge institutes. The final project proposal is evaluated by the management board and by an independent program council. The program council, consisting of independent experts from the field, advices the management board on the project proposal based upon three pre-defined criteria:

- Scientific quality
- Innovation potential
- Composition of research team

Based upon the program council's advice, the management board decides on acceptance of the proposal after evaluation of its strategic fit in the program and its financial feasibility.

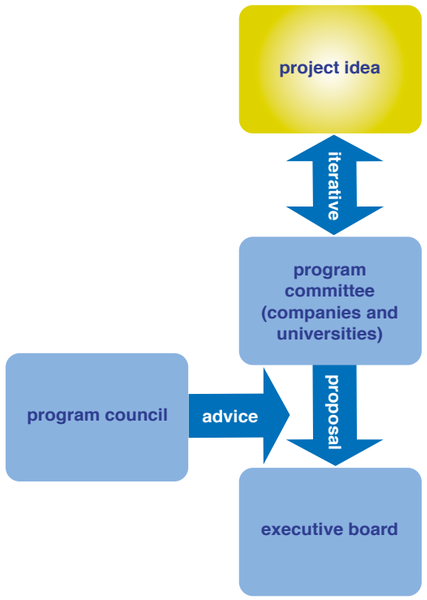



*Figure 5.2: Schematic representation of the assessment of project proposals*



# 5.3. Research program

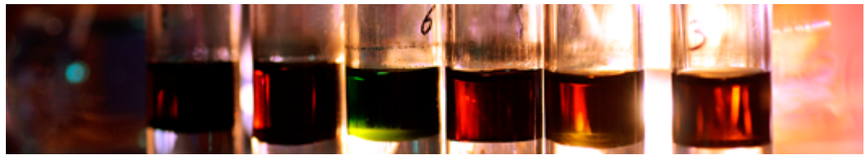
The research program for 2016-2020 is defined in 22 research themes, which are described in more detail in the following pages.

## 1 | Desalination

To face the current and future demands for fresh water and water reuse, sustainable desalination of seawater and treatment of groundwater and wastewater is required. New technology is needed, with the capacity to remove the salts and to recover them in a reusable form. Low energy use and prevention of harmful chemical discharge are further demands for sustainable desalination. In this theme, the focus is on the development of desalination technologies for sea water, brackish water and waste water. In this theme, several desalination technologies are applied and combined together, such as electrochemistry, supercritical water, crystallization, membrane separation, and adsorption in for instance ionic liquids. Theme started: 2004.

## 2 | Capacitive deionization

Capacitive electrosorption with activated carbon electrodes is a new and promising technique that has important advantages when compared to existing techniques for removing salts from water. Capacitive deionization combines a high salt removal efficiency with low use of energy, virtually no chemical requirement and simple and robust operation. In this theme this technology is further developed. Theme started: 2004.



## 3 | Priority compounds

Cost effective and non-specific UV degradation of priority compounds into harmless products is the main focus of this theme. The effect of UV lamps with different emission spectra will be studied upon the (geno-)toxicological effect of the degradation products. New technologies that enhance the effectiveness and/or lower the amount of toxic byproducts of UV technology by removing interfering compounds (e.g. natural organic compounds) are developed as well. Theme started: 2010.

## 4 | Applied water physics

The emphasis in this theme is on the physical interaction of water with external signals. For instance, application of a high electrical potential difference between two closely located glass beakers filled with de-ionized water leads to the formation of a socalled "floating waterbridge". The physical principles that can describe this phenomenon are studied using advanced measurements (ultrafast fluorescence spectroscopy, neutron scattering, high-speed video imaging and analysis). The effect of other water treatment concepts that are based on physical interaction technology are further investigated in physical, chemical and biological model systems that have practical relevance. Any proven effect of the new water treatment concepts on the behavior of the model systems may result in new insights and (new) breakthrough technologies. Theme started: 2007.

## 5 | Smart Water Grids

The network of drinking-water pipelines in the Western world is very extensive. However, it varies in age and many different materials and laying methods have been used. Generally the condition of the network is hard to gauge because it is underground. New technologies are vital to allow inspection of the condition of pipelines and appendages at low cost. Developments such as (ultrasonic) sound, magnetic wave and radar technologies are very relevant. The ambition for this theme is to develop methods for the in-line and on-line inspection of pipelines, to make well-founded decisions about the possible replacement of pipelines. Theme started: 2009.

## 6 | Virus Control

Many different household water treatment and safe storage (HWTSS) systems have been developed for low-income consumers to produce drinking water of acceptable microbiological quality and to maintain this quality during storage and use. However these HWTSS systems are not very effective

in removing or inactivating wide varieties of enteric viruses. These viruses are major agents of infectious diseases such as gastroenteritis. The goal within this theme is to develop effective and efficient treatment processes to produce safe and virus free drinking water. Membrane technologies, oxidation technologies, UV disinfection as well as adsorption technologies are potential techniques to achieve this. The mechanism of virus inactivation, damage and removal by these treatment technologies needs to be elucidated not only for model organisms (M2S bacteriophages) but also for human pathogenic viruses. The gained knowledge will allow the development of effective, controllable and affordable treatment processes. Theme started: 2009.

## 7 | Ground Water Technology

Our drinking water springs from the natural system of ground and surface water and extracting water from usable underground freshwater supplies is very important. Innovative research is needed to improve current operations but also gives bidding opportunities for the international market. An important reason to develop smart concepts for the development of the underground is the increasing pressure on available space. Theme started: 2008.

## 8 | Biofouling

In order to produce safe and healthy water, membrane filtration is often applied in water treatment. Biofouling is the accumulation and growth of micro-organisms on the membrane surface, leading to an increase in the required feed pressure. In case no pretreatment is installed, severe fouling may occur when applying nanofiltration and reverse osmosis in surface water and wastewater treatment. This may result in a reduced production capacity and/or a frequent membrane cleaning. In all cases, the consequence is an increase in costs per amount of produced or treated water.

The challenge of the research within Wetsus is to develop membrane systems that are less susceptible to biofouling. This may lead to the development of chemical biofouling inhibitors, adapted operational conditions or new membrane module designs. Current research projects are based on the concept of nutrient limitation to control biofilm development, which could be obtained by more extensive pre-treatment. Also, cleaning and detachment of biofilms are important topics within the research program. Know-how areas that are used in the research program are: microbiology, molecular biology, surface chemistry and membrane and process technology. Theme started: 2004.

## 9 | Concentrates

Membrane filtration and ion exchange chromatography are both proven technologies in the food & beverage and process water industry. They have major advantages over traditional methods: excellent product quality, limited use of chemicals and the simultaneous removal of a variety of contaminants. The disadvantage, however, is the production of a concentrated salt liquid waste product.

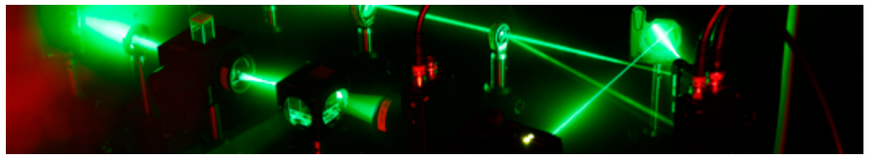
Current practice is to discharge the concentrate stream into the sewer system or directly to surface water. This can lead to exceeding the (local) emission standards. Increasingly strict emission standards (including the European Framework Directive on Water) means that more sustainable recycling techniques must be found. Also in the oil and gas industries, concentrated salt streams are found. They are produced during the exploration of oil and gas and their salinity exceeds that of sea water. The theme is focused on finding solutions for membrane concentrates, ion exchange reclaim and concentrated salt industrial effluents. The research is aimed primarily at: technologies to remove (and preferably reuse) specific components such as salts and anti-scalants, concepts for the reuse of concentrates in agriculture and industry, and technologies to reduce the volume of the concentrates. Theme started: 2007.

## 10 | Advanced Water Treatment

The emphasis in this theme is on new sustainable waste water purification technologies to remove or decompose all particles, priority compounds, organisms and other contaminants as stated in the Water Framework Directive. Through the development of new physical, electrical and electrochemical water treatment technologies, low-cost, low-investment waste water treatment will be possible. These technologies will be robust and insensitive to fouling since they are combined with, among others, new fluidized bed UV-LED reactors, ultrasound treatment, and deterministic ratchet technology. Theme started: 2007.

## 11 | Source separated sanitation

Source separation sanitation (SSS) is a concept in which waste streams with specific characteristics (e.g. urine, faeces, greywater, hospital waste streams) are collected, transported and treated separately at the source. Hospital wastewater, for instance, contains about 10 fold the concentrations of pharmaceuticals in municipal wastewater and is considered an important source of antibiotic resistant bacteria. By treating (hospital) wastewater at the source the risks associated to wastewater can be addressed more specifically and effectively, thereby preventing the spread of antibiotic resistant bacteria and other pathogens in the population and discharge of toxic components into the environment. Furthermore, sustainability objectives such as water reuse, recovery of resources and energy savings can also be more effectively reached within SSS. The main advantage is that source separation prevents dilution of wastewater streams. New technology must be developed to treat these concentrated waste water streams. For the treatment of hospital wastewater it is important to remove antibiotics and to develop a disinfection technology in which bacteria are not only killed but their DNA is destroyed. Theme started: 2004.



## 12 | Natural Flocculants

In this theme the focus is on the development of natural alternatives for synthetic organic polymeric flocculants for treatment of surface waters or wastewaters. 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 microorganisms during biological wastewater treatment not only are more sustainable than synthetic polymers, indications are that they also can 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. Theme started: 2004.

## 13 | Sulfur

This theme focuses on integrated processes for removal and conversion of volatile sulfur compounds from aqueous solutions. These aqueous 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 at removal of 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 recycling of all water. The scientific disciplines needed for development of such an integrated process are chemistry, microbiology, biotechnology and modeling. Theme started: 2011.

## 14 | Dehydration

This theme focuses on enhancing the efficiency of dehydration processes. A key element for enhancing this efficiency is selective water vapor removal. This enables small scale water production systems that can produce water directly from air at the location where it is needed. The approach is to use water vapor selective membranes to separate water directly from air before cooling it. In this way only the water vapor is condensed without producing cold air. By this means up to 60% of energy could be saved reducing the price of water significantly. The quality of water is improved drastically as no pollutants can permeate the membrane.

Super critical $CO_2$ is applied in food drying technology as alternative to hot air drying, vacuum drying or freeze drying. However, continuous operation of such process requires efficient dehydration of the pressurized $CO_2$ stream. Water vapor selective membranes are used to efficiently separate

water from a $CO_2$ stream. Membrane development is needed to produce membranes which are resistant against $CO_2$. Theme started: 2009.

## 15 | Blue Energy

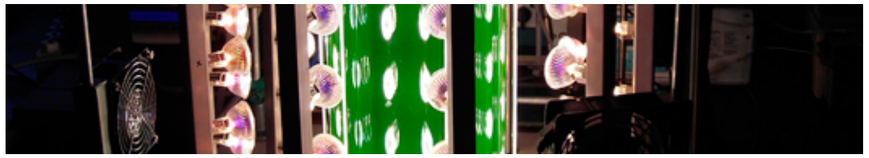
Sustainable energy production is a huge challenge in our world. Obtaining energy from environmental resources will play an important role in future energy supply. For example, electricity can be produced from advanced mixing of salt and fresh water in a process called reverse electro dialysis, or blue energy. In this visionary theme ionic current technologies are developed in which electrochemistry, membrane technology, and process technology are combined in the research program. Theme started: 2004.

## 16 | $CO_2$ -energy

Society is in need of alternative energy sources, to meet the growing demand of energy in a more sustainable way. Mixing energy is such an alternative energy sources that has been widely overlooked and only explored for mixing fresh water with sea water, the so-called Blue Energy. The concentration of $CO_2$ is much higher in the combustion emission (5-20%) than in the atmosphere (0.04%) meaning that upon mixing a large amount of energy is released. This energy is currently wasted as until recently no technology was available to harvest this energy. In 2013 for the first time a concept for such technology was presented by Wetsus researchers through laboratory experiments. The principles underlying the technology were postulated.
This theme aims at further developing this technological concept by combining, physical chemistry, materials science and process engineering. Theme started: 2015.

## 17 | Phosphate Recovery

Phosphate is an important fertilizer needed for food production. The sources are finite and mining and processing of the ore is an energy intensive and polluting process. An appreciable part of the phosphate in food ends up in the 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 manner that the phosphate becomes available as fertilizer and the water will be clean. The theme will focus on expanding and improving current technology so that more phosphate can be at lower costs, while producing high value products. Theme started: 2013.



## 18 | Algae

Focus of the algae theme is sustainable biotechnology for the production of valuable products. Algae are the perfect candidates to do this: they absorb nutrients and carbon dioxide and convert this into valuable biochemicals and oxygen, using light as the sole source of energy. However, to develop this into an economically feasible technology, improvements need to be made in the conversion from light and minerals to biochemicals. This is investigated using different strategies to improve light colour, and the effects of light-dark cycles and light frequency on growth and product yield. For specific products such as proteins or lipids, research is done on the effects of specific culture conditions. Furthermore, research is done on better integration of algae culture with downstream processing, such as culturing algae in biofilms, bio- and auto-flocculation of algae and scenario studies on the boundary conditions required for this integration. The envisaged breakthroughs in algae culture will enable closing of nutrient cycles, making it the sustainable biotechnology of the future. Theme started: 2008.

## 19 | Resource recovery

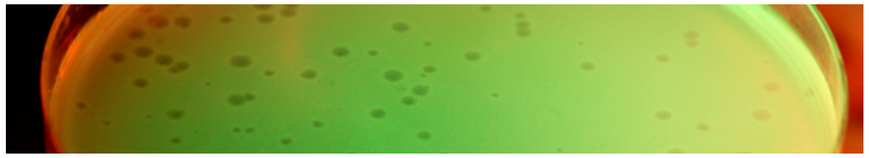
In this theme new technology related to the harvesting of energy and valuable compounds from waste water is developed. Ionic current technologies will be combined with physical and chemical technology to specifically recover compounds and produce energy. With technologies involving microbial fuel cell and biocatalyzed electrolysis, electricity or hydrogen is produced from waste water. Hydrogen production from biocatalyzed electrolysis makes a much wider variety of waste waters suitable for energy harvesting. This is a revolutionary breakthrough technology in the field of biological hydrogen production from waste water. Ionic current technologies have the possibility to combine energy generation with separation. For instance ammonia can be separated from urine and used as a fertilizer or as a fuel for additional electricity generation. Biological conversion of soluble sulfur compounds can be combined with metal recovery in a single process. Co-precipitation with in situ generated precipitants like iron oxides makes it possible to adsorb or include compounds like selenate. Selective recovery of components via specifically designed adsorbents are necessary to recover only the compounds of interest. The adsorption/ desorption cycles need to be reversible and independent of other chemicals. Preferably light or electricity driven regeneration of the adsorption material is used to enable chemical-free regeneration of adsorbents. Development of technology to develop these advanced materials is necessary to specifically recover compounds from waste water in an economical and sustainable way. Theme started: 2004.

## 20 | Protein from Water

The theme Protein from Water aims to develop technologies to upgrade nitrogen and other nutrients from wastewater and manure into valuable microbial proteins. The theme focuses on technological breakthroughs needed to create sustainable and economically production of single cell proteins and to ensure product safety. High-quality microbial proteins will be produced efficiently at high rate and can be applied as a substitute for proteins in the feed and food chain originating from soy and fish. This concept has the potential to revolutionize the water-energy- food nexus. Compared to current food production, less land and less water is needed while off-peak electricity can be used. Theme started: 2015.

## 21 | Sensoring

The Sensoring theme of Wetsus focuses on the development of devices for monitoring the quality (composition) of water, whether that is, surface water, drinking water or industrial waste water. The motivation to develop reliable water quality sensors is twofold. First, from the point of view of public health, safe drinking water is of utmost importance. Secondly, the quality of discharged industrial waste water is more and more dictated by governmental regulation, implying the need to strictly control its quality. The technology applied within this research theme ranges from microfluidics combined with Raman spectroscopy to (waveguide) laser optics and acoustics. Whatever the technique and whatever it is a sensor to detect pathogens or chemical toxins, the challenge always is to develop a system that operates on-line and continuously, sensitive, fast and cheap. The currently used method of culturing and plating out in order to test for the presence of pathogens may serve as an example. This analysis is laborious and takes a couple of days, requires skilled personnel and therefore is rather expensive. The alternative we work on is based on an on-line recording able not only to test for the presence of just a single bacteria cell in 10 ml of water but, in addition, also identifies the particular bacteria species we are dealing with. Theme started: 2006.

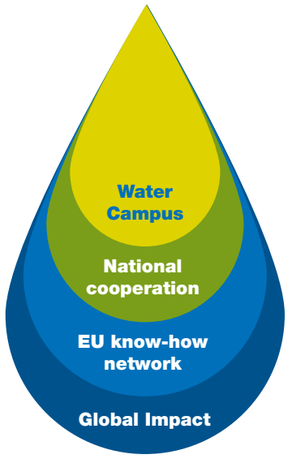


## 22 | Genomic based water quality monitoring

The application of direct cell counts (microscopic and flow cytometry) has shown that the culturable microorganisms in water are only presenting a fraction of the total microbial population (<1%) and that most of the cells seem to be active. Drinking water sources, treatment and distribution have an enormous impact on the (micro) biological composition/quality of the drinking water produced and distributed The main question is whether it is possible to predict and control the changes in biological quality and stability of drinking water caused by changes in drinking water processes. Within this theme the focus will be on generating fingerprints (sometimes called barcoding or barcodes) of the complete microbial population present in (drinking) water based on Next Generation Sequencing (NGS). With this the effect of disturbances on the fingerprint can be examined and indicator organisms/markers can be characterized. The final aim is to develop applications for a precise (online) monitoring/control of water quality and water treatment processes. Theme started: 2013.

# 6. Internationalization

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




The objective is to create a strong European know-how network for water technology business and research. This network is currently formed by over 125 organizations. The network is created around an integrated water technology campus (WaterCampus Leeuwarden), which acts as the physical core of the network. In and around WaterCampus, facilities like a multidisciplinary laboratory and demonstration sites are located. A concentration of research, know-how, entrepreneurship, venture capital, talent and education is being created on WaterCampus Leeuwarden. This forms the critical mass for the program. In the Wetsus laboratory in Leeuwarden, about 120 international professionals work on water technology innovations.

## European Centre of Excellence

Wetsus combines a dedicated public-private international research program with the EU policy of smart regional innovation strategies for smart specialization (RIS3). The heart of Wetsus' activities is the execution of its demand driven research program on water technology. Companies participate with a long-term commitment to develop breakthrough technologies. With an increasing number of international companies and institutes participating (some 25% of the partners is non-Dutch), the program has clearly developed beyond the regional and national scale. Further Europeanisation is enhanced by participating in European research and innovation projects in various EU programs (Horizon2020, EIT Climate-KIC, EIT Raw Materials, COSME, Interreg, European Fund for Regional Development) and through collaboration with WssTP, ERRIN and EIP Water.

A long-term focus on a specific theme, with the core activities concentrated in a physical place is essential for the establishment of a European Centre of Excellence. For a decade Wetsus has shown how the former Technological Top Institute PPP-model of The Netherlands can form an excellent basis for a center of excellence. Relevant research and validation of research results is guaranteed by the connected companies, and this also ensures the coupling with innovative SMEs. The connection with 55 top professors from all over Europe ensures high quality scientific output.

With its world class research facilities, high trust cooperation structure and dedicated IPR regulations, Wetsus provides the much-needed link between the scientists and the most innovative companies in the region, the State and Europe. Long-term commitments of the involved professors, companies and relevant governments, in order to achieve breakthrough water technology, is essential. With all this established, Wetsus can be a global niche player, boosting European competitiveness in this field.

Linking this bundled innovation capacity to companies from other sectors or regions with a complementary RIS3 strategy, can lead to cross-sectorial innovations that contribute to solving major societal challenges. Wetsus fulfills the role of European Centre of Excellence with a proven capacity of generating world class knowledge, interesting patents, competitive spin-offs and supports growth and jobs development across the EU. In doing so, Wetsus contributes to the desired outcome of effective RIS3 strategies: delivering European economic growth and competitiveness.

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. The combined momentum of regional, national and EU funding increase the critical mass of the water technology research program. Wetsus strives to become and stay the most integrated program for this emerging industry in the world.

## Meeting of international minds

The activities in the field of education aim to increase the number of young professionals in the international water technology community and simultaneously support a strong mobility of knowledge-workers in the European labour market. These activities also result in a meeting place for master and PhD-students and their professors from across the European Union. A place where water technology minds meet and inspire each other. Currently, some 60% of the scientific staff, researchers and students are from outside the Netherlands.

# 7. Organization and Finance

## 7.1. Organization and Management

### Legal form and management

Wetsus is a not-for-profit foundation, with the main objective to organize and carry out a nationally and internationally relevant, demand oriented, pre-competitive, industrial, multidisciplinary research program in the field of water technology, and to organize the financing thereof.

Wetsus is managed by its executive board. This Board is formed by a two-person executive, prof. dr.ir. Cees Buisman and Johannes Boonstra. Together, Buisman and Boonstra are an experienced (in both business and academic roles) and complementary team that has built the current Wetsus organization, research program, participant network and reputation.

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

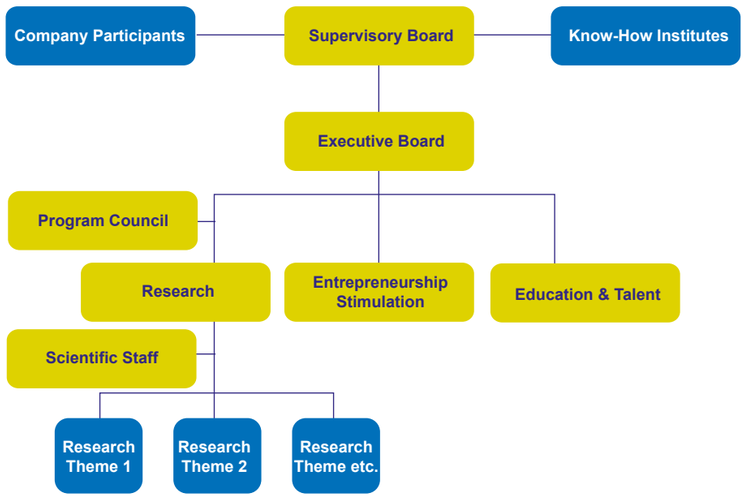



*Figure 7.1: Organization of Wetsus and its program. The blue areas are directly influenced by the Wetsus participants*

### Organization

Wetsus' international research program is coordinated by a multidisciplinary team of Wetsus scientists. The research is mainly performed by PhD-students, employed and supervised by the participating international know-how institutes. These researchers are typically full time seconded in the Wetsus organization. The PhD students work in Wetsus' multidisciplinary laboratory on WaterCampus Leeuwarden, where a multidisciplinary team of scientists takes care of their day to day supervision. In the Wetsus lab, dedicated analysts and technicians ensure the 24/7 availability of world class research facilities for the research program.

Wetsus employs staff to manage and facilitate the execution of the research program and to perform the activities in the fields of education and entrepreneurship. In addition, a small staff team ensures dedicated support and control functions.



### Communication

In order to stay in close contact with its participants, other important stakeholders, and society, Wetsus puts significant effort in professional communication:

- General and program developments are communicated through means such as newsletters, website, brochures, annual reports, etc.
- Relevant technological developments for society are broadly communicated through newspapers, television, internet, social media, dedicated magazines, etc.
- Scientific results are communicated through workshops, conferences, publications in international peer reviewed journals, patents, etc.

Obviously, a confidentiality policy is in place for discussion about classified business and scientific information between the partners that together constitute the Wetsus network.

## 7.2. Financial Aspects

### Funding of innovation ecosystem activities

For its activities in the field of valorization, entrepreneurship, spin offs and talent, Wetsus closely works with Water Alliance and CEW, its WaterCampus partners. For the financing of these activities, dedicated funding is expected to be made available by the regional authorities. A joint WaterCampus budget of some € 1,7 million per year has been requested, for the period until 2021. The Wetsus share of this budget will be some € 500.000 per year.

### Research funding

The below table shows the envisaged research funding for the period until 2021. A division is made between the research funds for project financing that can be won in competition (such as Horizon 2020) and the funds for the financing of the Wetsus core research program. This funding strategy is aligned with the Dutch Topsector Water board. In the table, underlined numbers have been secured and normally printed numbers are expected based on discussion and/or experience. The 2015 figures are preliminary.

#### *Research competition EU*

Wetsus expects to allocate some € 1,75 million per year from various EU programs for innovation and regional economical development programs (Horizon2020, EIT, COSME, Interreg, European Fund for Regional Development). Additional funds are to be derived from a program for widening cooperation in the EU (TTI-transition funds) and from bilateral cooperation with regions that have water technology as one of their ambitions in their EU RIS strategy.

#### *Wetsus Research program*

For its research funding, Wetsus continues to work according to the TTI principles (company contribution is doubled by government subsidies, and universities add a significant amount in kind). Starting point for the core research financing is that a base financing of € 6,5 million per year from governments, increased by 50% of that amount by companies and with additional in kind support from universities, is required to maintain the current impact, quality, attractiveness and viability.

The participating companies and universities have a rolling financial commitment and will invest some € 5,8 million per year in the program. The main government research funding is derived from REP funds, made available through regional authorities until 2021. Additional research funding is expected to be continued by two ministries. From 2017 onwards, Wetsus will start to cooperate with NWO, the Dutch Organisation for Scientific Research. In 2016 the first call for joint projects is expected to be issued.
Regional funds are used for the financing of the research infrastructure and other critical facilities to enable the program to be executed in a world class research environment.

In the table, an outlook to the financing after 2021 is provided. Discussions about the ambitions that follow from that have already been started with the relevant actors.

| Envisaged research budgets and financing Wetsus 2015-2020 (in million €) | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 *outlook* |
|---|---|---|---|---|---|---|---|
| EU centre of excellence | | | | | | | |
| Overall budget scientific program | 14,9 | 15,1 | 15,5 | 15,6 | 15,3 | 15,4 | *15,5* |
| | | | | | | | |
| Research competition EU | | | | | | | |
| Total budget: | 2,1 | 2,5 | 2,4 | 2,2 | 1,9 | 1,9 | *2,0* |
| Finance sources | | | | | | | |
| Research competition funds | 1,50 | 1,75 | 1,75 | 1,75 | 1,75 | 1,75 | *1,75* |
| Ministry of economic affairs (tti-transition funds) | 0,60 | 0,65 | 0,55 | 0,30 | | | |
| EU regions | | 0,05 | 0,10 | 0,10 | 0,10 | 0,10 | *0,20* |
| | | | | | | | |
| Wetsus Research Program | | | | | | | |
| Total budget/costs | 12,8 | 12,6 | 13,1 | 13,4 | 13,4 | 13,5 | *13,5* |
| Finance sources | | | | | | | |
| Private contributions (>80% cash) | 3,30 | 3,30 | 3,30 | 3,40 | 3,40 | 3,50 | *3,50* |
| Contributions know how institutes (in kind) | 2,50 | 2,30 | 2,30 | 2,50 | 2,50 | 2,50 | *2,50* |
| Ministry of Economic Affairs (TKI subsidy) | 0,73 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | *1,25* |
| Ministery of Infrastructure and Environment | 0,50 | 0,50 | 0,50 | 0,50 | 0,50 | 0,50 | |
| NWO (Netherlands Organisation for Scientific Research) | | | 0,50 | 0,50 | 0,50 | 0,50 | *2,00* |
| REP-program Northern Netherlands | 4,75 | 4,75 | 4,75 | 4,75 | 4,75 | 4,75 | |
| Province of Fryslân (research infrastructure) | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | *1,00* |
| Province of Fryslân (research funding) | | | | | | | *3,25* |

## Division of Budget

The total budget is available for the activities contained in this business plan. In the below table, the expected division of the budget over the main activities is provided.

| Envisaged division of budget (%) | |
|---|---|
| Scientific projects | 79 |
| Talent program | 3 |
| Wetsus core* | 13 |
| Housing (labs and offices) | 5 |

** network management, support & control, knowledge transfer, internationalisation*



# 8. Impact and Output

## 8.1. New collaboration model

The return on investment from this business plan will be a world leading position for the EU in water treatment technology, both for the know-how institutes and for the companies. At the same time, the resulting technologies will contribute significantly to the solution of the global water crisis and the Millennium Development Goals.

Producing clean water is a complex matter, because water treatment technology is a technology sector which is extremely multidisciplinary. Safe water will have physical, chemical and biological aspects. Therefore Wetsus aims to create talent mobility between universities. No single university can cope with all the necessary disciplines and many universities focus on a specific aspect of water technology. Therefore, cooperation is a strict necessity. Scientists from different universities, from different countries and different disciplines work, to a large extent physically, together in the Wetsus research program. They work on problems defined by companies and other stakeholders. In this cooperation their work is relatively much more relevant and creative.
The proposed set-up leads to a high trust, high commitment collaboration between more than 150 partners and will distinguish itself this way.

## 8.2. New technologies for society

The worldwide water technology business is estimated at € 500 billion per year, with a growth of more than 10% per year. The developed know-how in Wetsus will put the EU water sector in a very competitive position on the global market place.

The envisaged Wetsus program will lead to 90 patents, 25 new technologies and 35 new companies in 2020. More than € 75 million will directly be invested in research at Wetsus. A multiplier of this amount is expected to be invested in research and development at the participating companies for the valorization of the results. Also a significant venture capital investment is envisaged. All this will lead to new and sustainable solutions for the global societal water problems. This will not only lead to improved quality and availability of water resources, but also to significant new business for the water sector.

The innovation chain in the water business is rather complex due to the large public interest in water supply and environmental protection. Due to the large population increase, increased wealth, groundwater depletion and climate change more and more countries experience a water crisis. The demand side for business opportunities is therefore very interesting. Consumers all over the world become aware of consumer products that contribute to the short term health (bacteria and viruses), long term health (toxic compounds and medicine rests) and esthetic (taste, color, special physical aspects) characteristics of water. Industries realize the importance of water due to water shortage and groundwater depletion, leading to increased interest in water reuse technologies. Biodiversity in water bodies is threatened by water pollution urging governments to install more strict discharge standards all over the world leading to demand for purification technologies.

These demand drivers will in the Wetsus program be translated into business options by commercial companies who will be the suppliers to the end users, being governmental water authorities, public water companies, consumers or industrial water users. The commercial companies can be segmented in several groups:

- Specialized water technology companies focusing on exporting knowledge and special equipment
- Component producers like electrodes, activated carbon, membranes, sensors
- Water technology consultants
- Producers of consumer products
- Multinationals with water technology businesses
- Start-ups and new ventures

## 8.3. Research excellence

Multidisciplinary research is difficult to organize. Wetsus invites researchers (for PhD projects of 4 years) from different disciplines to work together in one geographical location, WaterCampus Leeuwarden. This multidisciplinary approach, combined with the fact that Wetsus works with leading chairs in Europe, leads to top research. The citation impact of the Wetsus program until 2015 was 2.4, which is of world class level. Wetsus aims for a very high scientific impact and therefore the citation impact objective of the new program is at least 1.5 times better than the world average, based on more than 700 produced scientific papers.

Wetsus' initiative will liberate enough impact, connectedness, synergy, talent and research investments to become the world's number 1 in water technology.

## 8.4 New kind of PhD graduates

At Wetsus, PhD's from over 50 know how disciplines physically cooperate in 1 research laboratory. This way  people from different backgrounds learn to cooperate and to understand and benefit from each other's knowledge. Further, PhD-candidates have regular contact with the involved companies in the program, enabling them to develop an industry orientation.

Wetsus' ambition to combine scientific excellence with commercial relevance demands a new and dedicated approach towards the personal development of the involved PhD-candidates. Because the Wetsus system demands a special attitude of the researchers, a broad training is required. Wetsus offers its training on top of the scientific training which is provided by the university the PhD student is connected to. The Wetsus training is centered around insight into four pillars of one's own personal development: talents, values, independence and connection.

- Insight in one's talents is needed to determine where one can contribute and where one needs support. This is especially needed in a multidisciplinary environment where an open attitude towards other disciplines is needed.
- Insight in one's values is needed to steer in situations where common rules not strictly apply. This is true for technology itself but also for a value based organization like Wetsus.
- Autonomy is needed to make clear choices. This is important as water technology is a rapidly evolving field with many opportunities to pursue.
- Connection is needed to cooperate in a meaningful way with others like supervisors, students, fellow scientists of other disciplines, companies and technical support. Connection is rooted in insight in one's own talents and values but also in seeing differences with others  and knowing how to use these differences in a fruitful way.

By combining these elements in an insightful way, the PhD candidate is able develop the leadership needed to bridge scientific excellence and commercial relevance.  The graduated Wetsus PhD's will therefore be uniquely trained for innovative leadership positions in multidisciplinary teams, both in industry and universities.

## 8.5. Output

On the next page, the performance criteria for the period until 2020 are listed.

The criteria from 2016 onwards are based upon the envisaged available research budget. In this table Wetsus' ambitions are quantified by a summary of the envisaged output of this business plan.



# Performance indicators

| Performance indicators Wetsus | 2007 realized | 2008 realized | 2009 realized | 2010 realized | 2011 realized | 2012 realized | 2013 realized | 2014 realized | 2015 realized | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Input** | | | | | | | | | | | | | | |
| Program budget (mln €) | 7.0 | 9.2 | 11.7 | 13.2 | 13.8 | 15.7 | 16 | 16 | 14.9 | 15.1 | 15.5 | 15.6 | 15.3 | 15.4 |
| Contribution of companies to research programme (mln €) | 2.3 | 2.8 | 3.0 | 3.4 | 3.6 | 3.8 | 3.6 | 3.3 | 3.3 | 3.3 | 3.3 | 3.4 | 3.4 | 3.5 |
| Overhead (%) | 11 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| **Network** | | | | | | | | | | | | | | |
| Number of participating companies | 53 | 66 | 78 | 86 | 92 | 95 | 93 | 95 | 105 | 107 | 109 | 111 | 113 | 115 |
| Percentage of SME companies (turnover < € 100 mln/y) | 34 | 51 | 54 | 56 | 55 | 54 | 54 | 56 | 57 | 50 | 50 | 50 | 50 | 50 |
| Percentage of foreign companies | | | | 17 | 20 | 20 | 23 | 25 | 24 | 26 | 27 | 28 | 29 | 30 |
| Number of participating research chairs | 17 | 25 | 33 | 38 | 45 | 46 | 48 | 52 | 54 | 50 | 50 | 50 | 50 | 50 |
| Number of public knowledge institutes (participants) | 6 | 8 | 14 | 16 | 16 | 18 | 19 | 19 | 21 | 21 | 21 | 21 | 21 | 21 |
| **Impact, Output and Outcome** | | | | | | | | | | | | | | |
| *Education* | | | | | | | | | | | | | | |
| Number of PhD candidates and post-docs | 44 | 60 | 90 | 102 | 117 | 131 | 148 | 163 | 179 | 188 | 203 | 218 | 233 | 250 |
| Number of joint degree students | | 10 | 8 | 15 | 11 | 21 | 23 | 30 | 36 | 40 | 42 | 44 | 47 | 50 |
| Number of MSc thesis students / year | 21 | 46 | 37 | 71 | 61 | 80 | 76 | 72 | 79 | 80 | 80 | 80 | 80 | 80 |
| Number of talent events | | | 10 | 20 | 19 | 19 | 16 | 20 | 25 | 25 | 25 | 25 | 25 | 25 |
| *Scientific* | | | | | | | | | | | | | | |
| Number of scientifc papers in international journals (cumulative) | 19 | 39 | 66 | 121 | 176 | 234 | 294 | 376 | 425 | 480 | 535 | 590 | 645 | 700 |
| Numbers of papers in top 10% citations (cumulative - 1y) | | | | | | 45 | 67 | 80 | 107 | 113 | 120 | 127 | 134 | 140 |
| Citation impact (overall) | | | 2.5 | 1.9 | 1.8 | 2.4 | 2.8 | 2.4 | very high | very high | very high | very high | very high | very high |
| *Valorization/entrepreneurship* | | | | | | | | | | | | | | |
| Number of spin-off companies (cumulative) | 3 | 3 | 9 | 15 | 17 | 20 | 24 | 26 | 27 | 28 | 30 | 31 | 33 | 35 |
| Number of patents (submitted, filed and granted) (cumulative) | 13 | 22 | 32 | 39 | 53 | 61 | 64 | 67 | 76 | 79 | 82 | 85 | 88 | 90 |
| Number of transferred patents (cumulative) | 3 | 4 | 7 | 14 | 14 | 22 | 22 | 26 | 27 | 30 | 34 | 37 | 41 | 45 |
| New technologies (cumulative) | | | | | | | | | | | | | | 25 |
| Optimization existing technologies (cumulative) | | | | | | | | | | | | | | 20 |

# Appendix: Participants (March, 2016)

| | |
|---|---|
| Waterschap Aa en Maas | www.aaenmaas.nl |
| ABENGOA WATER | www.abengoawater.com |
| Algae Food & Fuel | www.algaefoodfuel.com |
| alliander | www.alliander.nl |
| love every drop anglianwater | www.anglianwater.co.uk/ |
| THE AQUA NIRVANA FOUNDATION | www.aquanirvanafoundation.com |
| AquaBattery | www.aquabattery.nl |
| AQUACARE EUROPE BV | www.aquacare.nl |
| ARCADIS | www.arcadis.nl |
| AVEBE | www.avebe.nl |
| Avecom | www.avecom.be |
| berson masters in uv | www.bersonuv.com |
| BIOTRACK | www.biotrack.nl |
| brabant Water | www.brabantwater.nl |
| Waterschap Brabantse Delta | www.brabantsedelta.nl |
| Bright Spark | www.brightspark.nl |
| BTO | www.kwrwater.nl |
| dc water is life | www.dcwater.com |
| Waterschap De Dommel | www.dommel.nl |
| desah | www.desah.nl |
| DMT | www.dirkse-milieutechniek.com |
| DOW | www.dow.com |



| | |
|---|---|
| Duplaco | www.duplaco.com |
| EasyMeasure | www.easymeasure.nl |
| EFC separations | www.efc.nl |
| evides | www.evides.nl |
| FeyeCon | www.feyecon.com |
| FrieslandCampina | www.frieslandcampina.com |
| DE FRIESLAND ZORGVERZEKERAAR | www.defriesland.nl |
| esco european salt company Frisia Zout B.V. | www.esco-salt.com |
| FUJIFILM | www.fujifilm.nl |
| GRUNDFOS | www.grundfos.com |
| H2motion clear water through motion | www.h2motion.nl |
| a.hak | www.a-hak.nl |
| ACQUAINT B.V. PREVENTING FAILURE | www.acquaint.eu |
| Heineken International | www.heineken.nl |
| HUBERT water treatment installations | www.hubert.nl |
| ICL Where needs take us | www.icl-group.com |
| INTEGRO | www.integro.nl |
| GRANDER Belebtes Wasser / IPF Implosions Photonenfeld Forschung | www.grander.at |
| izore centrum infectieziekten friesland | www.izore.nl |
| kemira | www.kemira.com |
| van der Knaap group of companies | www.vanderknaap.eu |
| LABORELEC | www.laborelec.be |
| Landustrie | www.landustrie.nl |
| LIONIX | www.lionixbv.nl |
| MAGNETO SPECIAL ANODES B.V. | www.magneto.nl |
| MAST | www.mastcarbon.co.uk |

# Platform participants (March, 2016)

| | | | |
|---|---|---|---|
| AQUATECH AMSTERDAM 31 OCT - 3 NOV 2017 | www.aquatechtrade.com | O2 Environmental | www.O2env.com |
| bioclear | www.bioclear.nl | Corbion purac | www.corbion.com |
| BioCompact | www.biocompact.nl | empower people | www.empower-people.nl |
| BIOSTREAM | www.biostream-international.com | Royal HaskoningDHV Enhancing Society Together | www.royalhaskoning.com |
| Brightwork | www.brightwork.nl | Rabobank | www.rabobank.nl |
| cew centre of expertise water technology | www.cew-leeuwarden.nl | sabic | www.sabic.com |
| energy valley | www.energyvalley.nl | skion | www.skion.de |
| EWS | www.ews.eu | TechnologieCentrum NoordNederland | www.tcnn.nl |
| imagination at work | www.ge.com | van hall larenstein university of applied sciences | www.vhl.com |
| HAPSS | | Van Remmen UV Techniek | www.vanremmen.nl |
| hoogheemraadschap Hollands Noorderkwartier | www.hhnk.nl | VEOLIA WATER | www.veoliawater.com |
| High Voltage Water | www.highvoltagewater.com | wafilin SYSTEMS BV | www.wafilin.nl |
| IZER | www.izer.frl | wateralliance | www.wateralliance.nl |
| KURITA | www.kurita.co.jp/english | wml Limburgs drinkwater | www.wml.nl |
| metalmembranes | www.metalmembranes.com | WATERSCHAP ZUIDERZEELAND | www.zuiderzeeland.nl |

| | | | |
|---|---|---|---|
| oaseo | www.oasen.nl | SWECO | www.sweco.nl |
| Koninklijke oosterhofholman | www.oosterhof-holman.nl | TROJAN UV | www.trojanuv.com |
| Paqell. | www.paqell.com | Unilever | www.unilever.nl |
| PAQUES | www.paques.nl | Vitens | www.vitens.nl |
| Pentair X-Flow | www.x-flow.com | Voltea | www.voltea.com |
| Pure Green | pure green | Waterbedrijf Groningen | www.waterbedrijfgroningen.nl |
| PWN. Puur water en natuur. | www.pwn.nl | WMD water | www.wmd.nl |
| REDSTACK | www.redstack.nl | waternet | www.waternet.nl |
| Schauberger Natur Technik | www.schauberger-natur-technik.at | WATERSCHAP Hunze en Aa's | www.hunzeenaas.nl |
| Shell | www.shellglobalsolutions.nl | Waterschap Noorderzijlvest | www.noorderzijlvest.nl |
| NX Filtration | www.somut.nl | WETTERSKIP FRYSLÂN | www.wetterskipfryslan.nl |
| vecoy precision metal | www.vecoprecision.com | wln waterlaboratorium noord | www.wln.nl |
| stowa STICHTING TOEGEPAST ONDERZOEK WATERBEHEER | www.stowa.nl | YARA | www.yara.com |

# Know-how institute participants

(March, 2016)

| | | | |
|---|---|---|---|
| Deltares | www.deltares.nl | UNESCO-IHE Institute for Water Education | www.unesco-ihe.org |
| FOM | www.fom.nl | University of Amsterdam | www.uva.nl |
| Kaunas University of Technology | en.ktu.lt | umcg | www.umcg.nl |
| Imperial College London | www3.imperial.ac.uk | University of Twente. | www.universiteittwente.nl |
| KWR Watercycle Research Institute | www.kwrwater.nl | Universität Duisburg Essen | www.uni-duisburg-essen.de |
| Universitas Masarykiana Brunensis | www.muni.cz | Universidade do Minho | www.uminho.pt |
| Rijksinstituut voor Volksgezondheid en Milieu | www.rivm.nl | Universiteit Gent | www.ugent.be |
| rijksuniversiteit groningen | www.rug.nl | Universiteit Utrecht | www.uu.nl |
| TU Delft Delft University of Technology | www.tudelft.nl | Wageningen UR For quality of life | www.wur.nl |
| TU/e Technische Universiteit Eindhoven University of Technology | www.tue.nl | Wrocław University of Technology | www.pwr.wroc.pl |
| TU Graz | www.tugraz.at | | |

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.

**www.wetsus.eu** **www.watercampus.nl**