



ANNUAL REPORT

2017



THE ENERGY AND RAW MATERIALS FACTORY

Recovering, processing and marketing energy and raw materials from wastewater with which the regional water authorities contribute to the circular economy.

The Energy and Raw Materials Factory is a team of motivated water specialists who want to make the transition from wastewater treatment to the reuse of energy and raw materials from wastewater in a refreshing way.

The Energy and Raw Materials Factory is a haven of practical idealists from the wastewater industry and beyond. We therefore associate ourselves with society. For clean water and recovering resources of value. Of course, we do this with a close eye on the costs. We always explore new insights, techniques and methods. Thinking differently means working differently. We believe in spreading our expertise and products. That is our contribution to a circular economy. The Energy and Raw Materials Factory mobilises and concentrates the will, knowledge, ability and power to overcome obstacles. We investigate whether something is feasible, if it is, we will prove it and encourage its realisation. We do this together with companies who are leaders in their market, universities, local initiatives and public organisations.

Our mission is:
recover what is of value!

FOREWORD

We are proud to present the 2017 annual report of the Energy & Raw Materials Factory.

In the past year, the Energy & Raw Materials Factory has pre-sorted the contribution of the regional water authorities to the circular economy and energy transition. Two pillars of the Investment Agenda that the IPO, VNG and the Dutch Water Authorities have offered to the new Cabinet in the spring of 2017.

What started in 2008 with a dream of recovering energy and raw materials from wastewater is now becoming a reality at a rapid pace. Major steps have been taken for alginate, bioplastics, cellulose, struvite, biomass and energy. Working groups, supported by the STOWA, focus on research and raw material recovery. What is new is that directors and managers from different regional water authorities, working in so-called front runner groups, work together intensively to value the raw materials. As a result, product chains are closed and regional water authorities demonstrably contribute to a sustainable society.

Sustainability is a responsibility for everyone. We see that central government, educational and research institutions, interest groups and the business world, are putting more and more energy into the transition to a green economy. And that is paying off. For example, we notice more interest from companies in our raw materials, bringing the tipping point from supply-oriented to market-driven trading closer.

The Netherlands is becoming increasingly more sustainable, it is important for the Energy & Raw Materials Factory to be able to continue to contribute to this in an effective manner. The steering group and the programme team of the Energy & Raw Materials Factory therefore cooperate more intensively to resolve the issues as quickly as possible. This annual report is therefore offered to you by the entire team. Enjoy reading it!



Paul Koemans
*Chairman,
Steering group
Energy and
Raw Materials
Factory*



Shane Kleyhorst
*Programme
manager Energy
and Raw Mate-
rials Factory*

ORGANISATIONAL STRUCTURE & BUDGET

The organisation consists of six working groups, a reconnaissance group and five front runner groups. At the helm of each group is a working group leader. The programme team, the broad programme team and the leaders of the working groups meet regularly to share knowledge and exchange experiences.

Since 2017 The Energy & Raw Materials Factory has grown a new green shoot on its stem. An addition with which we can make the last step in the valuation of raw materials. A bottleneck that we as organisation increasingly ran into was the lack of decision-making power within the working groups. Ultimately, the good ideas must be converted into projects and/or product chains. Agreements have to be made on behalf of the group with external parties. Flexibility and decisiveness are needed here. For this purpose, the front runner groups were established in the autumn of 2017. These front runner groups are formed around the top 5 raw materials and staffed with decision-making people. These are usually department heads and / or directors. 2017 was all about establishing, selecting participants and seeking coordination within the working groups. The first results of this are expected in 2018.

In 2017 the organisation had 175 members, of which about 75 were active. The Energy & Raw Materials Factory is accountable to a steering group in which the Association of Wastewater Treatment Managers (VvZB), the Dutch Water Authorities (DWA) and STOWA (Foundation for Applied Water Management Research) are represented. The organisation has three cross-cutting themes that are represented by supportive working groups: legal, subsidies and business development. The legal and subsidies theme groups advise the working groups on general issues and act as knowledge brokers.

The business developer works on product market combinations for raw materials from our wastewater that are usable for industry, agriculture, transport and households. The focus here is on the top 5 raw materials. Where necessary, external parties with specific expertise are called in. An example of this is AquaMinerals. An increasing group of regional water authorities is interested in participating in this organisation which has expertise in the field of commodity sales.

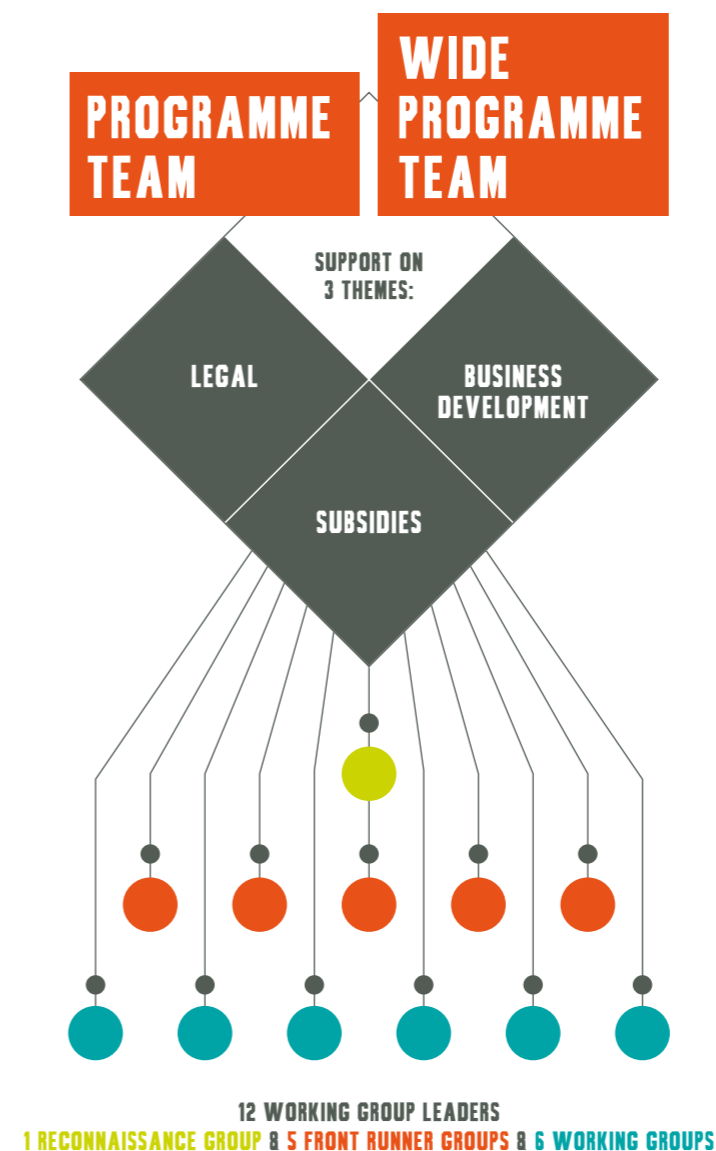
BUDGET

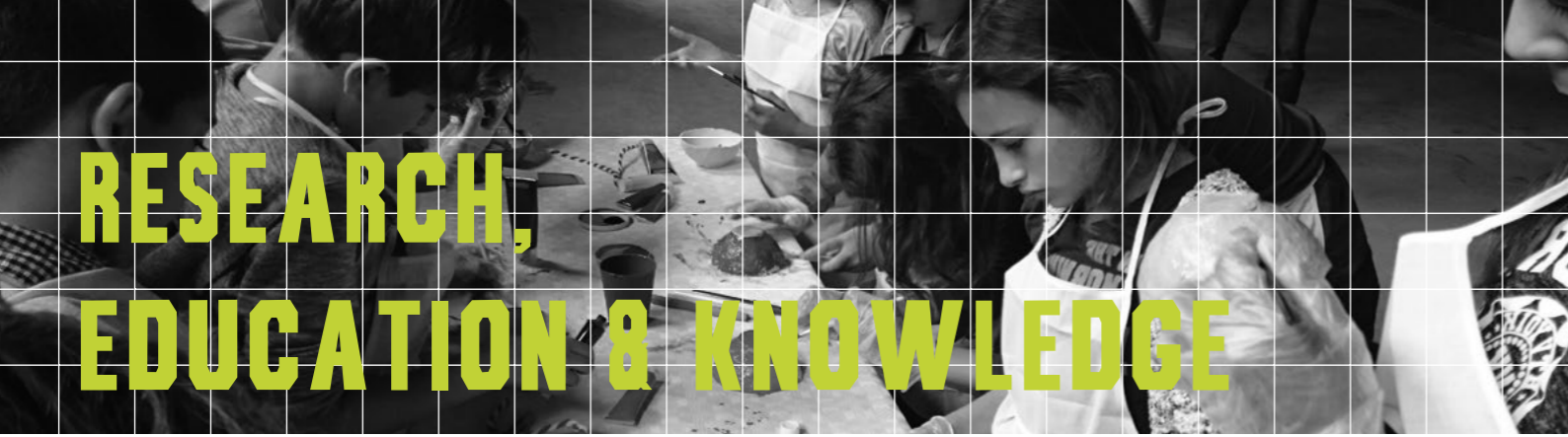
The Energy & Raw Materials factory had a budget of more than €650,000.- in 2017. This amount is jointly contributed to by all regional water authorities. Each year, the programme team draws up a budget and reports to the steering committee of the Energy & Raw Materials Factory on the expenditure and results achieved.

ORGANISATION DEVELOPMENT

2017 was an important year for the Energy & Raw Materials factory when it comes to organisational development. The front runner groups for the top 5 raw materials were established in mid-2017. These are the leader groups alginate, biomass, bioplastics, cellulose and phosphate. The division of roles between the working groups is geared to each raw material. The front runner groups are mainly involved in increasing market share. This can be done by lowering the costs of production or by developing better marketing chains and, in particular, jointly investing in and scaling up the pilots. They connect to the working groups that continue to explore the broad playing field for improvements, applying new technologies and the like. The programme team facilitates this process by making so-called roadmaps together with the leader and working groups, thereby pursuing sharply-defined ambitions and goals.

The STOWA study into its own role in the further development of the Energy & Raw Materials Factory was completed in 2017. The conclusion is that STOWA will not play an organisational role in the Energy & Raw Materials Factory, other than sitting in the steering committee. For the financing of larger pilots and demonstration factories, the administrative anchoring, in particular the collective ambition and the management of the new organisation – including the front runner groups – a proposal will be made in 2018 together with the CWE (Committee Water and Emissions of the Dutch Water Authorities). This means that organisational development will also remain an important topic in 2018.





RESEARCH, EDUCATION & KNOWLEDGE

The Dutch regional water authorities develop knowledge together with governments, businesses, and education and research institutions. All acquired knowledge and experience is optimally shared.

The Energy & Raw Materials factory has accumulated a lot of knowledge in recent years about recovering raw materials and producing energy from wastewater as well as the transition to a circular economy. We share this knowledge within our network that consists of partners, water authorities, researchers, market parties and knowledge and educational institutions. Sharing knowledge remains an important spearhead for us.

EDUCATION

The Energy & Raw Materials Factory is regularly invited to give guest lectures, in 2017 this was for example at the Free University in Amsterdam and Amsterdam High School. By connecting with education, (new) knowledge is collected, shared and the ideas of the Energy & Raw Materials Factory are spread further. For the course 'Water treatment as a source of energy and raw materials' from PAO (Stichting Postacademisch Onderwijs) the Energy & Raw Materials Factory delivered the largest part of the course material. Last year we also looked to connect with secondary education, partly through our contribution to the development of the Poepfabriek teaching programme and cooperating with WaterWise.

In 2017 we worked on an edition of the comic booklet Droppie Water, meant for primary schools. In the theme booklet on wastewater treatment, the recovery of energy and raw materials also receives attention.

EXPLORING INNOVATIONS

In addition to recovering raw materials from our wastewater, we continue to look for innovations that contribute to the sustainability of the regional water authorities and in particular the wastewater chain. The scouts are there to annually translate some new developments into the working practices of the regional water authorities and to share this knowledge with the members. Due to the organisational development and the establishment of the leader groups, this has received too little attention in 2017. Nevertheless, there are now plenty of opportunities to explore, such as humic acid, artificial intelligence, thermal energy for housing (the Union of Water Authorities expert group) and hydrogen. The steering committee agreed that promising concepts could create a new working group to make the concept 'market ready'. In the ultimate case, a new market with an associated leader group will finally be created, with which the Energy & Raw Materials factory will continue to innovate and develop.





COOPERATION

The Energy & Raw Materials Factory works closely with the Dutch Water Authorities and with organisations such as KWR, AquaMinerals, the Dutch Biorefinery Cluster (DBC) and Groen-gas Nederland.

Cooperation is necessary to achieve a circular economy. In many places, the regional water authorities are developing new initiatives with the result that they must apply more situational awareness. We actively seek the business world and are open to their goals and interests. Knowledge of the market is essential for this, but also a clear positioning and a view of our own role.

COOPERATING AT LEGAL LEVEL

Raw materials still have the status of ‘waste’ and this hampers us in marketing these raw materials. Together with the Dutch Water Authorities, the members of the Legal working group bring this to the attention of Rijkswaterstaat and the Ministry of Infrastructure and the Environment and also the ministry of Economic Affairs in all possible ways. This should lead to clear standards for the recovered materials from wastewater treatment plants.

Legal assistance

The working group has updated the legal guide under the direction of the corporate organisation expert Berenschot. The guide shows which legal aspects are involved in the production and supply of energy and raw materials. The guide, mandatory material for every ground-breaking project, can be found on the website of the Energy & Raw Materials Factory and of the DWA/UvW.

Legal obstacles

When regional water authorities want to utilise opportunities with struvite, for example by selling it abroad, struvite must formally be recognised as a non-waste product. Risks must then be excluded. The RIVM sees no indications that the use of struvite poses an increased risk for the environment or public health for specific chains. However, more monitoring is needed. In 2018 the regional water authorities will carry out this monitoring. At European level, the Legal Working Party of the Energy & Raw Materials Factory advises on how struvite can be admitted as fertilizer throughout Europe. The terms of a Green Deal will be examined to see how the obstacles to exporting it to France can be resolved.

RIVM

The National Institute for Public Health and the Environment (RIVM) wants to develop a working method for tackling sustainability issues. At the initiative of RIVM, we discussed the core issue of the Energy & Raw Materials Factory, the sustainability of ‘wastewater treatment’, in three workshops in 2016. The focus is on the raw materials phosphate and cellulose and associated value chains. RIVM has now further developed the approach to sustainability issues on the basis of the three workshops. In 2017, an environmental expert from RIVM, Michiel Zijp, obtained his doctorate at the Radboud University Nijmegen on the approach to sustainability issues.

WATER IN THE CIRCULAR ECONOMY

The Energy & Raw Materials Factory and STOWA want to use WiCE “Water in the Circular Economy” together with the drinking water sector to prepare steps to prepare the sectors for “The Netherlands Circular in 2050” and the energy transition.

Research themes within the programme are:

- recovery and reuse of raw materials from water chains;
- reuse of freshwater, a sector-wide approach to water quality;
- energy;
- climate adaptation and governance of value in the sector.

AQUAMINERALS

Until the end of 2017, AquaMinerals was the marketing organisation for the raw materials of the drinking water sector. Since this year, Regional water authority Aa en Maas has joined it as shareholder.

As a regional water authority, finding sustainable and profitable marketing chains is of great importance in order to maximize the value of raw materials from wastewater. For the raw materials struvite, sand and cellulose, we work together with AquaMinerals. An example is the development of new marketing/product chains for struvite by the Energy & Raw Materials Factory and the regional water authorities in consultation with AquaMinerals.

GOVERNMENT-WIDE CIRCULAR ECONOMY PROGRAMME

The Netherlands has the ambition to be completely circular by 2050. To this end, in January 2017, a raw materials agreement was signed by 180 parties, including the Dutch Water Authorities. State Secretary Dijkma (Infrastructure and the Environment) and Minister Kamp (Economic Affairs) will make agreements with businesses, governmental organisations and civil society organisations to achieve a hundred percent circular economy through so-called transition agendas. To achieve this, they will meet each other to draw up an action plan for various subjects. The regional water authorities are willing to do this for the subjects biomass and food, plastics and construction.

Investment agenda

In March 2017, the Dutch Water Authorities, IPO and VNG offered the new government the investment agenda Towards a Sustainable Netherlands. To speed up the transition to an energy-neutral and climate-proof Netherlands, provinces, municipalities and regional water authorities have joined forces. The new government has been asked to invest in national programmes and to remove bottlenecks in legislation and regulations. This is the first time the local authorities have made a joint proposal for the cabinet formation.



DUTCH DESIGN WEEK

Regional water authorities win high-quality raw materials from wastewater and thus make an important contribution to a circular and sustainable economy. With that message, the water authorities were at the Dutch Design Week in October 2017 and showed an urn made from bioplastic from wastewater. Studio Nienke Hoogvliet made this urn and showed in a few steps during the Dutch Design Week how bioplastic is made from bacteria in wastewater. With the urn as a symbol, Hoogvliet links the theme of circularity with the transient nature of man; circularity in optima forma.



Dutch Design Week 2017



Water tube Aqua Tech 2017

AQUATECH

At the international AquaTech exhibition In a 17-meter-long tunnel, made to look like a large tube, the regional water authorities, showed how they recover raw materials from wastewater and how the raw materials are used. The tube was part of the Circular Economy Expo. The trade fair and the tube were well attended and useful contacts were made. On one of the exhibition days, programme team member of the Energy & Raw Materials Factory Enna Klaversma gave a presentation on the recovery of energy and raw materials from wastewater.

GRÜNE WOCHEN BERLIN

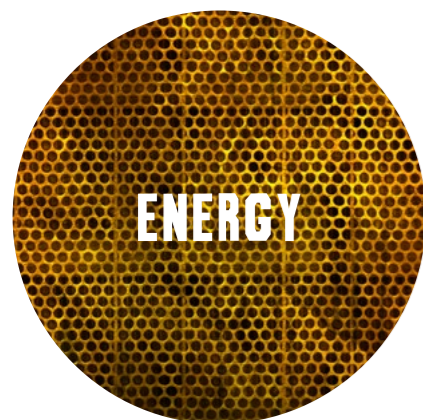
The Energy & Raw Materials Factory presented itself during the international Green Week in Berlin. This large commercial agricultural trade fair and political networking event is the joint start of the new year for all business and political decision makers from the Dutch agrofood sector. State Secretary of Economic Affairs, Martijn van Dam visited the stand of the Energy & Raw Materials factory, which consisted of a table and lamps made of cellulose from wastewater, and entered into dialogue with innovation technologist and expert Jan-Evert van Veldhoven (Regional water authority de Dommel). Also politician Joop Atsma talked to us about the work that the water authorities are doing towards the transition to a circular economy.

PRODUCTS

NEO ALGINATE

Wastewater is valuable. With innovative and smart technologies, the regional water authorities can recover energy and raw materials from wastewater that are beneficial to industry, agriculture or other parties. Energy is used for the wastewater treatment process of the regional water authorities, as transport fuel or for the sustainability of neighbouring companies. Raw materials recovered from wastewater, such as phosphate, cellulose, alginate and bioplastics can be used for many applications.

NEO alginate or 'Alginate like exopolymer' (ALE) is an alginate-like biological product that we can recover from the sludge granules formed during the Nereda® treatment process.



NEO alginate is a product with special properties that can be used for a variety of applications. For example as a thickener, or as a binding agent for the production of fertilizer granules. But also as 'bio stimulant' that ensures that crops absorb fertilizer easier, grow better and become more resistant. It can also be used as a coating to give concrete a longer life through better curing. And it is possibly suitable as a fire-resistant coating and in insulating material. At home and abroad, there is great interest in the developments regarding NEO alginate.

THE NATIONAL ALGINATE DEVELOPMENT PROGRAMME NAOP

In a special programme, a number of regional water authorities, the business community and knowledge institutions are currently working closely together on the recovery of NEO alginate from residual and wastewater. This is done, among other things, by researching the properties and possible applications of the recovered product and on the best methods for recovery. Research is also being conducted into the marketing and sale of it.



What is Nereda®?

Nereda® is a sustainable treatment technology in which the working agent, activated sludge (these are the bacteria that feed on the organic waste in the water) does not form flakes, but granules. As a result, this sludge settles much faster and easier. The technology achieves excellent treatment results, takes up little space (no large settling tanks needed) and uses relatively little energy. Moreover, alginate can also be recovered from the sludge granules.

NEO alginate/ALE from residual and wastewater: what's in a name?

It is in fact a mixture of different 'biopolymers'. It has some properties of the alginate that is made from seaweed, but also properties that are very different. Scientifically it is described as 'alginate like exopolymer' (ALE).

In fact, it is a new and unique material! The working name NEO alginate is still used: Nereda® Generated alginate. At the moment the parties involved are looking for a definitive brand name under which it will be marketed.

PILOT RESEARCH AT WASTEWATER TREATMENT PLANT (WWTP) APELDOORN

In 2016, a variance study was completed into various recovery processes. 2017 saw the start of the pilot study into alternative recovery methods which have a clear impact on the business case. A total of six alternatives were compared. The pilot study has yielded a great deal of knowledge and interesting results regarding to, amongst others:

- The amount of NEO alginate that can be expected per alternative on a practical scale.
- The influence of the different alternatives on the specifications of the product.
- Scale effects, the separation of streams (such as sludge and water) react very differently at pilot scale than at lab scale.
- Points of attention for the design process; the critical process components.

The results of the pilot study form the basis for the design process of the recovery installations. Parallel to this, a number of aspects are currently being investigated at lab scale, including the optimal balance between retention time, pH and temperature during the recovery phase and the effect on the product quantity and specifications.

CONSTRUCTION OF THE ZUTPHEN AND EPE INSTALLATION

Regional water authorities Rhine en IJssel and Vallei en Veluwe are the first in the world to build two installations, this is taking place in Epe and Zutphen. In the autumn of 2017 the construction of the Nereda® installation in Zutphen started. This installation receives the residual water from two dairy factories from Royal FrieslandCampina via a designated pressure pipeline, from Borculo and Lochem. The Nereda® process will be controlled to maximise the production of NEO alginate with the desired specifications from this industrial residual water. The construction of the recovery installation is expected to start in the second half of 2018 and will be completed in early 2019. Parallel work is being done on the installation in Epe. This installation will focus on the production of NEO alginate from communal granular sludge.



NEO ALGINATE AND THE MARKET

Following the successful laboratory test for the use of NEO alginate as a binding agent of pelletized fertilisers in the past year, a larger-scale study was carried out in 2017. The results achieved at lab scale were confirmed in this test. In other words, NEO alginate is an interesting binding agent for pelletizing for example, struvite. In particular, the required dosage is noticeable low, on the basis of dry matter, up to more than 10 x lower than other binders, such as lignosulfonate.

Another application for the short term is the use of NEO alginate as a bio stimulant in agriculture and horticulture. In addition, we focus on the further development of unique applications, such as the coating of concrete or the treatment of building materials to increase fire resistance. There is cooperation with a marketing party that sells the NEO alginate. Alginate from industrial wastewater shows interesting opportunities that can lay the foundation for alginate from municipal wastewater.

SUBSIDIES

The financing of the pilot installation and research costs was made possible by RVO through the Top Consortia for Knowledge and Innovation (TKI) subsidy scheme. The financing of the demonstration plants in Epe and Zutphen was made possible by RVO through the Demonstration Energy Innovation (DEI) scheme and through development support from the province of Gelderland. A LIFE subsidy has been obtained this year for the optimisation of the operational management, aimed at both final applications and reaching the specification of the NEO alginate.

PRODUCTS BIOPLASTICS

Bioplastics (PHA) is made from sewage sludge and added fatty acids and is completely biodegradable under natural conditions.

WHAT CAN YOU USE BIOPLASTICS FROM WASTEWATER FOR?

Bioplastics can be used as a substitute for various plastic products such as biodegradable crates for aquatic plants or for an alternative to lead fishing weights.

DEVELOPMENTS

Regional water authorities can make a very good quality bioplastic (PHA) with predictable properties with the help of the bacteria from wastewater treatment plants. To be able to demonstrate this is a success in itself. PHA from this source is made with a 70% lower environmental impact than the PHA currently on the market. Moreover, it can be produced at an acceptable cost price.

In 2017, the Phario 2.0 demonstration project was prepared and ready to be put into operation. This concerns the realisation of an installation for the production of dried PHA-rich biomass. In this installation a few thousand kilograms of PHA bioplastic can be made. Recovery of the PHA can take place on demand from the market and in a campaign-based manner in existing equipment in Delft at the Bioprocess Pilot Facility company. This means that high investments in recovery equipment are prevented.

PHA

PHA stands for polyhydroxy alkananoate. This is a special type of plastic (biopolymer) that is made by the regional water authorities by bacteria produced from wastewater. For the bacteria, the plastic is a kind of energy reserve. They make the polymer when there are varying amounts of food. When there is a lot of food they make a supply of this polymer, which they eat when there is little food. This also explains the good degradability of this polymer.

THE MARKET

The regional water authorities aim to use the positive results from the Phario project to interest industrial partners in particular in the next steps. At a conference in Berlin, Phario was presented to the European plastics industry where a lot of interest was harvested. Phario has been given a more business-like look with its own website and a team that deals with the market. Intensive contacts with compounders and end users in Europe make clear that there is demand for this type of bioplastic. Other PHA producers are also scaling up which gives a positive signal for Phario. The demand for PHA is growing, partly due to the social attention for pollution by “normal plastic” (plastic soup). PHA is one of the few bio-based and bio-degradable plastics used in home composting, industrial composting as well as in water.

PARTNERS

In the Phario project, the regional water authorities Brabantse Delta, Wetterskip Fryslân, De Dommel, Hollandse Delta and Scheldestromen work together with HVC, SNB, STOWA, TUDelft, Paques and Wetsus and now also the Energy & Raw Materials Factory.

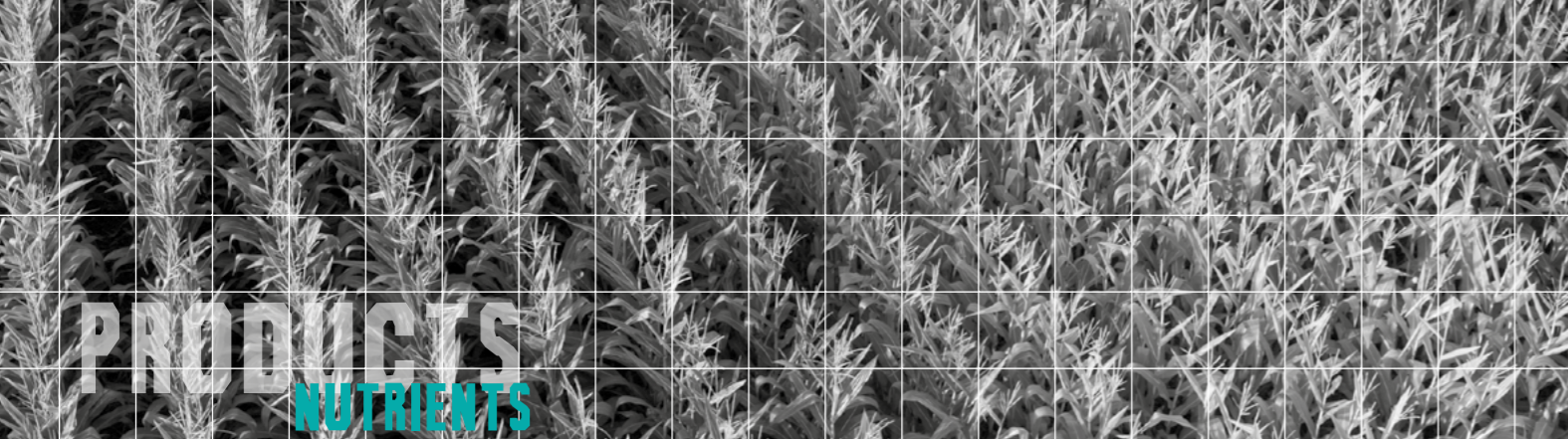
Making Waves

In September 2017, the bioplastics produced by the regional water authorities received attention during ‘Making Waves’, an event organised by the Ministry of Infrastructure and the Environment where innovations in the field of water, food, health and energy are central.

The Phario project gave a pitch for an international audience, including former Secretary General Kofi Annan.



Urns made of PHA bioplastic



The phosphate recovered by the regional water authorities falls into the category of nutrients. Phosphate is one of the raw materials that are becoming scarce. Phosphate is used in the food industry and it is expected that stocks will be depleted within 70 to 100 years. However, the Netherlands is the only country in the EU to have a surplus of phosphate due to excess manure.

Humic acids

Humic acids are of special interest to the Nutrients working group. These acids have a positive effect on the absorption of phosphate by plant roots. As a result, plants develop better. In 2018, field trials will be conducted with humic acids in collaboration with OPURE and an already running TKI project (Top Consortia for Knowledge and Innovation).



STRUVITE

The regional water authorities mainly recover phosphate in the form of struvite. This is used as a raw material for fertiliser. It is also possible to recover phosphate from the ash that is formed after the incineration of sewage sludge.

RESEARCH

Falling world reserves, closed loop and focussing on a circular economy mean that the working group has broadened its focus. In addition to phosphate, we now also look at other nutrients and bio stimulants that we can recover from wastewater such as humic acids and ammonium.

COOPERATION

- **Dutch Biorefinery Cluster**

With the Dutch Biorefinery Cluster (DBC), the Nutrients working group together with the business community (fertiliser manufacturers) paid a working visit to Seville. The use of recycled materials in (artificial) manure was a topic discussed.

- **European Sustainable Phosphorus Platform**

The European Sustainable Phosphorous Platform (ESPP) is a sparring partner of the Nutrients working group in adapting European legislation and regulations. Meetings of the ESPP related to adaptation of the EU fertilizer directive 2003/2003 were attended.

- **STRUBIAS**

For EUREAU, two members of the Nutrients working group have been appointed as experts in the European STRUBIAS project. Working on the inclusion of struvite, Biochar and Ash as component material category (CMC) in European manure regulations. Input has been provided in a technical draft report.

- **Nutrient platform**

The Nutrient Platform has been a permanent member of the working group on nutrients for several years.



Ammonium recovery

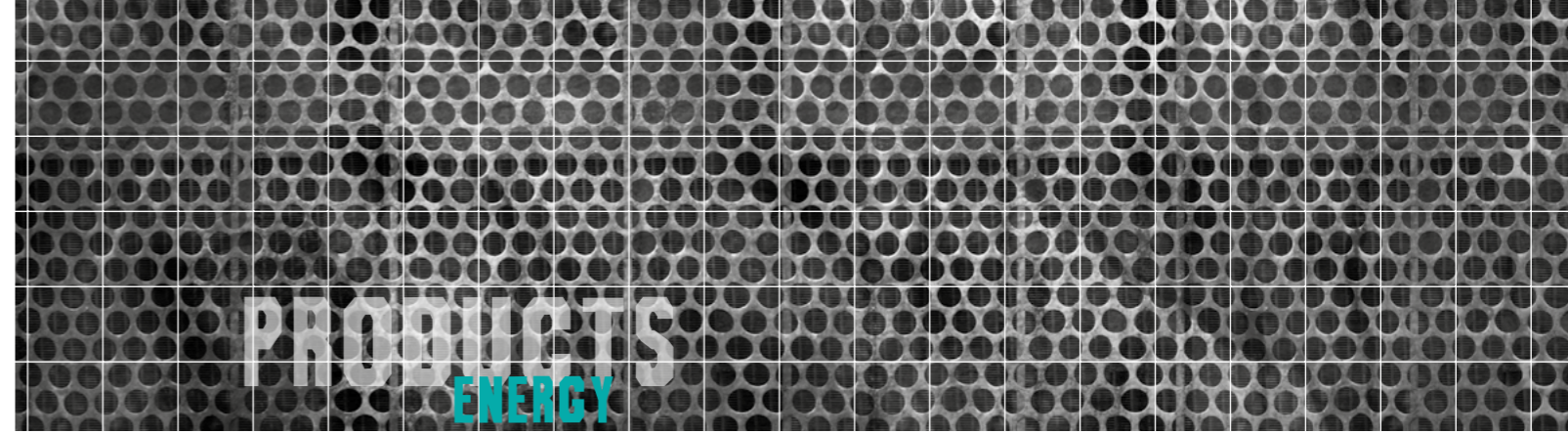
Ammonium recovery is a challenge for the future. Ammonium is currently being destroyed in a wastewater treatment plant with energy (for aeration). We think this can be done differently. Research has been done by a graduate student on ammonium absorption on a resin. It looks very promising and this too will be followed up in 2018.



Green Deal
The Dutch Water Authorities and the Nutrients working group are joining forces in the Green Deal, in which we want to change/simplify national regulations. The investment agenda "Towards a sustainable Netherlands" was discussed in the working group. Another important point is the 'waste status' of products that we recover from wastewater. Struvite is specifically highlighted here.

MARKET

With a number of smaller and large international (new) market parties, in cooperation with AquaMinerals, explorations have been made into the sale of struvite. Among other things for use in the derogation market in the Netherlands. To scale this up to a relevant level, higher production with constant quality is required.



A smart combination of existing and new technologies makes it possible to recover energy from wastewater. Energy that the regional water authorities can use to provide their wwtps with energy. And also energy that can be delivered to households and businesses. In theory, wastewater contains eight times more energy than is needed to treat it, so the possibilities are enormous. In the meantime, every regional water authority is in its own way busy recovering energy from wastewater. The concept has therefore already proven itself several times.



WHERE CAN YOU USE ENERGY FROM WASTEWATER?

The regional water authorities can use the energy they gain from wastewater to supply households with electricity or as fuel for cars.

DEVELOPMENTS

The Energy Working Group of the Energy & Raw Materials Factory has set itself the goal of exchanging knowledge and experiences between regional water authorities and to follow new developments.

STUDIES

Under the flag of STOWA, a number of studies were set up in 2017. Members of the Energy working group have participated in these studies via the supervisory committees. They contributed to the following studies:

- Review of the applications of biogas from sludge fermentation.
- The Wastewater Treatment Plant as a Power Bank.
- Energy Optimisation of Aeration Systems.

Noodvermogenpool

In the context of knowledge sharing, a presentation was provided by Noodvermogenpool NL (www.nlnvp.nl) in 2017. This is a joint venture between authorities that together supply emergency power to TenneT. TenneT uses emergency power in ultimate emergency situations to save the balance on the national transmission grid. For these rescue operations, TenneT may need either extra power or less power. The pool participants receive compensation for the incidental availability of their energy supply / emergency power supply. Each pool participant retains full control over its own energy supply and the business process is not disturbed. The one-off costs can usually be recouped within a few months and the variable costs, as a result of a request, are reimbursed. The risks are limited. The regional water authorities are an interesting partner to participate in the NL Emergency Power Pool with their power/heat generation plants at wastewater treatment locations.

Wide network

The working group maintains a wide network with other energy professionals. In 2017, for example, contact was made with Green Gas Netherlands, the regional network operators and the National Green Gas Acceleration Table.



COOPERATION

The members of the working group are involved in the development of the Green Deal for sustainable energy and the working group is part of the control group of the Dutch Water Authorities. The members are represented in the various expert teams, such as the expert groups sun, wind and heat. In this way the connection between the various energy activities of the regional water authorities is ensured.

BROADER INCENTIVE SCHEME SDE+

The broader SDE scheme went into effect in 2018, work was done in 2017 to achieve this. Regional water authorities can use the scheme to apply for a subsidy for the production of extra biogas from sewage sludge. It no longer matters with which technique the biogas is produced. All projects at wastewater treatment plants that increase biogas production by at least 25% are eligible for SDE+ subsidy. At the request of the Dutch Water Authorities and the Energy & Raw Materials Factory, a technology-neutral category –also called a generic regulation– for the production of extra biogas from sewage sludge will be added to the SDE+ in 2018. This gives innovative techniques for producing biogas also a chance for SDE+ subsidy.



OPENING ENERGY FACTORY TILBURG

In October 2017 regional water authority De Dommel officially opened the Tilburg Energy Factory (Energiefabriek). By recovering biogas and phosphate from wastewater treatment sludge, the invested millions will be recouped within ten years. Moreover, it is sustainable: the entire wastewater treatment plant runs on its own energy. Central to the production process of the Energy Factory is a Cambi installation; the first in the Netherlands. The sludge is treated by means of thermal pressure hydrolysis before it is pumped into the digesters. The temperature is raised to 155 degrees C and the pressure to 5 bar, which is sufficient to crack the strong cell structure of the sludge. As a result, more biomass is released than before. It produces 20-30% more biogas in the digesters than by conventional fermentation. The Cambi plant, even produces a surplus of biogas which is transported to the neighbouring company Attero, which upgrades it to natural gas. Thanks to the Cambi treatment, the digested sludge is a lot easier to dewater, which means less dewatered sludge needs to

be transported to the incinerator. That saves about 60,000 kilometres of transport per year. The water fraction recovered during dewatering goes to the new Phospaq plant, which recovers phosphate by adding magnesium. The final product is struvite. Residual water that is left over then passes through the Anamox plant that removes about 900 kilos of nitrogen per day. The Tilburg Energy Factory ensures that waste becomes a valuable raw material.

ENERGY GENERATED BY REGIONAL WATER AUTHORITIES

The energy that the regional water authorities generate is called “Waterschapsenergie”. The brand name “Waterschapsenergie” has been around for some time and in 2016 and 2017 research was carried out to determine how the brand can be developed further. This has been acknowledged at management level and together with communication professionals, methods to give this development shape are being looked into.

PRODUCTS

BIOMASS

Regional water authorities annually harvest a large amount of water plants, reeds and grass. There are many ideas for processing this “waste” as a new raw material.

WHAT IS BIOMASS USED FOR?

Biomass can be fermented or composted.

Bio refining can convert biomass into components such as proteins and fibres. These products can be used as raw materials for the production of cardboard, building materials, chemicals, biopolymers and animal feed. It can also serve as a raw material for biofuels that replace fossil fuels such as coal and oil and reduce CO₂ emissions. Organic polyesters can also be made from biomass, which can serve as a basis for products such as laminate and car dashboards.

A major problem for the flushing and draining in our water system is the rampant marsh pennywort plant. This species is now a potential source of sustainable proteins and fibres.

RESEARCH AND INNOVATION

- **Bio composites**

The STOWA project 'Circular bio composites, based on residual materials from regional water authorities and nature organisations', focuses on product development and is almost complete. The aim of the research is to determine which pre-processing is necessary and what product characteristics the bio composites of the various biomass streams have.



Park benches made of bio composite

To make bio composites from aquatic plants, reed crops and grass, the clippings must be made sand-free, dry and small. Simple pre-processing methods were tested in the project. The research into bio-composites has yielded a good recipe for making bio composites from waste streams from common reed. However, it is difficult to harvest reed of sufficient quality. The regional water authority Waternet now owns eleven bio composite park benches. These benches are used, among others, at events like the completion of dyke improvement projects. Research will take place in In 2018 to determine whether it can be used in other building materials, such as river bank protection planks.



A Grassa mobile refining unit

- **Bio-refining**

In 2016, STOWA launched research into how regional water authorities can recover proteins and fibres from biomass via bio-refining. Together with ten regional water authorities and Rijkswaterstaat, practical tests have been carried out with a mobile refining installation. The results of these tests led to modifications to the installation and the emergence of a 'fourth generation installation'. The regional water authorities show a healthy interest in this research. The STOWA report is expected mid-2018.

- **Fungi**

Initiatives have been taken here and there, to make building materials from biomass with the help of fungi. The fungal threads form the “reinforcing steel” as it were. It is important to make all of these initiatives visible.

- **Paludiculture**

Paludiculture is the cultivation of crops on wet peatlands. There are several projects in the Netherlands where biomass is expressly cultivated to develop business cases. This creates interesting cross-connections with the working group biomass, but also with the working group cellulose. In Paludiculture projects, fibres are recovered from the bulrush. Ways to market it are being sought.

COOPERATION

The Biomass Alliance is an initiative of many regional water authorities together with other organisations. There is overlap between the Biomass Working Group and the Biomass Alliance and several people are members of both groups. In this way there is good contact between both initiatives and it is important to keep it that way.

The Ministry of Infrastructure and the Environment is preparing an amendment to the Plant Dispensation Exemption Regulation. This success is partly due to the efforts of a number of members of the Biomass working group and the Legal working group who also participated in the Biomass Alliance.

LEGISLATION

The category “Agricultural and forestry material” is included in the Plant Dispensation Exemption Regulation. This again, makes it possible to take non-hazardous agricultural and forestry material outside a facility onto or into the ground. It will also increase the span of distance that materials can be transported before sale which complies with the wishes of other authorities and the sector. With this amendment it will still be possible to use non-hazardous agricultural and forestry material in or on the ground, even after amendment of Article 10.1a of the Environmental Management Act. The purpose of the expansion of the sales area is to comply with the Exemption Regulation Plant Matter in Agriculture. For regional water authorities, road authorities and managers of nature reserves, the extension of the distance limit will lead to a reduction in costs because it is then possible to market verge cuttings and clippings from nature reserves at greater distances.



There is a lot of toilet paper in our wastewater. Normally this is not specifically separated from the wastewater, but with new techniques the regional water authorities separate toilet paper from the wastewater by using micro screens before it enters a treatment installation. We call this screenage. Due to screening, the rest of the treatment plant is relieved of it and expensive expansions prevented. About 50% of the screenage material consists of cellulose fibres. Cellulose has many attractive properties.

WHAT IS CELLULOSE RECOVERED FROM WASTEWATER USED FOR?

A regional water authority can save money and energy by using screenage itself when dewatering sewage sludge to reduce the amount of dewatered sludge. Cellulose fibres from screens can also be used as raw materials for products. For example as a drip inhibitor in asphalt or as a raw material for insulating material in the building industry.

FILE FORMATION 'END OF WASTE STATUS'

At the moment, recovered cellulose is disposed of as waste. The supplier of the product is responsible for the legal status of the delivered product. In 2016 all bottlenecks and possible solutions were identified. The Cellulose working group gave a follow-up to this in 2017 by sampling and analysing screenage from a number of micro screens. Using this information, the working group compiled a file on the quality of screenage. To comply with health regulations, an assessment framework will be developed by RIVM on behalf of the Ministry of Infrastructure and Water

Management. The Energy & Raw Materials Factory and Waternet are actively involved in the development of this assessment framework and it comprises of seven groups of points of concern: residual medicine, antibiotic-resistance substances, pathogens, substances of very high concern, heavy metals, radio activity and a contribution to sustainability. The Legal working group focused mainly on the influence on the raw material phosphate. The Cellulose working group has used this knowledge again in research into micros and residual medicine. The results are expected in mid-2018.



WWTP AARLE-RIXTEL

The regional water authority Aa en Maas is working on the Screencap project in Aarle-Rixtel. The screening efficiency at this wwtp is lower than it was designed for. The yield of undissolved matter is about 20- 25%, while this was designed to be 49%. The COD yield (chemical oxygen demand) is around 10 to 15%, while this was designed to be 30%. As a result, less screenage was produced than expected. By using micro screens to recover cellulose before it enters the treatment plant, the aeration requires around 15% less energy and about 10% less sludge is produced. As a result, the capacity of the entire sewage treatment plant increased by approximately 10%.

WWTP DE BEEMSTER

During 2017, the Cellu2PLA subsidy project monitored the operation of the micro screen installation at the wwtp De Beemster (regional water authority Hollands Noorderkwartier). The purpose of the monitoring was to determine the effect of the micro screens on the wastewater treatment process. The screening yield on the removal of undissolved components was on average 38% and the energy consumption decreased by about 15%. The final measurement results are being used for both an economic analysis and a life cycle analysis. All results are included in a STOWA report that will appear in the second half of 2018. This contains the findings of the processing of screenage to PLA. Now that the monitoring phase has been completed, screenage is no longer processed by subsidiary partner Attero. The screenage from regional water authority Hollands-Noorderkwartier is currently being processed by GMB BioEnergie in Zutphen. There it is organically dried and eventually used as fuel.

CADoS

The project CADoS (Cellulose Assisted Dewatering of Sludge) was ended after four years. The research project CADoS focused on a far-reaching optimisation of both the water line and the sludge line. The process reduces the operational costs in the water line and at the same time the sludge processing is greatly simplified. There are also opportunities to use the screenage as raw material for, among other things, biogas and the production of bioplastics. The research took place at the wwtp Ulrum (Groningen). The results were shared at the Sludge Symposium in September 2017 and are shared on the CADoS website.

WWTP OMMEN

At the wwtp Ommen, a curved screen was used for screening with the aim of increasing the treatment capacity by removing inactive material (cellulose) from activated sludge. The execution was in the hands of regional water authority Vechtstromen in cooperation with the company Waterkracht, STOWA and the regional water authorities Limburg, and Rijnland. Reporting will follow in mid-2018 and consideration will be given to how a follow-up study can be set up for a more efficient removal of screenage with a better quality.

EVIDES

Two types of fine screens were tested at AWZI Schiphol by the water company Evides; namely De Salsnes CellCap and the Bellmer Turboscreen. These tests provide more insight into yields for the removal of undissolved components.



MERI F-PIT

In 2017 the STOWA research “Meri F-PIT project” started. This is an alternative screening technique used in the paper industry. The working group has stimulated this project because it introduces an essentially new screening technique. The technique aims at a form of classifying the fibres and thus a better defined product quality can be realised. A better quality of the recovered cellulose fibres offers the possibility of more high-quality reuse. The recovered fibres are being offered to a number of potential processors. In addition to the application as a drip inhibitor, it also concerns insulation material, bio composite and possibly the paper industry.

CELLULOSE AS A DRIP INHIBITOR

The useful application of cellulose from wastewater in the form of the drip inhibitor for the production of asphalt was again a great success in 2017. This drip inhibitor was specified in the tendering specifications for the road surface of the dike at Ameland. Several cycle paths and roads in the Netherlands, have been constructed using the drip inhibitor produced from screenage.

FRONT RUNNER GROUP CELLULOSE

The front runner group cellulose was started in 2017, in which six regional water authorities take part (Aa and Maas, Hollands Noorderkwartier, Fryslân, Zuiderzeeland, Vallei en Veluwe and De Stichtse Rijnlanden). AquaMinerals is supporting this group to reach a sales chain for the combined volume of approximately 12,000 tonnes of wet cellulose per year. Furthermore, the group also focuses on realising an integrated business case where the costs for separation and reprocessing at almost all wwtps (including those which do not need expansion) can be paid for from the proceeds of sales. Focus areas are separation, reprocessing and market sales. A roadmap has been developed for this.

In 2017 three routes were examined for scaling up potential: (de)centralised fermentation of screenage, the production of panels for the building industry and the production of drip inhibitors. The market chains and the companies who are leading them will be assessed by the leading group in 2018 on market potential, financial benefits, sustainability benefits and development risks. After assessment, selection and starting the construction of a reprocessing plant, production can indeed be scaled up to commercial volumes.

RESEARCH AND INNOVATION

Much attention is paid to the use of screenage and cellulose from screenage. In recent years an overview has been made based on discussions and research. In 2017 the search for other applications was expanded, including: raw material bioplastics non-food, Waste 2 chemicals, fatty acids, ethanol, sugars, PLA, reconnaissance of synergy, nappy recycling, cellulose from car wrecks in combination with screenage fibres in plastic sewer pipes.



Cellulose from wastewater conquers England

At the wwtp Geestmerambacht, cellulose is recovered, just like at wwtp De Beemster. Cirtec, a company based in Purmerend which manufactures micro screens, recovers 400 kg of cellulose per week at the wwtp Geestmerambacht and exports it to the United Kingdom. That has not gone unnoticed on the other side of the Channel. In addition to many professional publications, BBC Worldnews also pays attention to this. A great situation, because if there is demand from the market, it will be more attractive for regional water authorities to recover cellulose and we can actually be circular. Thanks to the efforts of the regional water authorities and companies such as Cirtec, the circular economy is getting a bit closer.