



The Energy Factory

for sustainable energy



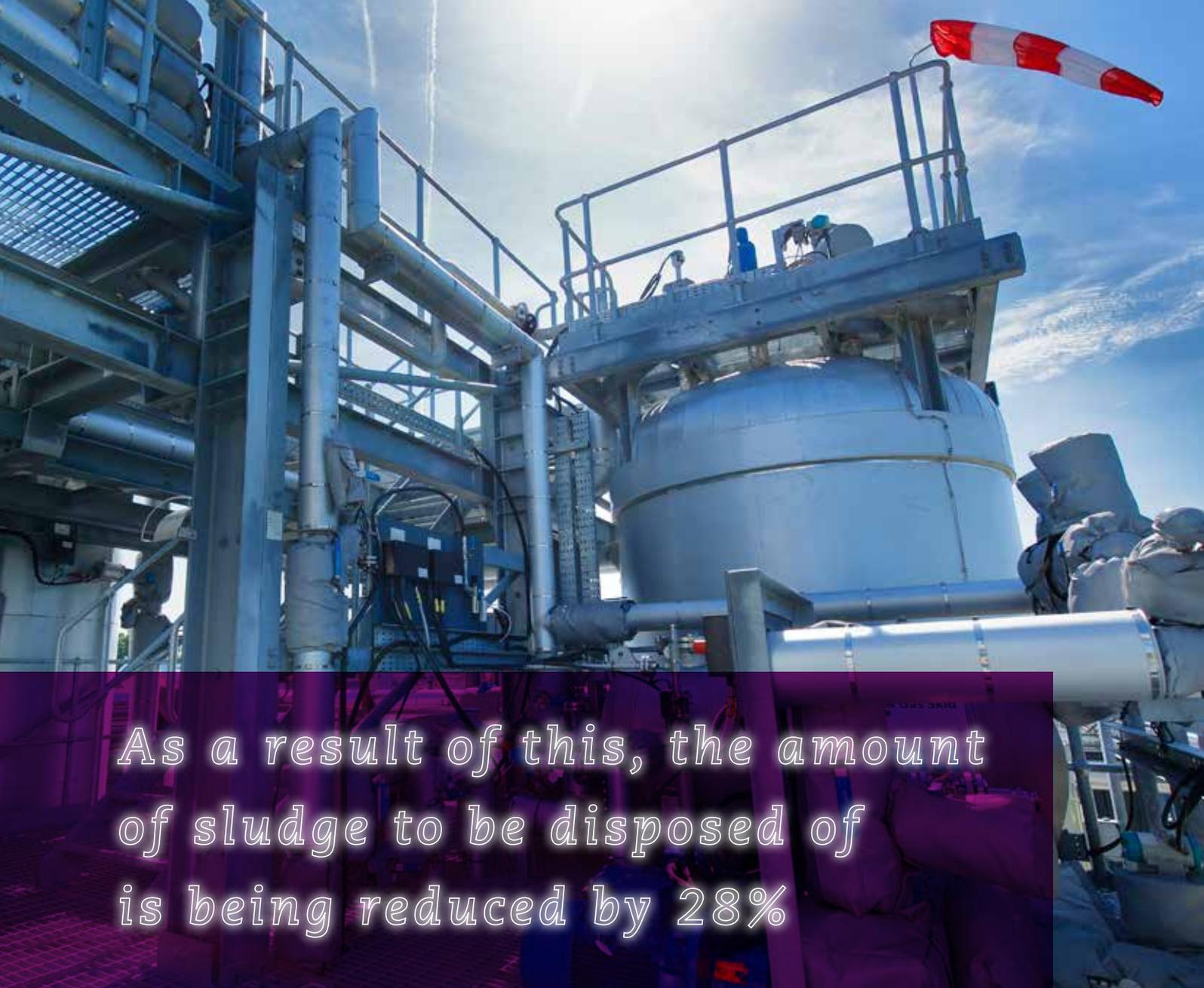
Water treatment produces energy

Water treatment doesn't necessarily have to use up any energy. It can actually produce energy! This is demonstrated by the Energy Factory, an initiative of the Vechtstromen Water Authority in the Dutch town of Hengelo. Once the facility will start operating at full capacity during the course of 2019, it will produce 16 million kWh of electricity every year. About a third of this (approx. 6 million kWh) will be used to treat wastewater at the Vechtstromen wastewater treatment plant. The remaining two thirds (approx. 10 million kWh, which equals the annual electricity consumption of 3,500 households) will be supplied to the electricity grid.

Innovative business case

When the treatment plants in Enschede and Hengelo, in the East of the Netherlands, needed to be revised drastically a couple of years ago, the Water Authority decided to opt for an innovative approach in order to make the wastewater treatment more future-proof. Cost savings and environmental benefits were the points of departure for a business case based on two innovations:

- 1.** Centralisation of the sludge digestion and sludge dewatering of nearly all treatment plants of Vechtstromen in Hengelo.
- 2.** Considerable improvement of the digestion process by breaking down the sludge first by boiling it via the Thermal Hydrolysis Process or THP (at high temperatures and at high pressure).



As a result of this, the amount of sludge to be disposed of is being reduced by 28%

Financial benefits

The financial benefits of the Energy Factory are achieved in two areas:

1. Because more sludge is being digested and the sludge can be dewatered better, the amount of sludge cake to be disposed of to the sludge incineration plant at Moerdijk will be significantly reduced, as will the associated costs.
2. In addition, the digestion has substantial biogas yields, which in turn can be converted into electricity. This means that the treatment plant does not need to buy any electrical energy, but will actually supply a large amount of energy to the grid. The operating expenses for the Vechtstromen Water Authority will decrease by EUR 1.5 million per year, and the costs of the entire project will be recovered within eight to ten years' time.

Environmental benefits

The environmental benefits are closely linked to the above. As of 1 January 2020 the Energy Factory will produce 16 million kWh of green energy. In the total coverage area of Vechtstromen, this means that the percentage of energy generated by the Water Authority itself will be increased from 30 to 37% of the total amount of energy consumed. The amount of sludge to be disposed of will be reduced by 28%. On an annual basis, this equals 500 fewer trucks driving to the Moerdijk facility for final processing of the remaining sludge. This allows the Energy Factory to contribute substantially to the realisation of both the administrative objectives of the Vechtstromen Water Authority and several climate agreements at national and European level.

the technology of

The Energy Factory



Side stream treatment ④

Like in the old situation, the sludge that ultimately remains is dewatered once more before it is taken to the sludge processing facility in the Maasvlakte industrial area. The water that is released contains a lot of nitrogen, like in the Energy Factory's traditional digestion process. It cannot be introduced into the water system, and therefore needs to be treated. The amount of nitrogen in this water that is released is too high for it to be introduced into the regular treatment process directly. For this reason the Energy Factory has now realised a side stream treatment that removes nitrogen using an energy-efficient method with special bacteria before the water is introduced back into the treatment process. Due to the large scale on which this process occurs, the investment for this side stream treatment can be recovered within an acceptable period. A great advantage of this side stream treatment compared to the old situation is that the water from which the nitrogen has been removed is a lot less burdensome for the further treatment process. Consequently, the treatment results are considerably improved everywhere.

THP reactor ①

The sludge will be boiled at a pressure of 6 bar and a temperature of 160 degrees Celsius for 30 minutes straight. The result of this process is that the sludge in the sludge digestion tanks breaks down much better, thereby allowing more biogas to be obtained from the same amount of sludge. The sludge becomes more degradable (i.e. breakdown of 38% of the dry matter compared to the previous 24%), and can be dewatered much better as well. Until recently we were faced with a fairly liquid substance from which biogas was obtained, while after processing in the THP reactor, the substance is now thicker. In addition to the much higher energy yield, the THP process also results in a considerably reduced amount of residual sludge to be disposed of, so that the processing costs and the transport costs will go down significantly as well. This is obviously highly favourable in terms of operation as well as for the environment.

Sludge digestion ②

The digestion of the pre-boiled sludge takes place in three egg-shaped digesters. This is not a new process, but in Hengelo it is being optimised by means of the pre-boiling process in the THP reactor. In addition, the digestion will now take place on a much larger scale because the sludge from the majority of the Vechtstromen treatment plants is being collected and processed in a central location. These changes have turned out to be more impactful than we anticipated. The technology is complex and requires proper process coordination. As process operators we have basically had to reinvent our approach. The process has become a lot more critical and is therefore now being monitored closely 24/7. In 2017 we performed comprehensive tests of the new technology, and we are now managing the process as desired.

Cogeneration ③

The combined heat and power (CHP) system works like a combustion engine with a generator. The biogas produced in the egg-shaped digesters is converted into electrical energy through this process. This energy is then used for consumption by the treatment plant itself, but large quantities are also being supplied to the grid. The hot exhaust gases released during this process in turn act as a source of heat for the THP reactor, where steam is produced for the boiling process.

Biogas is stored in this storage tank





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Risk control

A project like the Energy Factory is innovative, but therefore also carries more risk than a regular replacement investment. For this reason, the project, in which EUR 30 million was invested and which will run from 2014 to 2019, will be executed in phases. This will ensure that financial risks can be kept under control, and that we can account for our activities and our performance.

The majority of the investment is paid for by the Vechtstromen Water Board. In addition, the Dutch government is making a contribution towards the operating expenses of around EUR 6 million, and the Province of Overijssel is making an investment contribution of EUR 1.9 million, plus EUR 0.5 million for the side stream treatment as part of the 'New Energy for Overijssel' project.

Phase 1

The first phase focused on the construction of the THP reactor as well as on managing the entire process. This phase was completed in the summer of 2017. The detailed design, the construction and the test stage with sludge from Hengelo alone took three years. We are now fully in control of all details of the process.

Phase 2

In the second phase, running from 1 July 2017 to mid-2019, the scale of the operations is being increased, so that in 2019 the total amount of sludge from virtually all treatment plants in the coverage area of Vechtstromen will be digested in Hengelo. The treatment plants in Coevorden, Sleen and Emmen will be the only ones not digesting their sludge in Hengelo. Due to the distances between these locations, transporting the sludge to Hengelo is justifiable neither from an economic nor from a sustainability point of view.



Combining technical innovations

Social context

The Energy Factory does not stand on its own. Instead, it is part of a much wider social context, and the Vechtstromen Water Authority aims to prominently establish its presence in this social context. We have therefore opted for combining new scientific knowledge and technical innovations not in a laboratory setting, but in our day-to-day processes. The technology, which was developed in Norway, is being applied directly in the treatment activities in Hengelo. This means that the process has become more complex, but it does immediately offer certainty as to the applicability and the results that can be achieved. During the test phase, process staff at the treatment plant learnt to do their work in a smarter way and to gradually increase their control over the process. The knowledge and experience gained will be shared with other parties where

possible. After all, sustainability is something we want to keep developing in a context that is as wide as possible, with as many partners as we can.

Ambitions beyond our core tasks

The administrative agreement of Vechtstromen sets out, among other things, that the Water Authority's ambitions go beyond the fulfilment of our core tasks related to the water system and the water chain. In close collaboration with the world around us, the Water Authority needs to work on the development of far-reaching measures relating to sustainability in particular. The realisation of the Energy Factory in Hengelo is perfectly in line with those ambitions.



Credits

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