"There is a lack of openness to technology" - Edison Media - Home Generation E

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Graforce has developed electrolysers that produce green hydrogen from wastewater at low cost. However, company founder Hanke believes he is being held back by politicians.

Figure 1: Managing Director Dr. Jens Hanke with a Schott glass of the carbon produced from the methane plasmalysis

Hydrogen harbors huge energy potential and is not only in water: It also a component of many organic and inorganic compounds in industrial wastewater, liquid manure, ammonia and gases. Graforce, a company founded in Berlin- Adlershof in 2021 by mathematician and physician Jens Hanke, uses this knowledge to build plasma electrolysers, known as plasmalyzers, which produce hydrogen from energy-rich chemical compounds in waste materials - at significantly lower production costs and with higher yields: Compared to water electrolysis, methane plasmalysis requires only a fifth of the energy to produce the same amount of hydrogen, according to the company. This reduces costs from an average of 6 to 8 euros to just 1.5 to 3 euros per kilogram of hydrogen.

The market-ready, modular systems enable the production of CO2-free and CO2-negative hydrogen and could therefore make a significant contribution to the decarbonisation of the economy. In an interview with company founder and Head of Technology Hanke, EDISON partner Energate wanted to find out what has happened at Graforce in recent years. The conclusion: it's not just the technology that is complex, but also the market environment. And the politics are not exactly helpful either.

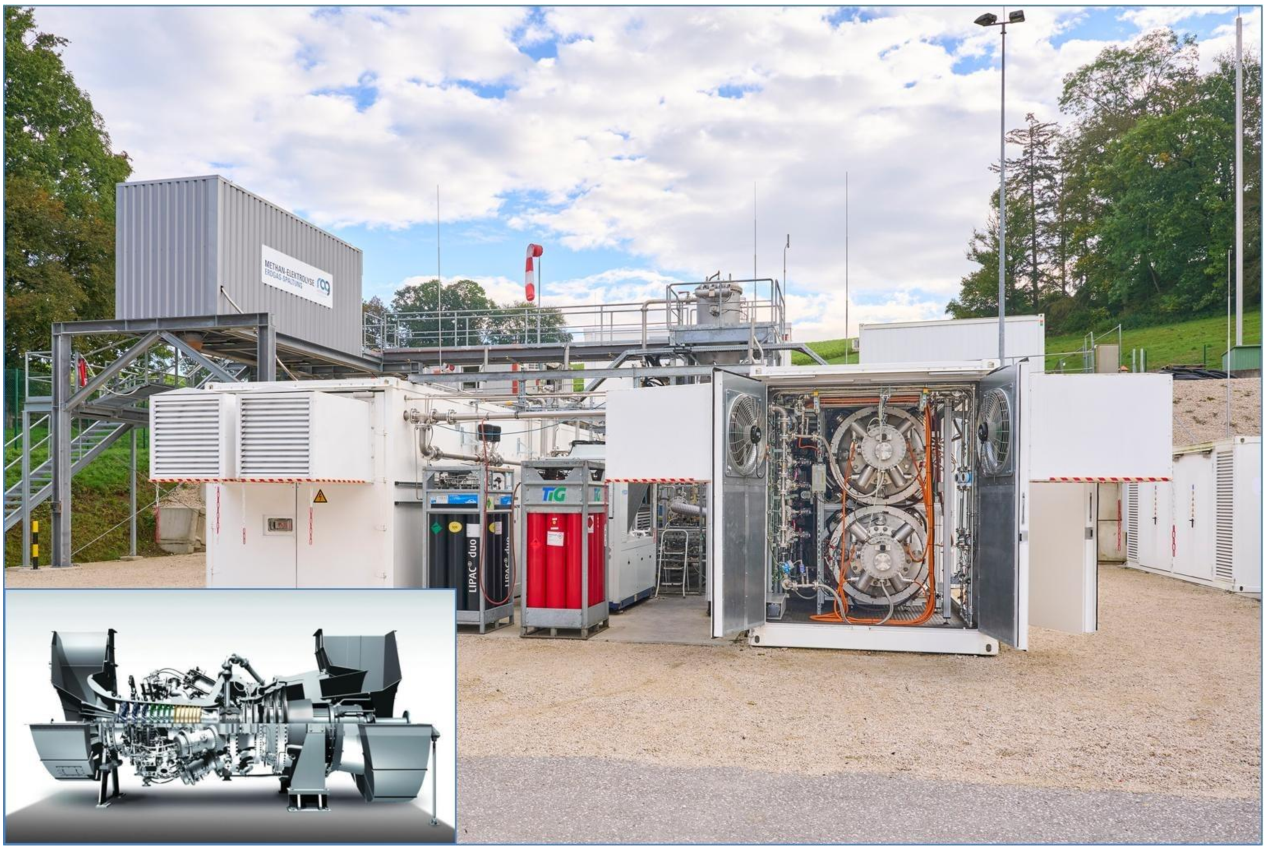

Figure 2: An innovative plant concept, in the background Graforce's methane electrolysis technology (plasmalysis) is used in combination with Kawasaki's hydrogen turbines (front) for emission-free heat and power generation. The resulting carbon can then be used as a synthetic raw material for industrial production. Image: Kawasaki Gas Turbine Europe

Mr. Hanke, Graforce uses waste water to produce CO2-free, i.e. green hydrogen. How does that work in a nutshell?

We use plasmalysis to produce green hydrogen from highly polluted wastewater. This technology is a further development of classic electrolysis - plasma electrolysis - which works with a high-voltage plasma and makes chemical reactions more efficient. The main difference to conventional electrolysis lies in the formation of the plasma: By applying a high electric field, a high-energy plasma is created between two electrodes and a carrier gas. This contains highly reactive species such as ions, radicals and excited molecules that accelerate and optimize chemical reactions. Thanks to the higher energy levels of plasma electrolysis, alternative reaction mechanisms are activated that enable more efficient splitting of molecules.

It's about wastewater as a raw material. To what extent are pollutants a challenge?

Wastewater plasmalysis was specially developed for wastewater treatment plants. Highly contaminated centrate or vapor water has a much higher concentration of pollutants than normal wastewater and poses a major challenge for conventional processes. Plasmalysis technology can eliminate up to 75 per cent of the ammonium load in water. The energy obtained in the form of hydrogen can then be utilized, while the release of nitrogen makes cost-intensive deammonification superfluous. This significantly reduces the operating costs of wastewater treatment plants and at the same time contributes to energy generation.

Is plasmalysis only suitable for extracting hydrogen from wastewater?

In addition to water and wastewater containing ammonium, hydrocarbon-rich media such as natural gas, biogas and flared gas can also processed. This not only expands the range of potential hydrogen sources, but also contributes to the circular economy by utilizing organic waste or renewable hydrocarbons as well as fossil fuels, which are converted into hydrogen and solid carbon.

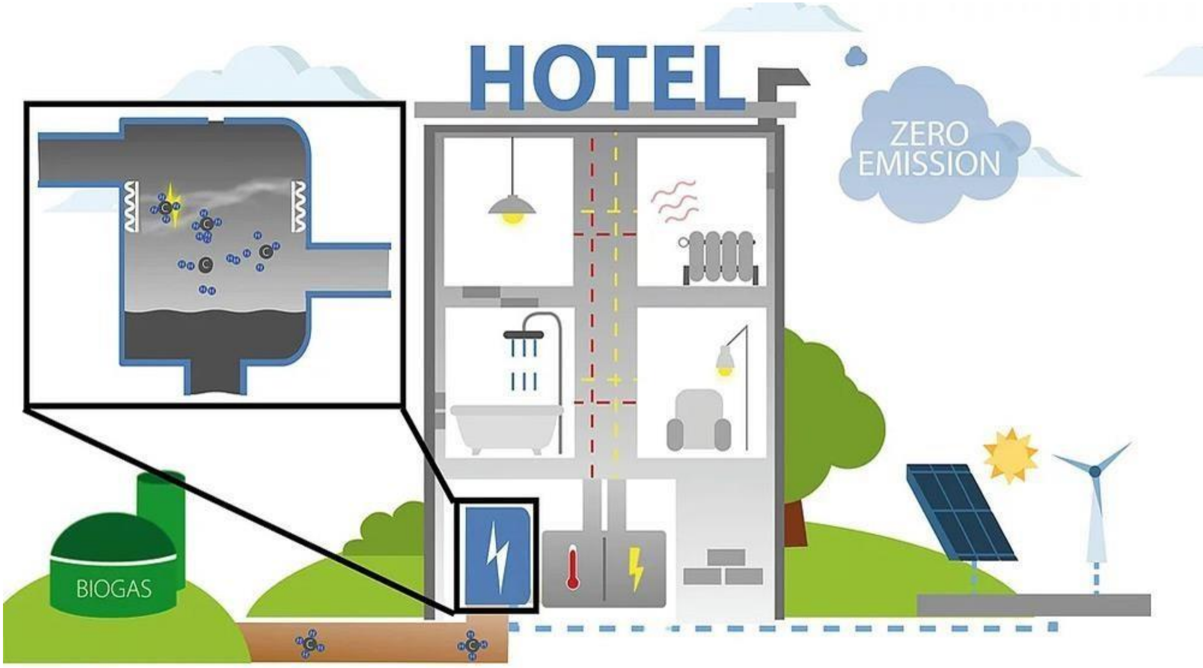

*Figure 2: **MOA-H2eat** At the Mercure Hotel MOA Berlin, methane from a biogas plant is split into hydrogen and solid carbon in a CO2-neutral process using very little energy. The hydrogen obtained in this way is then used to generate heat. Graphic: Graforce*

Graforce has now been around for almost 13 years. The first plasmalysis system went into operation in Berlin in 2019. What has happened since then and what are you currently working on?

In 2019, we opened the first German HCNG plasmalysis plant with an integrated filling station in Berlin-Adlershof. In this pilot project, hydrogen was extracted from wastewater using plasmalysis and mixed with natural gas to produce an HCNG mixture with 30 to 40 per cent hydrogen by volume. This mixture could be used directly as a fuel in natural gas vehicles and resulted in lower-emission combustion. In the years that followed, we realized several pilot projects to demonstrate the versatility of plasmalysis technology.

" The lack of technological openness, the ongoing EU overregulation and the high energy costs in Germany are making our company's development considerably more difficult"

This included a wastewater plasmalysis plant at Berliner Wasserbetriebe, which treats highly contaminated wastewater and produces hydrogen at the same time. Another project was the methane plasmalysis plant at the MOA hotel, which partially converted natural gas or biogas into hydrogen and solid carbon. The aim was to feed the hydrogen produced into existing boiler systems as a blending component in order to reduce CO_2 emissions from heating systems. The resulting solid carbon was used in building materials.

What about methane plasmalysis?

Methane plasmalysis is our most advanced hydrogen technology to date and enables cost-efficient production of 2 to 3 euros per kilogram of H_2. It converts natural gas or biogas into hydrogen and solid carbon. And it does so with an energy input of just 10 to 14 kWh per kilogram of H_2. Unlike conventional steam reforming, releases large quantities of CO_2, the carbon remains in solid form during plasmalysis and can be used in various industries - for example in the construction, steel or fertilizer industries. With a methane conversion rate of 98 per cent and a considerably lower energy requirement - around 80 per cent less than conventional electrolysis - this technology offers an economical and sustainable alternative to hydrogen production. It also enables significant CO_2 reductions, especially in the case of LNG imports, as it can save millions of tons of CO_2 emissions every year.

What are your biggest challenges at the moment?

Like many other young technology companies, we face the major challenge of quickly scaling up our innovative plasma technology in a difficult market environment. The lack of technological openness, the ongoing EU overregulation and the high energy costs in Germany are making our company's development considerably more difficult.

When you started with H2 production, the topic was still in its infancy, but there is now an approved H2 core network and an import strategy. How do you rate this progress for a green H2 ramp-up?

The establishment of an H2 core network and an import strategy are the first steps, but they focus one-sidedly on imports and electrolysis. What is needed is funding that is open to all technologies and rewards every form of CO2 reduction - regardless of the scale. Instead of a rigid hydrogen color theory, economic incentives, tax breaks and the use of existing natural gas infrastructures are needed to reduce emissions quickly and efficiently.

Source: *Edison Media - Home of Generation E; Author: Lisa Marx; https://edison.media/energie/es-fehlt-an-technologieoffenheit/25254994/*