BERLIN / GERMANY

THE GREAT GREEN HOPE

Whether for food or biofuels, the raw material of the future is algae. A research team is working on a prototype facility to produce the new energy source – and Georg Fischer is supplying the hightech plastic tubing needed to get the job done.

Extremely appealing. To make sure the algae get enough light, Professor Wildenauer uses transparent PVC tubing manufactured by GF Piping Systems.

There's an old steam engine parked right in front of the building. Perfectly polished with a smoke stack and large coal tender – as though it was just about to depart. But it's not just the missing train tracks that give a clue that the engine is well past its prime. The museum piece now on display in front of the former steam locomotive factory in Wildau, located in the German state of Brandenburg, is a reminder of the past. These days, hidden behind the brick walls of the Technical University of Applied Sciences, approximately 4,500 students are more interested in research and coursework – and shaping the future.

Professor Franz Xaver Wildenauer put together a young team of academics at the Institute for Biosystem Engineering/Bio-Informatics to search for tomorrow's source of energy; and nature is expected to supply the fuel. To be precise, green algae. There are more than 40,000 types of algae with such names as "spirulina maxima" and "scenedesmus rubescens". It's impossible to overlook the project unfolding in the blue building located diagonally across from the locomotive. An enormous laboratory has been assembled in the 7.5-meter-high entrance. A jumble of tubing, pistons and lines hang there, squeezed in between the spiral staircases and ladders.The sounds of whirring and bubbling are illuminated by a disco-like light display. "This is our baby. The Biophotonic Combined Energy System," says Wildenauer. That's BCES for short.

The BCES reactor is about three meters high. Plastic tubing winds itself around bright luminous plant lights, stretching its way upwards in a 103-meter long serpentine. Inside, a green soup sloshes together with gurgling bubbles. To cultivate the microalgae, GF Piping Systems provided the university with an innovative photobioreactor designed by the the Dutch manufacturer LGeme. GF Piping Systems has brought in the necessary know-how and materials expertise, and partnered up with the project to drive innovative technology. The research reactor is equipped with special PVC tubing and has thin walls to improve both the light input and the microalgae's photosynthetic activity. "We're studying the suitability and long-term stability of the tubing to cultivate microalgae and operate the reactor," explains Professor Wildenauer as he outlines the aims of the research project.

> "GROWING ALGAE IS AN EFFECTIVE METHOD FOR SEQUETERING CO_2."
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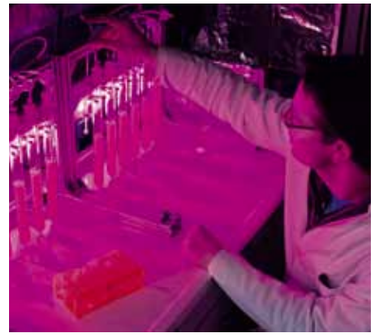
> Dr. Stephan Schüssler, R&D Manager at GF Piping Systems

Working together with partners in the United States, the Netherlands and the Technical University in Wildau in Germany, GF Piping Systems is developing various innovative components. "Microalgae needs to receive enough light to grow properly," explains Dr. Stephan Schüßler, Technical Manager of Research & Development at GF Piping Systems. That requires high-performance tubing and molded parts made from transparent PVC, which are both extremely UV-resistant and promote the production of biomass through photosynthesis. "Photobioreactors are one of the key technologies for the algae-based biomass gyro stabilizer. Improving their efficiency and cost structure will open up new avenues for the production of foodstuffs and green fuels. At the same time, growing algae is an effective method for sequestering CO_2," says Dr. Schüssler.



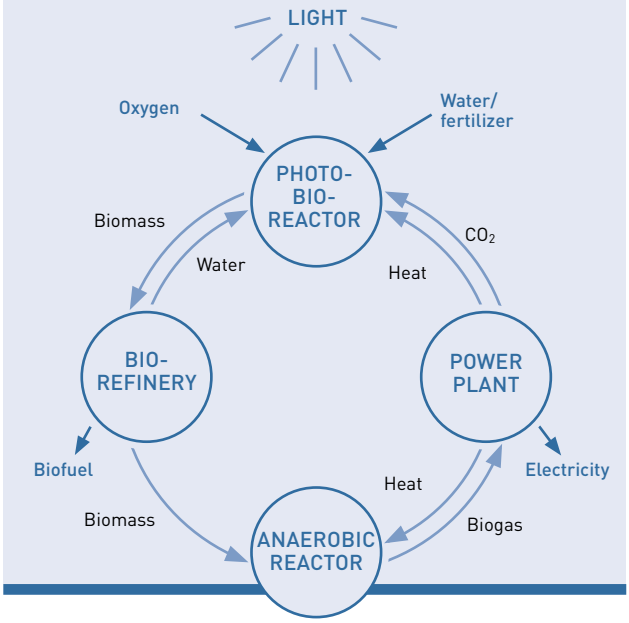
It's all about algae: For the optimal cultivation of algae, Prof. Wildenauer (top) and his team use red LED lights.

Code Platzhalter

Visit the algae lab: Professor Wildenauer presents his work in the **VIDEO**.

A SUSTAINABLE CYCLE

Understanding the algae formula



In doing so, the bioreactor exploits the algae's preferences. "We provide the cultures with artificial fertilizer and CO_2 from the exhaust of the Institute's combined heat and power station," explains Professor Wildenauer. "The exhaust is fed in at the bottom of the reactor. The bubbles rising upward in the serpentine tubing keep the algae suspension in motion so they can't attach to the tubing. In doing so, the culture binds with the carbon dioxide to produce the biomass as it continuously releases oxygen. The result is a sustainable cycle." Since algae only uses about five percent of available daylight for photosynthesis, the researchers also use energy-saving blue and red LED lamps with frequencies of 420 and, respectively, 680 nanometers in their laboratory. The lights provide the ideal concentration of photons needed for growth while adding a little color to the researchers' lives.

At the end of the cultivation period, which is about 10 days, the microalgae are harvested in the centrifuge. The materials recovered are extracted and processed into plastics, food additives, cosmetics or biofuels (biodiesel and biokerosene), for example. Bacteria and the remaining biomass are put into an anaerobic reactor and converted to methane gas, which in turn can be used as another source of fuel for the combined heat and power station.

This has sustainable prospectives well beyond the confines of the Wildau campus. Around the world, algae have gained a good reputation for delivering excellent solutions to urgent questions on energy supply, while protecting the climate and natural resources. In the United States, biodiesel extracted from algae is considered to be the fuel of the future – particularly because it's not made from grain, sugar cane, rapeseed or corn, which would endanger the world's food supply. "I had always thought of algae as some kind of underwater spinach or grass," admits Professor. Wildenauer. "But when you take a closer look, their compounds are more like high-quality cultivated plants. But with their sugar, starch, oil, protein and omega fatty acid content, their productivity is seven times higher," says the biologist. Now its up to science to model and calculate the links between the individual mass transfer processes.

Wildenauer believes the potential of the new technology is enormous – but so are the investments needed. "We and our partners are achieving applied research and qualification of innovative technology." It sounds like it will take a lot of hard work and patience. "In ten years," the researcher predicts, "we should be ready to go into mass production." And then, fossil fuels might become a thing of the past – just like the old steam engine. ▮▮

A GREEN WAVE IN TEXAS

Biofuel made of algae for the new world

GF PIPING SYSTEMS USA DESIGNED A PROTOTYPE FACTORY for algae-based biofuels in collaboration with the J.J. Pickle Research Campus at the University of Texas in Austin, and the Open Algae and AlgEternal research institutes. The photobioreactors made of specially structured PVC lines will be the carrier medium for the energy-generating microorganisms. The pilot facility in Texas is the largest of its kind in the United States. It has more than 648 vertically arranged photobioreactors, which can hold more than 50,000 liters of algae suspension in its tight quarters. The PVC piping was specially designed by GF Piping Systems to protect the cultures from damaging UV rays. The researchers want to test various types of algae, measure their CO2-absorption potential, search for innovative methods of dietary supplementation and tap into new ways to control the temperature when cultivating algae.