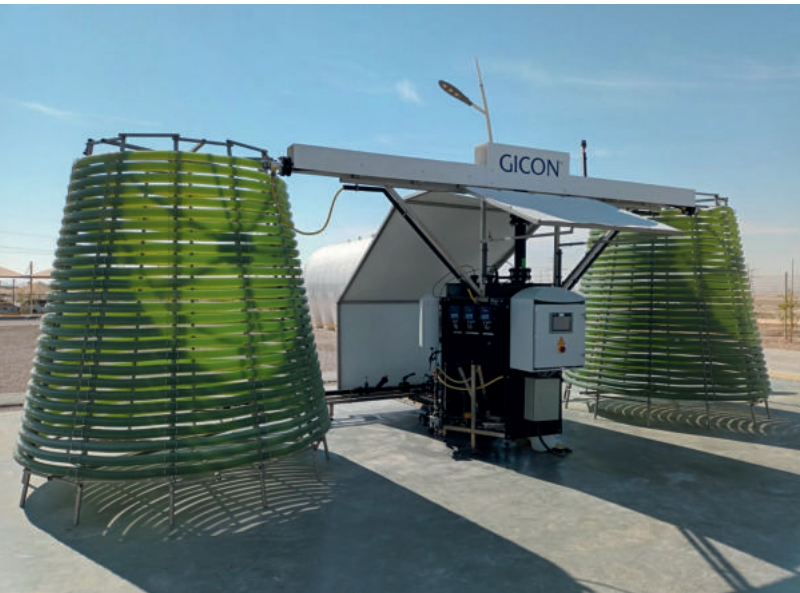



# GICON®



GICON® References  
in Microalgae Photobioreactor Technology  
– Market Innovations since 25 Years



GICON® engineers have planned a broad variety of photobioreactor plants ranging from **R&D to commercial sized systems for 25 years** using their detailed expertise in plant design, approval planning, process engineering, biotechnology, biology and bio-energy systems.

GICON® has great experience in **plant design of photobioreactor systems with a total production volume of more than 2 million litres. This represents a total tube length for microalgae growth of more than 1,000 km.**

Starting with glass tubular photobioreactor systems, the development of a microalgae plant in 1997/1998 (Elbingerode/Germany) was **fundamental pioneering work** at that time and resulted in the planning and construction of **World's first and largest microalgae production plant** in 2000 (Kloetze/Germany, now owned by Roquette) – setting a new state-of-the-art technology in effective and stable production of microalgae mass cultures. GICON® engineers operated the plant with a production volume of 700 m<sup>3</sup> for 10 years in leading position.

In subsequent years and with intensive involvement of GICON® engineers, the IGV (Potsdam/Germany) constructed and marketed a great amount of glass tubular systems for R&D and commercial production of microalgae. GICON® (former engineers of BISANTECH NUOVA) performed the plant design and bioprocess engineering of the PBR's and harvesting systems.

Moving forward the microalgae production technologies, GICON® developed **a novel photobioreactor design**, beginning in 2011 – the **GICON®-PBR**. Using a **highly transparent and flexible double-wall tubing system**, an **effective biomimetic design for sunlight capture** and an **integrated and closed temperature control cycle** allow the maintenance of ideal growth conditions and stable production of microalgae at R&D and commercial scale. This successful technological principle in photobioreactor design was rewarded by the German Center for Research and Innovation in New York (2012). In combination with automated and predictive process control, a 2-year cultivation period without any fresh inoculation from laboratory cultures have proven this innovative concept. Once again, GICON® successfully created a higher standard in photobioreactor technology.

## Selection of planning and construction/installation services of microalgae plants (R&D and commercial)

The plant design by GICON® comprises all relevant aspects in the field of R&D and commercial plant construction – ranging from systems planning, approval planning, bioprocess engineering, basic and detail engineering, construction planning.

GICON® successfully performed various planning services in Germany and various countries around the world, e.g. the Netherlands, Poland, France, Middle East, USA, Sri Lanka, Madagascar and Mauritius.

# REFERENCES



## ELBINGERODE | GERMANY (1997/1998)

6 m<sup>3</sup> plate type/4 m<sup>3</sup> glass tubular system – pilot plant for usage of lime kiln exhaust for microalgae production – first glass tubular system with state-of-the-art bioprocess

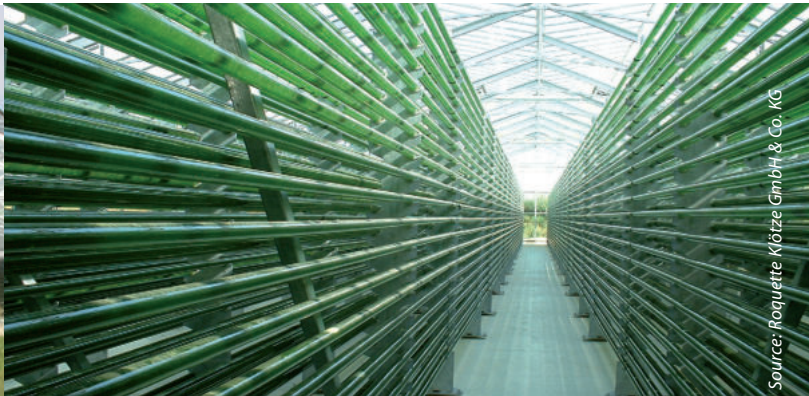
technology using sunlight. First successful demonstration of industrial flue gas-based CO<sub>2</sub>-fixation by microalgae cultivation in Germany.



## KLÖTZE | GERMANY (2000)

Due to their modular construction consisting of several reactors, the microalgae systems can be extended as required. Employees of GICON®'s Bitterfeld-Wolfen branch have, then still as employees of Bisantech Nuova, planned and installed the World's first and largest tubular production facility for microalgae in Germany (Saxony-Anhalt) with 20 pho-

tobioreactors and around 700,000 litres of utilization volume on a 1.2 hectares area for the client. The biological connection was realised in cooperation with IGV GmbH Potsdam Rehbruecke. Based on the experience of this project, GICON® has developed its PBR and thus improved algae cultivation.



Source: Roquette Klötze GmbH & Co. KG

# REFERENCES



## KÖTHEN | GERMANY (2012)

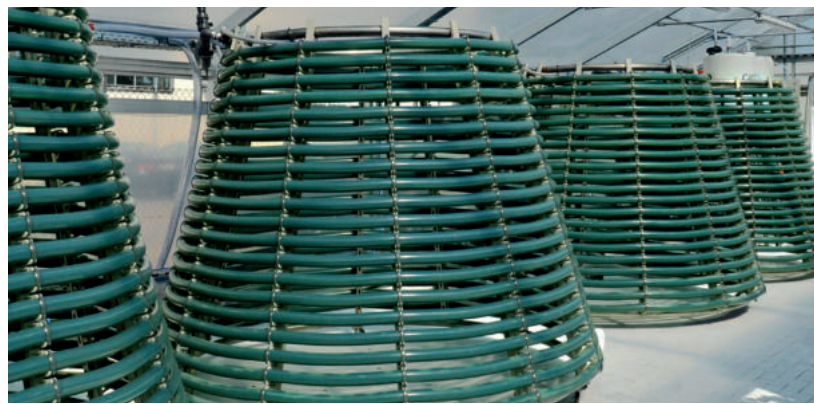
1.7 m<sup>3</sup> modular microalgae platform using novel design of GICON®-PBR using flexible and transparent double-wall tubing system in biomimetic design and integrated temperature control

The modular arrangement of four light collector modules provide a variety of operating modes - single use, in series, in parallel.

Long-term cultivation tests over a period of 2 years without fresh lab inoculum demonstrated the successful maintenance of ideal growth conditions - especially the concept of the water-conserving closed and integrated temperature control system.

The developed process control unit collects and controls the bioengineering and process engineering data of more than 70 sensors.

Predictive process control systems ensure a stable and efficient cultivation process.



## TREIZE-VENTS | FRANCE (2014)

The potential of biogas plants for the cultivation of microalgae use - this goal has been implemented by GICON® in an installation in Treize-Vents in the west of France. A 190 kW plant directs the surplus heat into

two raceway ponds, in which algae are cultivated. The heat supply stimulates the growth of microalgae. The resulting algae biomass is used, among other things, as an admixture for animal feed.



Source: France Biogaz Valorization S.A.R.L.

# REFERENCES



## COTTBUS | GERMANY (2019)

4 m<sup>3</sup> GICON®-PBR demonstrating modular-scalable commercial application according to highest industry standards

The GICON®-PBR is designed for use as a basic module for large commercial systems as well as a self-sufficient small system as a pilot plant for R&D. By combining individual modules, any number of scalable reactor systems are accessible. Using the double wall tubing

concept, stable production is ensured even under extreme climatic conditions. The systems are tailor-made to the needs of the customer. Consequently, they guarantee a continuous production of high quality, defined algae biomass. The unified tubular collector system enables the integration into other biotechnological processes (e.g. the material coupling with biogas plants).



## HALLE | GERMANY (2017)

Commercial microalgae production plant for yearly production size of 125 t Chlorella biomass – plant design ranging from fully equipped laboratories for

culture collection, starter cultures and process control to downstream processing and marketable products.



# REFERENCES

## ERLAU | GERMANY (2021)

As part of the research project AlgaPork, a continuous microalgae production using a GICON®-PBR 1,000 was established in the agricultural environment directly on the farm. The local production enables the daily removal of fresh algae biomass for feed admixture in pig fat-

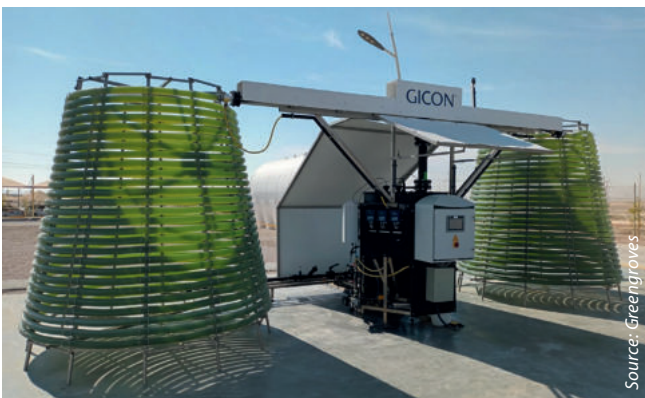
tening, whereby no additional transport and storage costs arise and the energy-intensive step of dehydrating the microalgae biomass is omitted. For low-energy and low-cost production of the algae, the production process was integrated into existing material cycles.



## QURAYYAH | SAUDI ARABIA (2021)

The Kingdom of Saudi Arabia aims for a massive reduction of CO<sub>2</sub> emissions pursuing its VISION 2030. GICON® is collaborating with its partner in the arabic region Greengroves in the field of engineering and consulting and the realisation of microalgae projects. In doing so, GICON® assisted in planning and consulting tasks for an Algae Pilot Plant on a 2.8 ha site with a total volume of

800 m<sup>3</sup>. The plant consists of laboratories for algae screening and process control analytics on site and several raceway pond systems for microalgae production as well as downstream processing. The integration of two GICON®-PBR 1,000 units ensure the stable and consistent inoculum production at outdoor conditions in the Arabian desert using the innovative closed cooling cycle.



## Additional highlights of GICON® services in PBR plant design

| Location    | Plant size                     | GICON services              | Application |
|-------------|--------------------------------|-----------------------------|-------------|
| Netherlands | GICON®-PBR, 100 t/a            | Plant design                | Commercial  |
| Middle East | GICON®-PBR, 20 t/a             | Plant design                | Commercial  |
| Middle East | GICON®-PBR, 1,000 t/a          | Plant design                | Commercial  |
| USA         | Open pond, 1.6 ha              | Design of Harvesting system | Commercial  |
| Sri Lanka   | GICON®-PBR, 4 m <sup>3</sup>   | Plant design                | R&D         |
| Madagascar  | GICON®-PBR, 4 m <sup>3</sup>   | Plant design                | R&D         |
| Mauritius   | GICON®-PBR, 4 m <sup>3</sup>   | Plant design                | R&D         |
| Poland      | GICON®-PBR, 0.5 m <sup>3</sup> | Plant design & Construction | R&D         |

## R&D innovations (in collaboration with research partners and networks)

In order to keep its position as one of the leading engineering companies in the field and according to its business philosophy, GICON® continuously invests in R&D projects to level up the boundaries of state-of-the-art technologies. In collaboration with research institutes and universities, innovative solutions and marketable products ranging from technology development to market applications provide contin-

uous and groundbreaking progress for microalgae biotechnology. More than 10 research projects in less than 10 years are proof of GICON®'s own expectations as an innovative engineering service provider in order to meet the company's self-imposed demands. The exploitation of the R&D knowledge into markets is one core business of GICON®.

### A selection of active research areas:

- Development of GICON®-PBR, design, operation, process automation
- Gentle and effective cell disruption using biological treatments
- Material and energetic combination of biogas process and microalgae production
- floating modules for producing microalgae at offshore sites
- Novel process for application of microalgae as feed supplement for pigs using stable and continuous on-site production
- Microalgae production as remediating step in agriculture
- Solutions for understanding and preventing of environmental-immanent contaminants in microalgae mass cultures

# GICON®

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