

# **Electrochaea Press Kit**

**06/2021**

# Electrochaea Fact Sheet

## Headquarters

Electrochaea GmbH  
Sommelweisstrasse 3  
82152 Planegg/Munich  
Germany

Phone: +49 89 3249 3670  
www.electrochaea.com

## United-States

Electrochaea Corp.  
500 Capitol Mall, Suite 1900  
Sacramento, California 95814-4762  
USA

## Denmark

Electrochaea.dk ApS  
Chr. M. Oestergaards Vej 4A  
8700 Horsens  
Denmark

## Industry

Power-to-gas, energy storage, CO<sub>2</sub> recycling, renewable fuel, renewable methane, e-methane, green methane, clean methane, renewable natural gas, renewable energy, green gas, biotechnology, cleantech, RNG, SNG

## About Electrochaea

Electrochaea is commercializing its power-to-gas (P2G) technology to replace fossil fuels by providing a grid-scale renewable gas generation and energy storage solution. Our proprietary process converts renewable electricity and carbon dioxide into grid-quality renewable methane for storage and distribution. Our pilot plants have injected renewable methane into commercial gas grids in Switzerland and Denmark.

Using our process, renewable methane is synthesized from CO<sub>2</sub> and H<sub>2</sub> by our patented biocatalyst, a selectively evolved microorganism referred to as a methanogenic archaea. Pipeline-grade methane is produced in our scalable and robust methanation system for injection into the gas grid or immediate use as a fuel. Our process mitigates CO<sub>2</sub> venting, instead recycling CO<sub>2</sub> sources such as anaerobic digestors, landfills, dairies, fermentation facilities or industrial processes. Renewable H<sub>2</sub> can be generated from renewable electricity by electrolysis or from certain industrial processes for which H<sub>2</sub> is a waste product.

The high efficiency and robust nature of our biocatalyst enables our patented methanation technology to operate at lower capital and operating costs and with greater flexibility than conventional thermochemical methanation processes. The biocatalyst is compatible with variable duty cycles and common impurities in CO<sub>2</sub> sources. P2G energy storage enables practically unlimited storage capacity via existing gas grid infrastructure. And the scalable process enables a broad range of deployments.

Electrochaea licenses its technology to commercial partners, providing access to our proprietary biocatalyst, certain engineering/design documents, and related services in support of operational implementation of our processes.

Electrochaea GmbH is a dynamic growth stage company with headquarters, engineering and development teams in Munich, Germany. Electrochaea's subsidiaries are located in Denmark and in California, USA.

Click [here](#) for a virtual tour of our industrial-scale pilot plant in Solothurn, Switzerland.

## Technology

- Renewable methane is synthesized from CO<sub>2</sub> and H<sub>2</sub> by our patented biocatalyst
- Pipeline-grade methane is produced in our scalable and robust methanation system for injection into the gas grid or immediate use

## Electrochaea Firsts

- Electrochaea is the first company to deploy and successfully operate an industrial 1 MW plant using biological-methanation-based power-to-gas technology
- Electrochaea's BioCat system is the first power-to-gas application to inject biomethane into national gas grids in Denmark and Switzerland

## Customers and Commercial Applications

- CO<sub>2</sub> can be used from any source such as anaerobic digestors, landfills, wastewater treatment plants, dairies, fermentation facilities or industrial processes
- Utilities, community choice aggregators and energy providers are further enabled to provide renewable natural gas to their customers.
- When Electrochaea's technology is used with biogas from anaerobic digestion, CO<sub>2</sub> emissions are reduced, methane production is nearly doubled, resulting in an overall improvements in the carbon footprint
- Cement and lime industry valorize the unavoidable CO<sub>2</sub> emission and generate renewable methane
- Gas network operators generate a long-term strategy by "greening" the existing gas grid
- Power grid operators avoid capital expenditures for grid expansion while leveraging existing natural gas assets as RNG storage infrastructure
- Producers and users of CO<sub>2</sub>-neutral fuels benefit from a stable supply of renewable fuel

## Unique Features of our Technology

- Unlike thermochemical methanation methods, Electrochaea's technology uses a selectively developed microorganism (archaea) that produces biomethane efficiently, quickly and with reliability
- Electrochaea has the exclusive license to the world's most efficient strain of archaea, which was developed at the University of Chicago; our archaea is patent protected
- Large-scale production and use of biological methanation allows grid scale energy and carbon storage
- National gas grids can be utilized for future energy-storage needs, thus reducing the need for new investments in storage infrastructure
- The process developed by Electrochaea can provide short- and long-term storage of large quantities of renewable electricity in the chemical bonds of renewable methane.
- The technology is scalable and provides an important solution for decarbonization of the gas grid
- The use of renewable methane-powered green peaker plants in combination with Electrochaea's biomethanation technology leverage intermittent availability of renewable electricity

## Market Drivers for a Power-to-Gas Solution

- Decarbonizing the natural gas grid and large-scale carbon reuse are emerging strategic objectives by leading industrialized countries, numerous regions and cities, as well as major corporations in connection with their ESG priorities.
- State and national climate policy
- Recognition of the importance and potential of long-term energy storage
- National and sub-national policies that incent decarbonization of the energy sectors, including for example, incentives for renewable transportation fuels and penalties for CO<sub>2</sub> emissions.
- Increasing renewable power curtailment

## Competitive Advantage

- Biocatalyst is selectively producing methane with no intermediates or side products
- 98.6% of the fixed carbon goes into methane
- Patented biocatalyst strain is licensed exclusively to Electrochaea
- P2G energy storage enables practically unlimited storage capacity via existing gas grid infrastructure
- Scalable process enables a broad range of applications (10 to > 100 MW power input)
- Lower CAPEX and OPEX than thermochemical methanation
- Biocatalyst is compatible with variable duty cycles and common impurities in CO<sub>2</sub> sources

## Business Model

- Electrochaea develops and licenses technology to use CO<sub>2</sub> and H<sub>2</sub> to store renewable energy and to integrate renewable energy across power, gas and heat sectors
- The Company licenses its patented catalyst and proprietary system design to customers and partners to realize commercial power-to-gas projects
- The Company's revenues derive from licensing and technology fees, continuing royalties on the sale of products and services enabled through the use of its proprietary technology, and supportive engineering and related services in support of technology deployment

## Markets

- The broadening recognition of required changes in our global energy sectors is leading to more and more markets with potential for Electrochaea's biomethanation technology
- Markets in Europe, North America and Asia are actively implementing and expanding policies in support of decarbonization, with major utilities and numerous high-CO<sub>2</sub> emitting industries pursuing investments to achieve self-established climate-based goals
- These key markets and regions also have a growing percentage of wind and solar energy production that can provide renewable energy essential to many of Electrochaea's deployments
- The demand for biogas and renewable gas is growing sharply in the EU, Canada, and in the US, in particular in California and the Pacific Northwest
- When regulatory changes are adopted that unmask the pricing signal for low-cost renewable power, the energy and CO<sub>2</sub> storage market can be in the billions<sup>1</sup>.

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<sup>1</sup> World Bank Group. (2020). State and Trends of Carbon Pricing 2020. <https://openknowledge.worldbank.org/bitstream/handle/10986/33809/9781464815867.pdf?sequence=4&isAllowed=y>

## **Milestones**

### **2006 – 2010:**

- Basic research and four years of “proof of concept” research
- Prof. Laurens Mets and his colleagues at the University of Chicago recognize the potential of archaea for methane production and isolate a highly efficient strain

### **2011:**

- Merger with 6-Convert, a start-up from Prof. Lars Angenent and Dr. Jeff Fornero at Washington University in St. Louis, MO, USA
- First major lab-scale tests with raw biogas at brewery digester in St. Louis, MO, USA

### **2013:**

- Pre-commercial field tests demonstrated scalability (5000 L bioreactor) in Foulum, Denmark

### **2014:**

- Electrochaea GmbH established as part of Series A financing by Munich Venture Partners, btov, Sirius Venture Partners, KfW, Focus First Holdings, Energie 360° and Caliza Holding
- Headquarters and laboratory space are secured in Munich, Germany
- Funding received from Energinet to design, build and operate the BioCat Project, a 1 MW industrial-scale field trial at a wastewater treatment plant outside Copenhagen in Avedøre, Denmark.

### **2016:**

- An international team of 20 engineers and scientists formed around Mich Hein (CEO) and Doris Hafenbradl (CTO) in Munich, Germany
- The world's first 1 MW P2G plant (BioCat Project) commissioned in Avedøre, Denmark, with support from Energinet
- Initiated second grid scale pilot project in Switzerland with Horizon 2020 Project STORE&GO

### **2017 – 2018:**

- Accelerated development of high efficiency microbial electrolysis cell and laboratory pressure reactor with grant and equity funding

### **2019:**

- Storengy invests in Electrochaea
- Commissioning and inauguration of the BioCat plant in Solothurn, Switzerland
- Inauguration of ORBIT pilot reactor in Regensburg, Germany
- First grid-injection of renewable methane produced by the BioCat system in Solothurn, Switzerland and in Avedøre, Denmark
- Commissioning of BioCat plant in Golden, CO, USA

### **2020:**

- Establishment of Electrochaea Corporation, currently located in Sacramento, CA, USA
- Management team is expanded with Harald Beschid as COO
- EU Innovation Council grants Electrochaea 2.485 million Euro and commits 14.975 million Euro equity investment in Electrochaea's power-to-gas technology

## 2021:

- Electrochaea participates in large project, with Storengy, Engie, Carmeuse and the John Cockerill Group, to cut CO<sub>2</sub> emissions from the lime industry
- Joe Feldman joins the Electrochaea Corp. as Executive Vice President of Business Development and Peter Plesner joins as Business Development Director in Denmark
- Baker Hughes invests in Electrochaea

## Reference Facilities & Projects

### Industrial-scale Pilot Plants:

- Avedøre, Denmark
- Solothurn, Switzerland
- National Renewable Energy Laboratories (Golden, CO, USA)

### Funded Projects:

- **Avedøre BioCat:**
  - Design, engineering and construction of a commercial-scale power-to-gas demonstration facility, and showcase of its capabilities to provide energy storage services to the Danish energy system
  - Funded by contract nr. 2014-1-1216 under the ForskEL program administered by the Danish Transmission System Operator Energinet.dk, and by the Energy Technology Development and Demonstration Program (EUDP) of the Danish Energy Agency
  - Collaborators: Audi, BIOFOS, Hydrogenics, Energinet.dk, HMN Gashandel, Insero, and Neas Energy
  - *Project completed*
- **POWERSTEP:**
  - Full integration of biomethanation into the process scheme of wastewater treatment plants to demonstrate energy-positive design
  - Funded by the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no. 641661
  - *Project completed*
- **STORE&GO:**
  - Demonstration of renewable gas production and storage using power-to-methane technologies, and their integration into daily operations of European energy networks
  - Funded by the European Unions' Horizon 2020 Research and Innovation Programme under grant agreement no. 691797
  - Collaborators: Regio Energie Solothurn (RES), Hochschule für Technik Rapperswil (HSR), Ecole polytechnique fédérale Lausanne (EPFL), Eidgenössische Materialprüfungs- und Forschungsanstalt (EMPA) and Swiss Gas and Water Industry Association (SVGW)
  - *Project completed*

- **ORBIT:**
  - Joint research project coordinated by OTH Regensburg on the optimization of power-to-gas plants to address growing need for energy storage and sector coupling
  - Funded by the German Federal Ministry for Economic Affairs and Energy
  - *Project completed*
- **KittyCat:**
  - Construction and operation of a laboratory-scale research reactor aiming at the identification of process control strategies to ensure robust automated process for industrial applications, validation of cost down strategies, implementation and verification of computational process models for process scale-up, and detailed characterization of process efficiency and robustness towards gas contaminants
  - Funded via BayStMWi within the ZIM-Kooperationsnetzwerks UseCO2
  - *Project completed*
- **European Innovation Council:**
  - Scaling, standardization and de-risking of Electrochaea's technology to enable cost reduction, faster project deployment and reduced risks. The project will enable the development of Electrochaea's technology from existing plants to commercial-scale plants
  - Funded by the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no. 101010276
  - *Project in progress*

## Investors

- Financial investors: Munich Venture Partners, btov, Sirius Venture Partners, KfW, Caliza Holding, Focus First Holdings
- Strategic investors: Energie 360°, Storengy, Baker Hughes
- Funding rounds:
  - Series A - November 2014
  - Series B - August 2018
  - Series C - February 2019
  - Series D – June 2021

## Memberships

### Europe:

- e-Fuel Alliance
- BVES
- Wasserstoffbündnis Bayern
- IBB Netzwerk
- UseCO<sub>2</sub>
- Brintbranchen
- The Danish Partnership for Hydrogen and Fuel Cells
- Förderverein Industrielle Biotechnologie Bayern e.V.

### North America:

- Biogas World
- RNG Coalition

## **Press Contact**

### **Europe:**

#### **Maria Beschid**

*Communications Manager*

Electrochaea GmbH  
Sommelweisstrasse 3  
82152 Planegg  
Germany  
Tel.: +49 (0) 89 / 32 49 367-40  
E-mail: [maria.beschid@electrochaea.com](mailto:maria.beschid@electrochaea.com)

#### **Tim-Åke Pentz**

HOSCHKE & CONSORTEN Public Relations GmbH  
Heimhuder Straße 56  
20148 Hamburg  
Germany  
Tel: +49 40 3690 5086

E-mail: [t.pentz@hoschke.de](mailto:t.pentz@hoschke.de)

### **North America:**

#### **Beth Bray**

*US Communications Director*

Electrochaea Corporation  
500 Capitol Mall Suite 1900  
Sacramento, CA 95814  
United-States  
Tel: +1 773 241-4948

E-mail: [beth.bray@electrochaea.com](mailto:beth.bray@electrochaea.com)



## About Our Management Team

### **Mich Hein, Ph.D. (CEO, Managing Director)**



As an inventor, entrepreneur, and corporate executive, Mich has 35 years' experience in technology development and commercialization. In addition to his role at Electrochaea, Mich is a Partner at Focus First Holdings (St Louis, MO). Prior to starting Focus First, Mich served as Executive in Residence at the University of Chicago's Office of Technology and Intellectual Property, and as Chief of Staff at the Illinois Medical District where he managed the Chicago Technology Park. He started his career as a research chemist with Monsanto and then PPG Industries before joining the faculty at The Scripps Research Institute in La Jolla, CA. Mich's investigations into mucosal immunology and plant-based proteins led him to found Epicyte Pharmaceutical, Inc which was acquired by Biorex, Inc in 2004. His entrepreneurial career also included positions as CEO at Chromatin, Inc and as founder of Heliose.

Mich holds a B.S. degree from the Honors Tutorial College of Ohio University and both an M.Sc. and Ph.D. in Plant Physiology from the University of Minnesota.

### **Doris Hafenbradl, Ph.D. (CTO, Managing Director)**



Doris has enjoyed a successful career as scientist and corporate executive in the biotech and pharma industry in the US and Europe. She joined Electrochaea from Axxam, a leading provider of integrated discovery services for the life sciences industry, where she was responsible for the company's discovery services activities. Prior to Axxam, she held several senior management roles in international, industry-leading pharmaceutical firms including BioFocus, Proteros, GPC Biotech, Axxima Pharmaceuticals, Genomics Institute of the Novartis Research Foundation, and Diversa. Doris dedicated her doctoral research in microbiology to the study of hyperthermophilic archaea in the laboratory of Prof. Dr. Karl Stetter at the Archaea Centre at the University of Regensburg.

### **Harald Beschid (COO)**



Harald has more than 15 years of experience in Industrial Project Management. In his previous roles, he managed major projects over all development phases, from early idea management, concept engineering to basic engineering and detailed engineering. Harald led organizations to successfully transfer ideas into engineering packages and to realization on construction sites and commissioned large-scale industrial process plants all over the world. Harald has extensive hands-on expertise in project management, project controls, operations and cross-department consulting. During his career, his responsibilities increased steadily; he led teams of more than 80 staff members and managed budgets over 320 mio EUR. As COO at Electrochaea, Harald is leading the Engineering, Projects and Operations Team and managing the implementation of upcoming commercial projects.

Harald has a degree in Technical Chemistry from the University of Applied Sciences Georg-Simon-Ohm, Nuremberg, Germany, and an Executive MBA in General Management from the Technical University of Munich.

### **Joseph Feldman (Executive Vice-President)**



In his business development role for North America, Joe brings over thirty years' experience with new market entry, strategic partnering, technology-enabled businesses, and cross-border transactions. Joe's large company experience includes finance, business development and international roles for Searle Pharmaceuticals, The NutraSweet Company and Monsanto; this included two years in Switzerland for NutraSweet. He has worked with venture-stage organizations including First Genetic Trust, Chromatin, and Sandbox Industries, as well as with technology development groups at the University of Chicago and the University of Illinois at Chicago. As President of Feldman Associates, Joe has worked with growing companies on acquisitions, new market entry and a range of strategic initiatives.

Joe is a graduate of the Wharton School of Business (BS, Finance) and Kellogg Graduate School of Management (MBA).

### **Thomas Friehe (Finance Director)**



Thomas has 21 years of experience in financial planning and forecasting, business development, M & A, and contract management in large and small multinational companies. As Senior Financial Controller at Knorr-Bremse AG, Thomas, in addition to controlling income statements and financial forecasts, was instrumental in affiliate consolidation and company risk management. Thomas also brings considerable experience in cost optimization, company restructuring and customer sales from his successes at Infineon Technologies AG, Boshuku Europe and Resmed. At the EDAG (Engineering + Design AG) subsidiary FFT in Puebla, México, Thomas demonstrated his skills in business development, participating in the growth of an automotive industry technology center.

Thomas earned a Diplom Kaufmann in Economics from the University of Freiberg, Germany, and studied at the University of St. Thomas in Minneapolis, MN, USA, with focus on buyer behavior, communications and marketing.