Climate-Positive Power

Highly Efficient Power Plants for Carbon-Negative Renewable Electricity and Gas Generation

Reverion is a highly tech-driven climate company and a spin-off from the Technical University of Munich, Germany. Over the years, they have successfully developed and patented their micro power plants, that enable a highly flexible and efficient decentralized energy supply. Founded in 2022, Reverion has expanded its team to more than 40 employees by now and they are poised to revolutionize the renewable energy sector. Felix Fischer, co-founder, managing director and COO of Reverion, provides details of the journey so far

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Felix Fischer, Reverion

Personal Profile

Felix Fischer, co-founder, managing director and COO of Reverion, is a driven climate tech enthusiast, who is co-founder. During his PhD studies at the Chair of Energy Systems at the Technical University of Munich, he developed one of the key components of Reverion's technology. Currently, he is dedicated to scaling the company and managing daily operations. On top of that, he is responsible for research projects and for the sales department.

CHEManager: What was your entrepreneurial journey?

Felix Fischer: Our journey began in 2015 with a groundbreaking vision: to pave the way to 100% renewable energy by unlocking the full potential of biogas.

Stephan Herrmann, who until recently was a group leader at the Chair of Energy Systems at the Technical University of Munich (TUM) in Garching, developed the idea for the new system design as part of his PhD. Over the years, together with the now co-founders, we developed and patented our novel high-temperature fuel cell system. After our prototype proved successful, Reverion was founded in 2022 to commercialize this technology.

Can you describe your technology and innovation? How does biogas contribute to achieving a 100% renewable energy system?

F. Fischer: The transition to a future without fossil fuels is among the greatest challenges humanity has ever faced—and the problem is more urgent today than ever before. 85% of global CO_2 emissions still originate from the combustion of fossil fuels. Fossil-based power generation covers the electricity demand when there's not enough renewable energy in the grid. Furthermore, the current energy crisis has highlighted the problems of the European Union's high dependence on natural gas imports.

Biogas can substitute imported gas and is the only major renewable energy source that is weather independent and can produce power 24/7. However, today's biogas plants use only 40% of the energy potential, are not flexible and emit tons of CO_2.

This is where our technology comes in. Our solution is a highly efficient, reversible, CO_2-negative power plant for biogas. Reverion plants can double the electricity production from the same amount of biogas through higher electrical efficiencies (up to 80%). In the process, pure, storable CO_2 is captured, enabling negative CO_2 emissions. In addition, the same plant can reverse the process and produce green hydrogen or methane from surplus electricity. Reverion plants can therefore be used when they are most needed— both to generate electricity at times when there is not enough renewable energy in the grid, and to produce gas when there is an excess of renewable energy. In this way, we also contribute to stabilizing the electricity grid and offer solutions for long-term energy storage.

What impact does your product/solution have on the energy transition?

F. Fischer: In Germany alone, the potential for electricity generation from existing biogas plants can be increased from around 5.5 GW today to up to 11 GW with Reverion plants. If we use the full flexibility of the technology, even 20 GW of electricity can be generated at peak times, up to 30% of total electricity consumption in Germany (more than coal-fired power generation today). If the technology were rolled out across Europe, it would also be possible to capture more than 100 million tons of CO_2 annually as true negative emissions and save 10% of Europe's total CO_2 emissions by additionally displacing fossil fuels.

Furthermore, synthetic, renewable natural gas from Reverion plants can be used for electricity, heat or mobility via the existing natural gas grid. In doing so, a long-term storage effect is achieved by using the existing gas infrastructure. At the same time, we reduce our dependence on gas-selling countries through decreased energy imports by both leveraging the potential of biogas and generating renewable gases.

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Reverion's micro power plants enable a highly flexible and efficient decentralized energy supply.

What is the economic impact of your innovation on key stakeholders?

F. Fischer: For biogas plant operators, Reverion can double the revenues from electricity production and add additional revenue streams from selling gases (H_2, CH_4, CO_2) or for trading in balancing markets. With these additional revenues, our customers can more than fivefold their overall income. Grid operators profit from a controllable renewable energy source to stabilize the grid. And of course, society as a whole benefits by reducing its need to import gas, doubling the electricity output from the same amount of biogas and by reducing energy costs.

Going from five to 40 employees in less than one year is a rapid growth. Where are you now and what are your next steps?

F. Fischer: Yes, we are indeed growing fast. Since May 2022, we have moved our offices and production facilities to Eresing in Bavaria. This year we will produce our first commercial units and next year we will start series production. As we continue to expand, we are always on the lookout for talented individuals who share our vision and want to be part of our exciting journey! We have advertised several positions, and more will be added in the coming months.

Business Idea

Enabling a 100% Renewable Energy System

Volatile renewable sources require technologies that can balance the power grid and provide energy storage. Biogas is already a fundamental component of the energy transition and the only renewable energy source that can provide both secure base load and controllable power for the fluctuating feed-in from wind and photovoltaics. However, today's biogas plants are operated with gas engines that have very low efficiencies (max. 40%), are not flexible, do not offer storage capability, and emit millions of tons of CO_2 yearly.

Reverion power plants are the first all-in-one solution that

- electrochemically convert biogas or hydrogen into electricity with highest electrical efficiencies of 80% (which doubles the efficiency of state-of-the-art solutions);
- have a reversible operation mode and can also produce green hydrogen or methane from electricity (power-to-gas)
- capture pure, storable CO_2, enabling cost-effective, negative CO_2 emissions for the first time.

This ensures the future economic viability of existing biogas plants and contributes to stabilizing the energy system, bringing flexibility to the market and solving the problem of long-term energy storage.

When cattle manure or similar waste streams are used as feedstock, Reverion additionally solves major environmental problems (methane emissions, nitrate, etc.) and offers farmers or regional utilities financial revenues instead of incurring costs for disposal treatment.

Our technology consists of modular scalable standardized container units. These are designed for series production and plug & play installation to easily replace existing gas engines and enable rapid market penetration. The first 100 kW plant will be delivered in the first half of 2023, with series production up and running from 2024. More powerful and even more economical 500 kW units will be offered from 2025.

- Reverion, Eresing, Germany
  https://reverion.com

Reverion

Elevator Pitch

Milestones & Roadmap

Reverion manufactures highly efficient, reversible, carbon-negative power plants. The technology doubles the electricity production from biogas compared to state-of-the-art solutions. In the process, pure CO_2, ready for storage, is separated, allowing negative CO_2-emissions. Additionally, the plants can switch to gas generation (green H_2 or CH_4) and enable long-term energy storage.

Their mission is to make carbon negative power generation possible at scale, by making the most out of biogas and becoming the first cost competitive BECCS technology in the market.

Now, one year after founding their company, Reverion's team is manufacturing the first commercial units and has an order book filled to cover its production capacity until 2025.

Reverion has been recognized with several prestigious awards, both nationally and internationally. These include the XPRIZE Carbon Removal Competition funded by the Musk Foundation, the Science4Life Energy cup, the Innovation prize from the German Gas Industry, the Bavarian Energy Price, the Energy Start-up Bavaria, the PlanB biobasiert competition, and being finalists in the world's top-rated competitions TechCrunch, Hello Tomorrow and SXSW.

Milestones

2015 – 2021
- Development, planning and engineering of prototype
- Building and commissioning of prototype
- Patents

2021
- Winner XPRIZE Student Award
- Field test completed and prototype validated

2022
- Incorporation and seed financing round
- New production and office site
- R&D of first commercial units
- First pre-order contracts signed
- Grew team to 30 employees

Roadmap

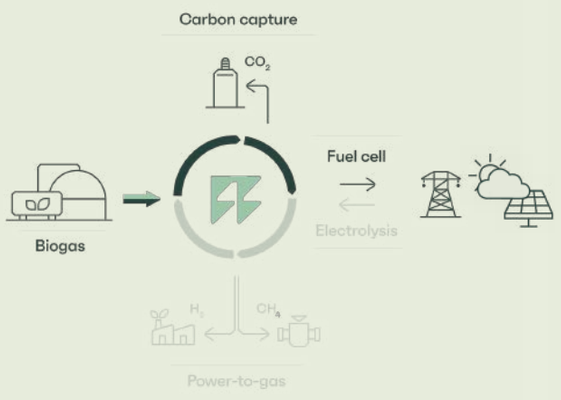
2023
- First commercial units delivered
- Expand team to 70 employees

2024
- Start series production
- Development of the 500 kW plant

REVERSIBLE OPERATION

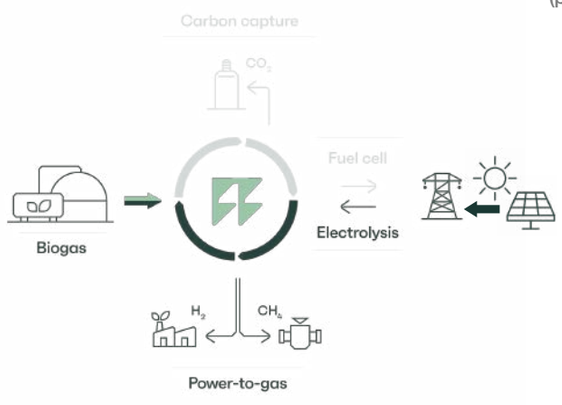
WHEN THERE IS NOT ENOUGH RENEWABLE ENERGY IN THE GRID

POWER GENERATION



WHEN THERE IS AN EXCESS OF RENEWABLE ENERGY IN THE GRID

GAS GENERATION



Reverion's plants have a reversible operation mode: They can electrochemically convert biogas or hydrogen into electricity and can also produce green hydrogen or methane from electricity (power-to-gas), both with highest electrical efficiencies of 80%.