

SEWAGE GAS

Turning
Wastewater into
Green Energy

JENBACHER
INNIO





YOUR CHALLENGES

As individual as you are

You may operate a wastewater treatment plant (WWTP), be a decision-maker in environmental infrastructure projects, or be part of a business that generates large volumes of wastewater. Regardless, no doubt you are stepping up your search for cost-effective and energy-efficient solutions for your treatment plant.

Your goals are diverse, but also individual to your business. Perhaps you are aiming for energy independence, or to capitalize on surplus energy by producing hydrogen. Maybe you would like to enter the electricity market.

Although your business is heavily affected by rising energy costs, you also want to play a role in the energy transition and help establish a reliable green energy infrastructure by switching from fossil fuels to renewables. But wastewater polishing can produce large quantities of biomass in the form of biosolids that require disposal.

Some processes used at WWTPs—such as wastewater recirculation and the aeration of biological cleaning agents in the activated sludge tank—are energy intensive, accounting for about 50% of the plant's total energy demand. No wonder energy costs are second only to personnel costs in your budget.

In Germany, for example, figures from the DWA¹ demonstrate just how much effort WWTPs already have put in to reducing their energy consumption. From this, based on the total capacity of Germany's 10,000 or so WWTPs, consumption fell from around 4,000 GWh in 2011 to around 3,600 GWh in 2020. Nevertheless, with the current electricity mix, WWTPs are the heaviest consumers of municipal electricity, emitting 2.3 million metric tons of CO₂ a year.²

Purification performance is still the number one priority. Consequently, additional efficiency improvements are needed to meet specific energy consumption requirements worldwide.

¹ German Association for Water, Wastewater and Waste (Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V.); https://de.dwa.de/files/_media/content/06_SERVICE/Zahlen%20%7C%20Fakten%20%7C%20Umfragen/leistungsvergleich_2020_final.pdf

² Based on the carbon intensity of power generation in 2021, IEA www.iea.org/reports/tracking-power-2021

THE RIGHT ENERGY SOURCES

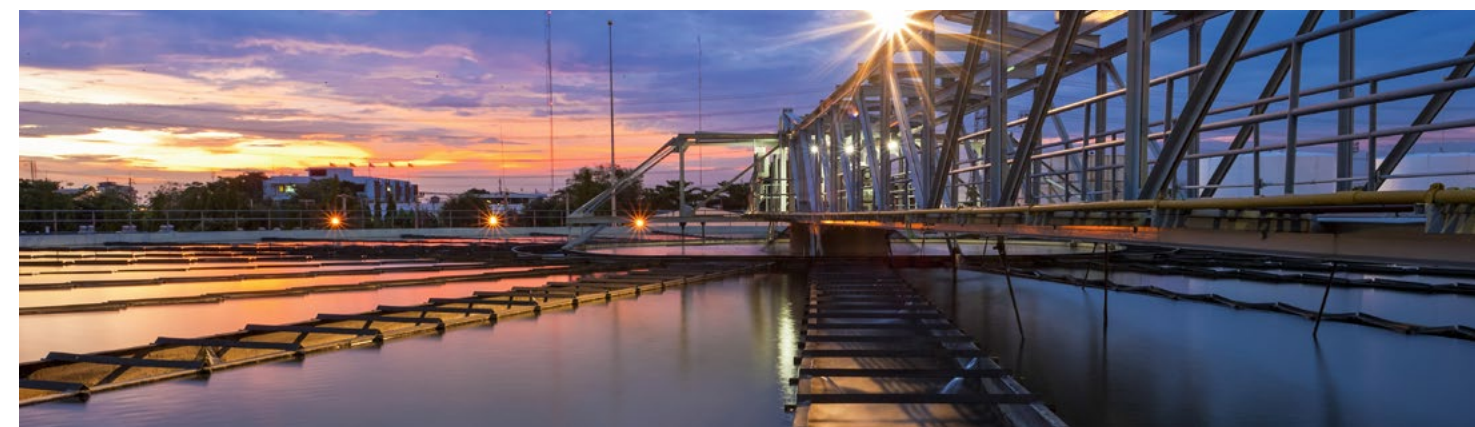
Act now to safeguard the future

With INNIO's solution, you can produce your own electricity! Anaerobic digestion lets you take advantage of the resulting sewage gas to generate sustainable power and heat.

Sewage gas is an exceptionally rich—and free—renewable energy source. It has the potential to make a definitive contribution to the energy transition. On average, the sewage gas produced in anaerobic digesters at municipal WWTPs contains 60–65% (vol.) methane with a heating value of around 6–6.5 kWh/Nm³. This means that the biosolids from the wastewater can generate approximately 1 MW of power per 500,000 population equivalents.

So how does INNIO's technology work? Our Jenbacher combined heat and power (CHP) systems use sewage gas as a renewable energy source by efficiently and reliably converting it to power and heat. With anaerobic digestion, WWTPs can not only cover 80–100% of their own power demand, but also reduce the quantity of fossil fuels that they use to heat the plant. In some cases, operators can even send surplus energy to the public grid—a major contribution to a sustainable electricity mix. This is crucial given the increasing expansion of renewables like wind and solar power, because capacity from sewage gas-fired CHP plants can be deployed when required, and therefore can actively support the power grid when renewables are in short supply. That is why these CHP units are becoming an important building block in the energy transition.

If you have already taken steps toward meeting your particular goal, a high-efficiency CHP plant will take you a step further by significantly improving your power and heat yield.



SUSTAINABLE

CHP solutions

INNIO's reliable, flexible Jenbacher combined heat and power (CHP) systems can run on a wide variety of special gases, including sewage gas. CHP uses around 30% less energy than the separate production of power and heat. INNIO is a world leader in CHP technology, with extensive experience in the field.

The power produced by your CHP system can be used not only to operate your WWTP but also to supply the public grid, opening up additional revenue potential for your business as well.

You can also use the heat you produce to cover your requirements for hot water or process heat. And in principle, you can even store this thermal power for later use. INNIO's Jenbacher engines have this capability built in; our tailored solutions deliver long-term savings.



Renewable energy

By nature, renewables are uncontrollable, so the more renewables that are in the energy mix, the more valuable these flexible CHP systems become. WWTPs also can assume the role of storage plants for renewable energy, because their stored sewage gas can be fed into the grid when required and used for power generation in periods of high demand. In other words, sewage gas systems with CHP technology actually help stabilize the grid.

CLEAR BENEFITS



Cut your energy costs and emissions

With an overall efficiency of up to 95%, CHP solutions can reduce your energy consumption and CO₂ emissions by up to 30% compared with the separate production of power and heat. They also cut your energy costs, because producing your own electricity and recovering your own thermal power is more cost-effective than buying electricity and fuel for your boiler.

Cost-effective operation

Combining CHP with a gas storage tank allows you to operate your plant flexibly, and to optimize your energy costs and revenues when electricity costs are high and the power you are producing exceeds your own requirements.

Reliability of supply through alternative energy sources

If you should run low on sewage gas, or even run out, the built-in flexibility of Jenbacher CHP systems keeps you up and running by giving you the option to admix any percentage of natural gas. This standard solution has a long and successful track record. When required, it can boost your system's resilience. Our systems also feature an island mode with blackout startup.

High operational reliability 24/7

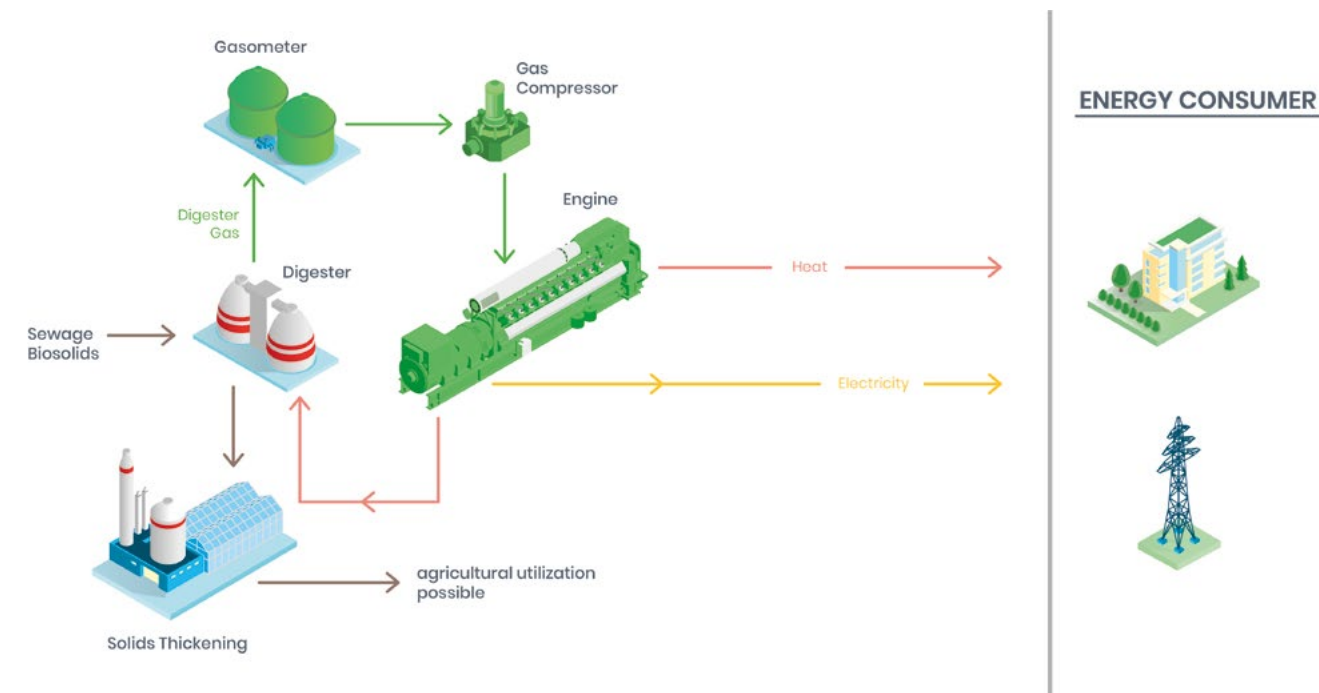
INNIO's Jenbacher CHP systems are designed with sophisticated (and remote) monitoring for high reliability.

TAILORED

to your WWTP

The high electrical efficiency of INNIO's Jenbacher engines makes them an economical solution for use with renewables. At the same time, they are rugged enough to meet the specific properties of sewage gas.

Our wide range of engine sizes and output levels lets you create the perfect solution for your project requirements.



As a WWTP operator, you can capitalize on the power you produce with CHP and use it as a reliable, independent supply for your wastewater treatment. Waste heat from combustion processes can be used to heat up the biosolids in the digester and thus heat your entire plant.

Large plants sometimes generate a large surplus of thermal power, which can be used to dry the biosolids or supply the heating network. And you have the additional option of sending surplus power to the public grid or making it available as balancing energy for grid stabilization. This opens up additional revenue potential for your business while allowing you to play a role in grid stability and the expansion of renewables.



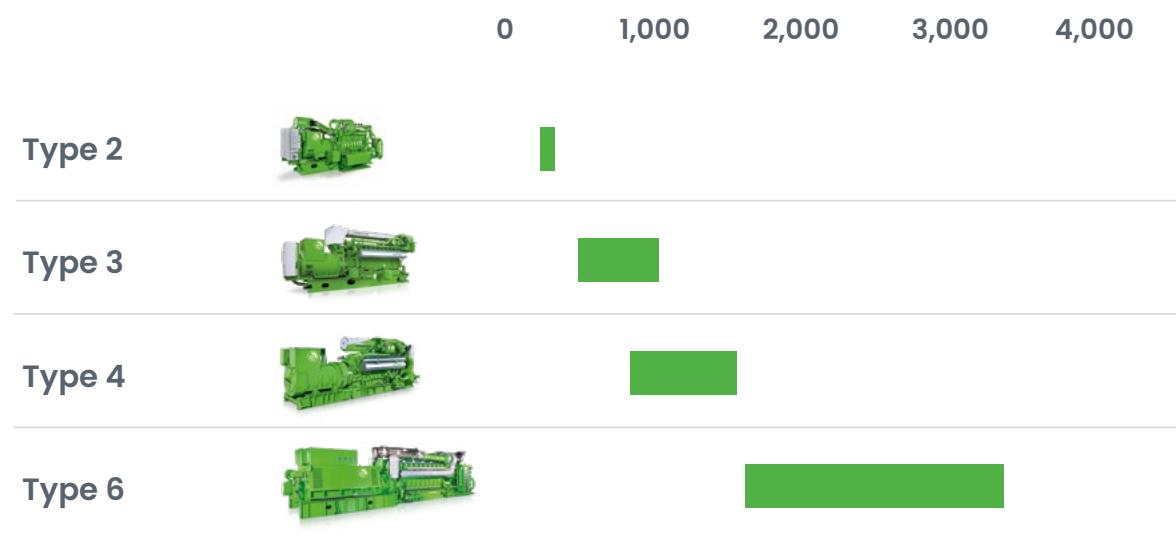
A HIGH-PERFORMANCE portfolio

INNIO’s comprehensive range of engines have an electrical output of 250 kW to 3.4 MW based on a single system running on sewage gas. By combining several Jenbacher CHP systems, you can improve your electrical efficiency while making significant gains in partial load performance and reliability.

Our wide range of generator voltages and flexible hydraulic integration variants is designed for excellent integration into your existing power and heating systems.

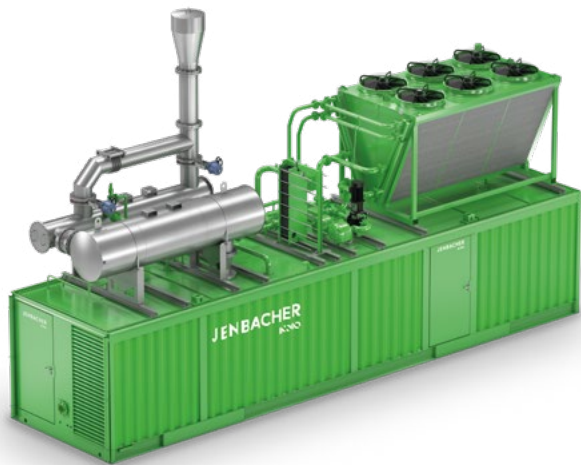
Depending on your requirements and capacity, INNIO supplies the basic module including controls, or an expanded package that also includes all system peripherals.

Electrical output (kWel)



Jenbacher Container Solutions

Containers are available for Jenbacher Type 2, 3, 4 and 6 with a broad range of options to meet the project requirements.



Benefits

- Pre-installed package completed with auxiliary systems ensures a quick and easy site installation
- Compact footprint consumes minimum amount of space on site
- All components perfectly matched and tuned to the specific site requirements by Jenbacher engineering experts to ensure optimal performance



Ready for a greener future?

Visit us at innio.com/hydrogen for more information on INNIO’s hydrogen solutions.

“Ready for Hydrogen” = optional scope on request



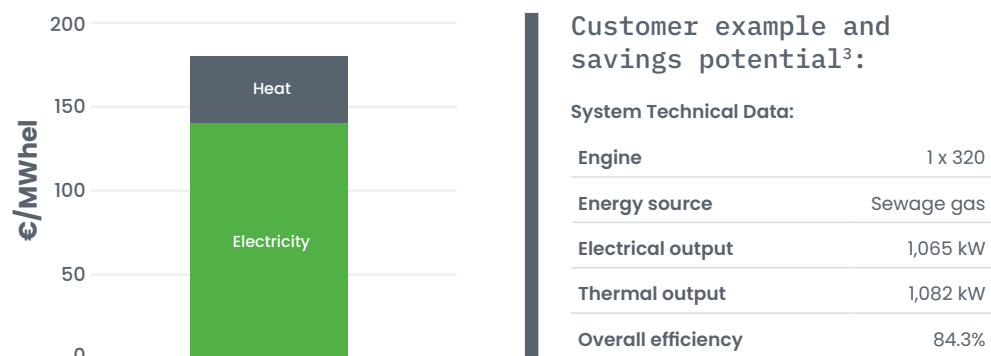
INVESTING

in Jenbacher sewage gas-fired CHP systems pays dividends

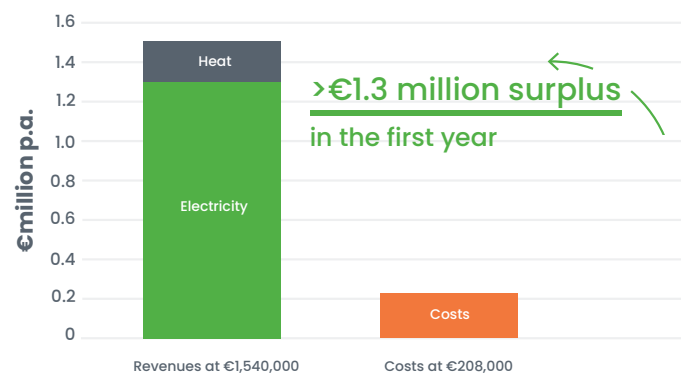
Secure long-term savings and revenue by generating power and heat on site with INNIO's sewage gas solutions. Want to know how?

Take a look at an example based on a real customer project in Germany.

Specific power and heat generation revenues with a Jenbacher CHP system



Full payback in year one



Assuming that the anaerobic digestion of biosolids uses a state-of-the-art grid stabilization method, sewage gas is valued as a cost-neutral energy source. In this scenario, onsite electricity generation with a sewage gas-fired CHP system delivers maximum efficiency and cost-effectiveness by simultaneously using the heat. In ideal circumstances, a CHP system fueled by sewage gas recoups its entire cost in the first year of operation.

³ Assumption: 8,000 operating hours p.a., 10 years
Price of electricity €140/MWhel
Typical price of heat €40/MWhth
Operating costs and capital expenditure: CHP system

800 SEWAGE GAS-FIRED CHP SYSTEMS

The sewage gas-fired systems we have delivered worldwide, with a total output of more than 620 MWeI, have the potential to generate 5,000 GWh of power every year.⁴

That is equivalent to the annual power demand of 1.3 million EU households.⁵ So, compared to the current electricity mix, our fleet is capable of reducing CO₂ emissions by some 3.2 million metric tons.⁶ It's impressive evidence of INNIO's prominent position in the sewage gas-fired CHP industry.



⁴ Based on the number of Jenbacher systems delivered worldwide and assuming 8,000 operating hours p.a.

⁵ Based on average electricity consumption per EU household in 2018.
www.odyssee-mure.eu/publications/efficiency-by-sector/households/electricity-consumption-dwelling.html

⁶ Based on the carbon intensity of power generation in 2021, IEA www.iea.org/reports/tracking-power-2021

ABWASSERVERBAND OBERE ILLER

Environmentally friendly energy solution for the district sewage treatment plant in Allgäu

Every year, the WWTP operated by the Obere Iller Wastewater Association (AOI) cleans 13.7 million cubic meters of wastewater from 11 municipalities in the Oberallgäu district.

Since 2016, the plant has been able to cover 65% of its power demand and 95% of its heat demand using a high-efficiency INNIO energy solution to produce its own supply. The sewage gas produced in the WWTP's digester is used to fuel a CHP system driven by a Jenbacher J208 engine.



PLANT FACTS

Engine	1 x J208
Energy source	Sewage gas
Electrical output	290 kW
Thermal output	371 kW
Total efficiency	87.3%
Year of commissioning	2016



»INNIO's innovative Jenbacher technology allows us to use sewage gas as a renewable energy source that not only provides most of the power for our wastewater treatment plant but also enables us to play our part in the energy transition.«

Siegfried Zengerle, Managing Director,
AOI Abwasserverband Obere Iller



ABWASSERVERBAND AIZ

Lowering operating costs and reducing the ecological footprint

The Achenal-Inntal-Zillertal (AIZ) Wastewater Association, based in Strass im Zillertal, uses two sewage gas-fired Jenbacher J312 engines to drive the CHP system at its wastewater treatment plant. The system has improved the plant's ecological footprint, making a key contribution to the energy transition. The treatment plant cleans 28,270 cubic meters of wastewater per day.



PLANT FACTS

Engines	2 x J312
Energy source	Sewage gas
Electrical output	2 x 635 kW
Year of commissioning	2018, 2020



»After more than 80,000 operating hours with our existing Jenbacher Type 3 engines, when it came time to replace them we had no hesitation in opting for the Type 3 again and upgrading to the new-generation 3F. The changeover was simple and seamless. From day one, the J312F delivered power and heat as reliably as ever, with the bonus of noticeably higher efficiency. So the gas we produce can now be used to generate even more power and heat for in-house processes. The new genset is therefore playing a key role in reducing our wastewater plant's operating costs and ecological footprint.«

Christian Fimml, Operations Manager,
AIZ wastewater treatment plant in Strass

ABWASSERZWECKVERBAND MARIATAL – KLÄRWERK LANGWIESE

A flexible, failsafe energy solution

The Langwiese treatment plant operated by the Mariatal Wastewater Administration Union (Abwasserzweckverband Mariatal) is the largest plant of its kind in the northern catchment area of Lake Constance. Every year, the plant receives between 14 and 19 million cubic meters of wastewater from almost 90,000 residents, plus a large number of trade and industrial businesses.

INNIO installed two sewage gas-fired Jenbacher J312 engines to safeguard the treatment plant's operations with an uninterrupted power supply. Should there be a blackout or if sewage-gas production is interrupted, one of the two engines also can be operated on blended fuel using pipeline gas.



PLANT FACTS

Engines	2 x J312
Energy source	Sewage gas/ pipeline gas
Electrical output	1,006 kW
Thermal output	888 kW
Total efficiency	up to 89.5%
Year of commissioning	2007, 2019

» We get double the benefit from our two innovative Jenbacher engines: We are playing our part in the energy transition, and thanks to INNIO's flexible technology, we also produce surplus power over and above what we need for plant operations!«

Alexander Hårdtner, Operations Manager,
AZV Mariatal Langwiese treatment plant

MUDDY CREEK WASTEWATER TREATMENT PLANT

Responsible use of resources while reducing power costs with CHP

Winston-Salem/Forsyth County Utilities used a sewage gas-fired Jenbacher J416 engine to reduce energy costs and boost efficiency at the Muddy Creek Wastewater Treatment Plant. The CHP system also can send electricity to the local power plant, generating additional revenue.



PLANT FACTS

Engines	1 x J416
Energy source	Sewage gas
Electrical output	1,137 kW
Thermal output	805 kW
Year of commissioning	2020



ABWASSERVERBAND HALL IN TIROL – FRITZENS

Using sewage gas to cover annual plant power demand

At the Fritzens wastewater treatment plant, three sewage gas-fired Jenbacher engines generate more than 4 MWh of electricity, providing for the plant's entire annual power demand. The heat generated by the engines is used to process food waste, thus producing additional energy for waste treatment.



PLANT FACTS

Engines	2 x J208 and 1 x J312
Energy source	Sewage gas
Electrical output	660 kW; 637 kW
Thermal output	761 kW, 867 kW
Year of commissioning	2002, 2005, 2016



OUR COMMITMENT

to you

Flexibility and experience you can count on

For the last 65-plus years, INNIO has been an innovator of power generation technology. Today's highly flexible Jenbacher CHP systems are an efficient, low-emission, reliable, and affordable energy solution that makes energy independence a reality. INNIO has already delivered more than 13,000 CHP systems worldwide.

Thinking long-term. Thinking circular

With our flexible, scalable, and resilient energy solutions and services, INNIO is embracing the circular economy—recycling, reusing, and upgrading our engines to meet the latest environmental requirements. For example, upgrading to hydrogen operations for a renewed life or using heat that normally would be wasted during power generation are sustainable solutions that can keep entire communities or businesses warm and electrified.

Through our service network in more than 80 countries and our digital capabilities, we provide life-cycle support for our globally installed units, helping to ensure a greater runtime for longer equipment life.

Zero-carbon H₂ operation tomorrow

In addition, the same proven and economically viable INNIO equipment can be moved from conventional fuels today to full CO₂-free H₂ operation tomorrow, once H₂ becomes more readily available.



BENEFIT

from a powerful digital platform



Through our myPlant Performance digital solution, INNIO provides digital remote support for our connected customer-operated systems across the globe. Today, more than 10,000 engines are managed remotely, with more than 900 billion data points evaluated annually—a powerful proof-point of INNIO's knowledge and experience.

Fulfill emissions requirements

Our engine and fleet emission monitoring solutions help you more easily comply with emissions requirements—until you can operate your plant with 100% H₂ and become carbon-free.

Improve business planning

Increase your power system's lifespan by taking advantage of self-learning algorithms that analyze component condition and calculate parts lifetime.

Optimize engine management

Real-time engine monitoring and operations provide you with remote access to your assets via desktop or app, whenever you need it, by aligning operational practice with maintenance requirements.

Achieve greater availability

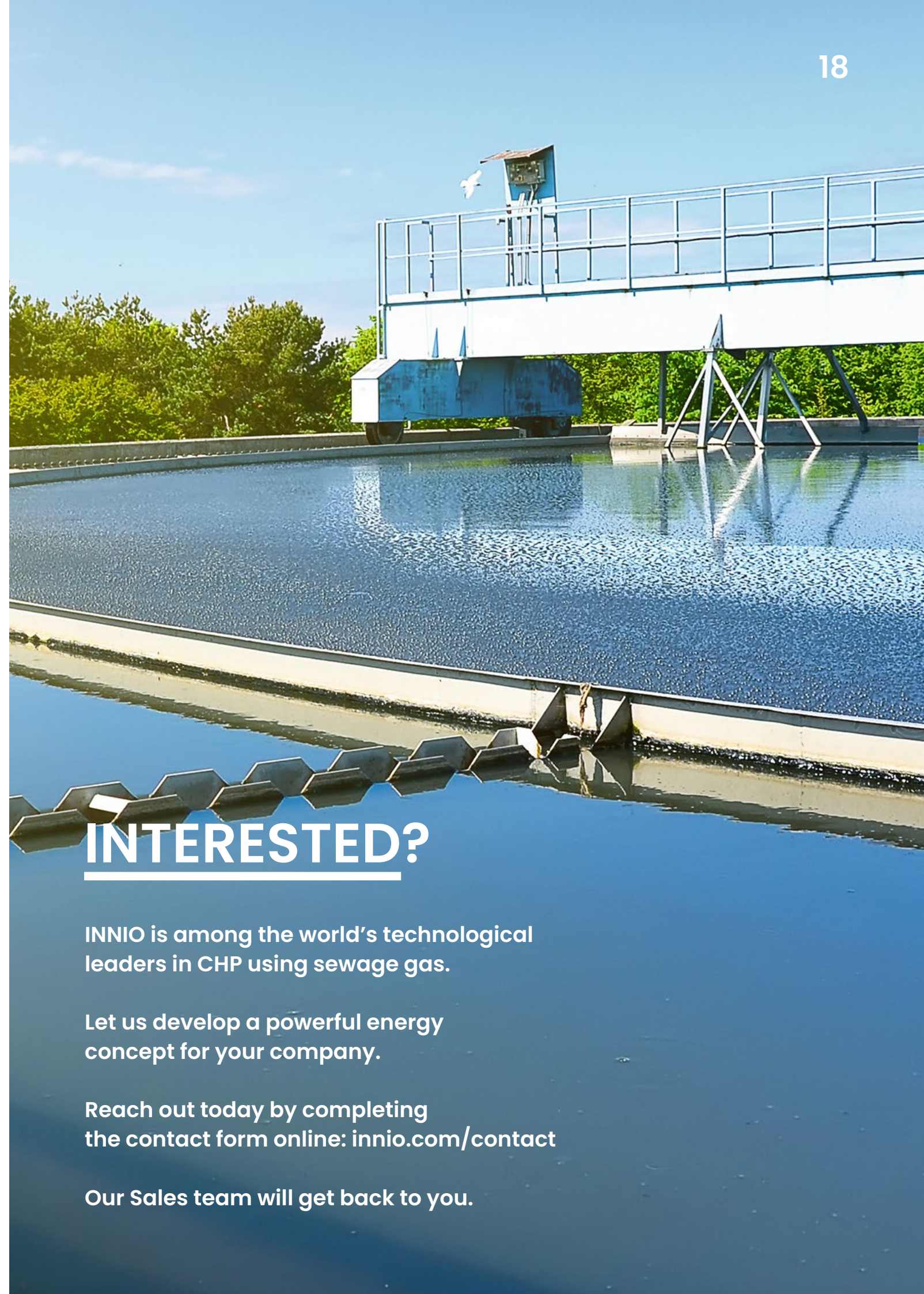
With the ability to solve more than 50%* of logged cases remotely, you can reduce the need for travel to your site—saving time and money.

Rely on INNIO's engagement to sustainability

For INNIO, ethics and compliance, along with a sustainable way of conducting business, are front and center of everything we do. By selecting INNIO as your supplier, you enter a long-term relationship with a dependable collaborator. Our fundamental mission to accelerate the world's transition to net zero was recognized with the prestigious EcoVadis ratings. Also in 2021, INNIO joined the "Race to Zero" campaign, initiated by the United Nations, to bring together global leadership for a healthy transition to a net-zero future. Thanks to our efforts in 2021, INNIO's ESG Risk Rating places us number one out of more than 500 worldwide companies in the machinery industry assessed by Sustainalytics.**

* The number refers to connected Jenbacher engines.

** Rating took place in February 2022



INTERESTED?

INNIO is among the world's technological leaders in CHP using sewage gas.

Let us develop a powerful energy concept for your company.

Reach out today by completing the contact form online: innio.com/contact

Our Sales team will get back to you.

INNIO is a leading energy solution and service provider that empowers industries and communities to make sustainable energy work today. With our product brands Jenbacher and Waukesha and our digital platform myPlant, INNIO offers innovative solutions for the power generation and compression segments that help industries and communities generate and manage energy sustainably while navigating the fast-changing landscape of traditional and green energy sources. We are individual in scope, but global in scale. With our flexible, scalable, and resilient energy solutions and services, we are enabling our customers to manage the energy transition along the energy value chain wherever they are in their transition journey.

INNIO is headquartered in Jenbach (Austria), with other primary operations in Waukesha (Wisconsin, U.S.) and Welland (Ontario, Canada). A team of more than 3,500 experts provides life-cycle support to the more than 54,000 delivered engines globally through a service network in more than 80 countries.

INNIO's ESG Risk Rating places it number one of more than 500 worldwide companies in the machinery industry assessed by Sustainalytics.

For more information, visit INNIO's website at www.innio.com

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ENERGY SOLUTIONS.
EVERYWHERE, EVERY TIME.



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