HYDROGEN

Investing in a green future

JENBACHER

INNIO

YOUR CHALLENGE

Decarbonization

Like all contributors to the global power industry, you are challenged by stricter emission regulations and the push for CO_2-neutral power solutions in a decarbonized world. All power producers need to be thinking ahead now about how to get to a greener future.

In addition to renewable power, traditional combustion technologies can become CO_2-free by using hydrogen (H_2) as fuel. H_2 is well suited as fuel for engines to generate electricity, heat and/or cooling. Integrated with solar, wind or other renewable technologies, H_2 plants can form the backbone of your 100% renewable microgrid. When using green H_2 in engines, you can even achieve a zero-carbon emission solution.

INNIO is ready to deliver H_2-capable power plants now. Invest today in our Jenbacher H_2 combined heat and power (CHP) technology, run it on conventional pipeline gas, flexibly start mixing in H_2 and seamlessly switch to CO_2-free operation when H_2 becomes more readily available.

READY FOR HYDROGEN

Today for tomorrow

INNIO is the market leader in hydrogen solutions for engines, and these products are available today.

As a form of storable renewable energy, H_2 is not only carbon-free, but also an important shaper of the energy transition. Using it in Jenbacher power plants provides you significant advantages.

ready for HYDROGEN H_2

POWERFUL BENEFITS

Rely on proven technology

Build on proven and established engine technology that enables you to flexibly move to 100% H_2 operation over time without changing the asset.

Flexibly move to green energy

Today, green H_2 is still a rare fuel. This will change over time, and with your Jenbacher Ready for H_2 plant, you won't lose momentum. You can move as fast as H_2 availability progresses and harvest all the green potential that opens up.

Achieve CO_2-free operation

Once operating your proven Jenbacher power plant with 100% H_2, you have a CO_2-free energy solution—allowing you to meet present and future emissions goals.

Make a smart investment today

Whether you convert your existing Jenbacher engine plant to Ready for H_2 operation accepting up to 20% (vol) of hydrogen in pipeline gas or opt for one of our Type 4 100% H_2 engines, Jenbacher H_2 engines are a smart investment choice. They also help you avoid increasing carbon credit costs.

Improve resource efficiency

With outstanding CHP efficiency of up to 95%, up to 33% of the H_2 fuel can be saved—compared to power generation alone. Running our H_2 technology in CHP mode also helps shape the energy transition by generating CO_2-free heat.

Ensure supply security

With their dispatchability, Jenbacher engines are an ideal solution to balance the intermittence of renewable energy sources, such as wind and solar, and support the resilience of the electrical grid.

3 WAYS TO USE HYDROGEN

with Jenbacher engines

H_2 in pipeline gas

Jenbacher engines are available with a Ready for H_2 option, capable of running with up to 20% (vol) of hydrogen in pipeline gas. As hydrogen becomes more readily available, all Ready for H_2 new units and most of the currently installed Jenbacher conventional gas-fueled engines can be converted to operate on 100% H_2. Type 4 engines and CHP systems are available today to run on 100% H_2.

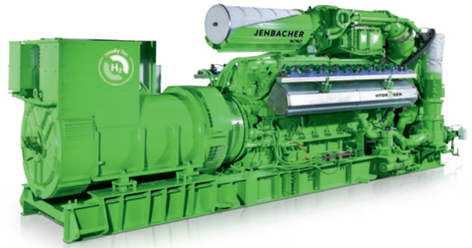
H_2 locally admixed to conventional gas

Up to 60% (vol) hydrogen content can be admixed to conventional gas fuel for use in special versions of Type 3, Type 4 and Type 6 engines. Type 4 engines and CHP systems are available today as dual-gas-fuel solutions capable of running on 100% conventional gas, 100% H_2 or mixtures of conventional gas and H_2.

100% H_2 as an energy source

Jenbacher Type 4 engines and CHP systems are now available as 100% H_2 engine systems operating exclusively on hydrogen. These plants are CO_2-free by design.

A POWERFUL portfolio



Electrical Power Output (kWel) 0 1,000 2,000 3,000 4,000 5,000 […] 10,000		H_2 in Pipe-line Gas <5% (vol)	H_2 in Pipe-line Gas <20% (vol)[2]	Gas[1]/H_2 Engine 0-100% (vol)	H_2 100%
Type 9	J920 FleXtra	✓	✓	25	2025+
Type 6	J612, J616, J620, J624	✓	✓	60	2025+
Type 4	J412, J416, J420	✓	✓	100	✓
Type 3	J312, J316, J320	✓	✓	60	2025+
Type 2	J208	✓	✓	60	2025+

H_2 conversion with minor investment

If you already have a Jenbacher engine in your fleet, then your engine likely can be converted to Ready for H_2, capable of running with up to 20% (vol) of hydrogen in pipeline gas. Most of these engines also can be converted to local admixing of high hydrogen content up to 60% (vol). The majority of the Type 4 engines installed can be converted today to a pure H_2 engine or a dual-gas-fuel solution capable of running on 100% conventional gas, 100% H_2 or mixtures of conventional gas and H_2. INNIO's Jenbacher technology team has defined the upgrade packages necessary to make your unit capable of running on high hydrogen mixtures and even 100% H_2 for the Type 4. In the future, more engine types will be available for operation on 100% H_2. Reach out to your Jenbacher contact to learn more about your specific upgrade options.

Watch the Video of the 1st Hydrogen Field Conversion for a Carbon-Neutral Future

[1] Conventional gas
[2] Subject to required modifications for the certification of the fuel gas components. A modification of the maintenance schedule for such components may be required

50 YEARS OF EXPERIENCE

with climate-neutral gases and high hydrogen fuels

INNIO has 50 years of experience converting alternative fuels into power, and more than 8,500 of our Jenbacher engines are operating on climate-neutral gases like biogas right now. Although some Jenbacher engine solutions still are running on conventional fuels today, they can be converted to run on 100% H_2 tomorrow. Some examples:

25 YEARS

using chemical process gas

Krems
Austria

At a chemical plant in Krems, Austria, four Jenbacher J320 engines have been operating since 1996 on a very low heating value gas with about 15% (vol) of hydrogen, produced from a chemical process. They have achieved well over 200,000 operating hours (oph).

13 YEARS

fueled by hydrogen mix

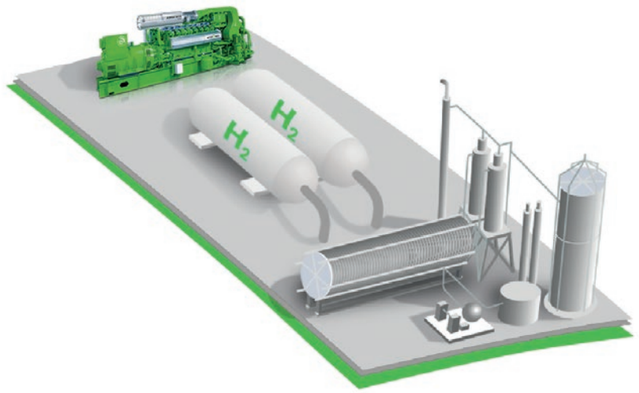
Hychico
Argentina

At the Hychico Diadema Wind Park and Hydrogen Plant in Argentina, renewable H_2 has been produced using water electrolysis since 2008. The hydrogen is stored underground for research purposes, and a 1.4 MW Jenbacher J420 engine runs for more than 70,000 oph on a variable mixture of conventional gas and up to 42% (vol) of hydrogen to produce power.

2020

First 1 MW engine globally to run on up to 100% H_2 commissioned in Germany

Hanse Werk Natur
Hanse Werk Natur, an EON company, is running a flagship CHP project in Hamburg. The 1 MW Jenbacher J416 engine can run on a variable hydrogen mixture from 0% up to 100% H_2—powerful proof that our Jenbacher Type 4 engines can operate exclusively on hydrogen.



»By field testing this INNIO CHP plant with up to 100% hydrogen, we are demonstrating that a greener, more reliable, more flexible and future-orientated energy supply for Hamburg is technically feasible.«

Thomas Baade
Technical Director of Hanse Werk Natur

Watch the Video with Thomas Baade, Technical Director of Hanse Werk Natur

GREEN JENBACHER H_2 TECHNOLOGY:

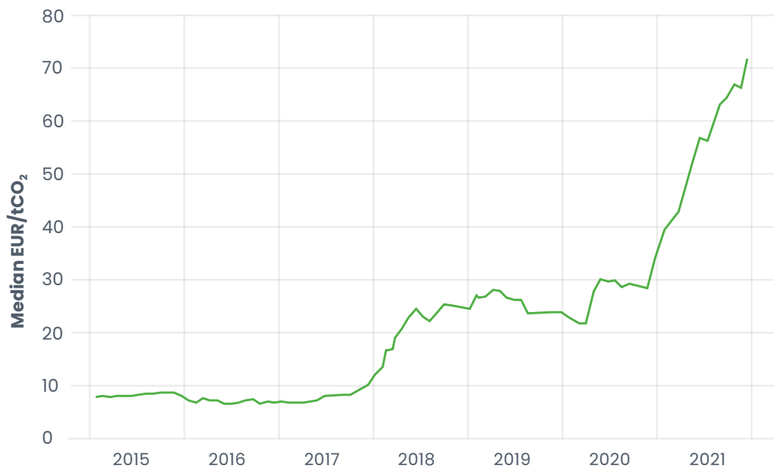
a smart investment choice

Preparing for 100% renewable power, including 100% H_2 use, is becoming increasingly important.

Some of the world's largest economies—the US, Japan, European Union member countries, China and Canada, for example—have committed to large-scale investment in H_2 technology in this decade with the belief that H_2 will be a widely available zero-CO_2 fuel. By investing now in INNIO's Jenbacher Ready for H_2 technology, you will be equipped to quickly harvest the opportunity of a hydrogen-based economy.

At the same time, Jenbacher H_2 engines enable you to avoid significant costs for CO_2 certificates related to expected stricter emission trading rules. Below, you can see how CO_2 pricing within the EU emission trading system has sharply risen since 2015.

EU Carbon Market from 2015 to 2021



Graphic: www.eex.com/en/market-data/environmental-markets/eua-primary-auction-spot-download

Carbon tax case and saving potential

A 1 MW CHP power plant running about 4,000 operating hours per year on conventional gas has current yearly emissions of about 2,000 tons of CO_2. When operating with 100% H_2, the same plant based on the current CO_2 price of around 80 €/ton from the EU Emission Trading System (ETS) would save a total of €160,000 per year.

OUR COMMITMENT

to you

Innovation strength you can count on

INNIO's Jenbacher team has been among the first to recognize the potential of hydrogen as the green energy vector. Twenty years ago, the first Jenbacher engine running on 100% H_2 was installed at a demonstration plant in Northern Germany. Today, more than 250 MW of INNIO's installed Jenbacher fleet runs on special gases with H_2 up to 70% (vol). We support 90 projects with high hydrogen fuels in 28 countries. And well over 300 engineers are focused on research and innovation projects at INNIO.

Zero-carbon H_2 operation tomorrow

In addition, the same proven and economically viable INNIO equipment can be moved from conventional fuels today to full CO_2-free H_2 operation tomorrow, once H_2 becomes more readily available.

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 over 40,000 installed units globally, helping to ensure a greater runtime for longer equipment life.

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, evaluating more than 900 billion data points annually—a powerful proof-point of INNIO's knowledge and experience.

Fulfill emission requirements

Our engine and fleet emission monitoring solutions help you more easily comply with emissions requirements—until you can operate your plant with 100% H_2 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 about 65% 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 Silver Medal Rating for 2021 and Gold Medal Rating for 2022. 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 it number one of more than 500 worldwide companies in the machinery industry assessed by Sustainalytics.*

*Rating took place in February 2022

INTERESTED?

INNIO is ready for H_2. Let us help you get ready, too.

Reach out today by completing the contact form on our Hydrogen website innio.com/hydrogen

Our Sales contact will follow up with 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.

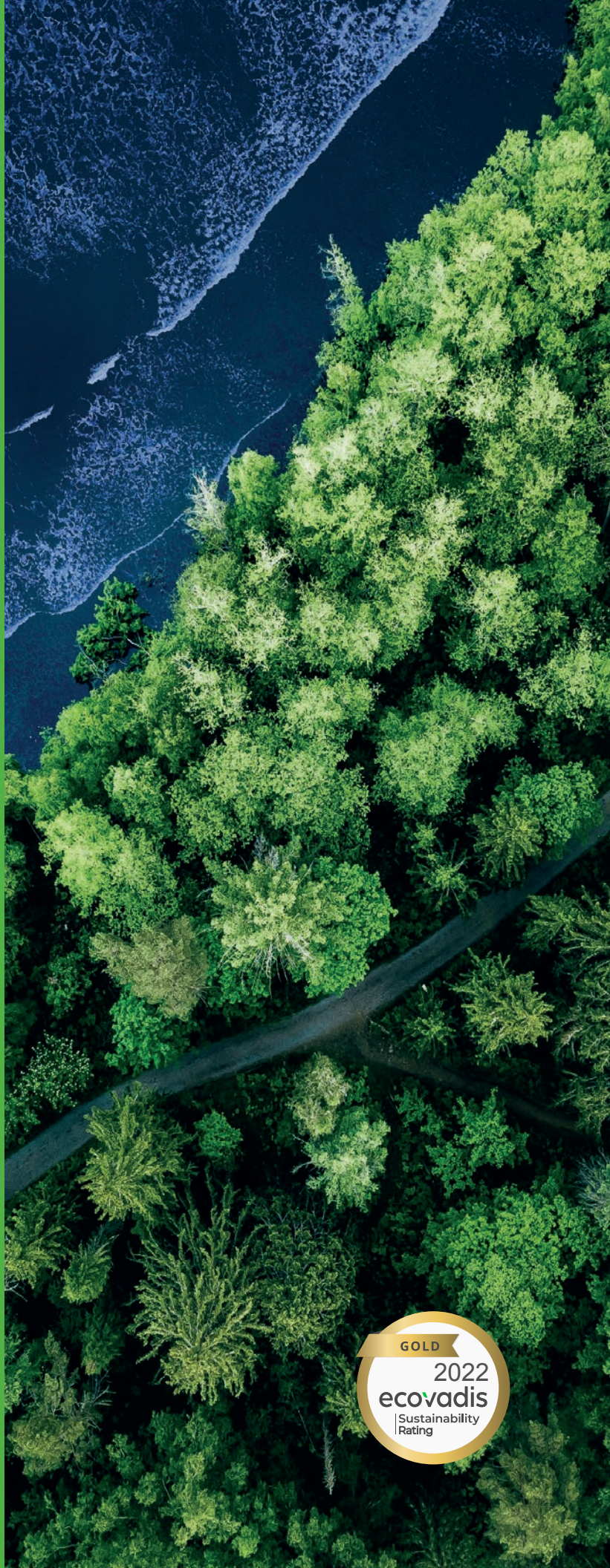
INNIO's ESG Risk Rating places it number one of more than 500 worldwide companies in the machinery industry assessed by Sustainalytics.

For more information, visit INNIO's website at **innio.com/hydrogen** or **www.innio.com**

Follow INNIO on

ready for H_2

ENERGY SOLUTIONS.
EVERYWHERE, EVERY TIME.



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