

# HYDROGEN

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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<sub>2</sub>-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<sub>2</sub>-free by using hydrogen (H<sub>2</sub>) as fuel. Hydrogen is well suited as fuel for engines to generate electricity, heat, and/or cooling. Integrated with solar, wind, or other renewable technologies, H<sub>2</sub> plants can form the backbone of your 100% renewable microgrid. When using green hydrogen in engines, you can even achieve a zero-carbon emission solution.

INNIO is ready to deliver H<sub>2</sub>-capable power plants now. Invest today in our Jenbacher H<sub>2</sub> CHP technology, run it on conventional pipeline gas, flexibly start mixing in hydrogen, and seamlessly switch to CO<sub>2</sub>-free operation when hydrogen becomes more readily available.

## READY FOR HYDROGEN

### Prepared for the future

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

As a form of storable renewable energy, hydrogen is not only carbon-free, but also an important enabler in the energy transition. Using hydrogen in Jenbacher power plants has a whole raft of benefits.

ready for  
  
 HYDROGEN



## POWERFUL BENEFITS



### Rely on proven technology

Build on proven and established engine technology that enables you to flexibly move to 100% H<sub>2</sub> operation over time without changing the asset.

### Flexibly move to green energy

Today, green hydrogen is used only to a limited extent as a fuel. This will change over time, and with your Jenbacher "Ready for H<sub>2</sub>" plant, you won't lose momentum. You can move as fast as hydrogen availability progresses and harvest all the green potential that opens up.

### Achieve CO<sub>2</sub>-free operation

Once your reliable Jenbacher plant is running on 100% H<sub>2</sub>, you have a carbon-free energy solution, allowing you to meet present and future emissions targets.

### Make a smart investment today

Whether you convert your existing Jenbacher engine plant to "Ready for H<sub>2</sub>" operation accepting up to 25% (vol) of hydrogen in pipeline gas or opt for one of our Type 4 engines operating with 100% H<sub>2</sub>, Jenbacher H<sub>2</sub>-Engines are a smart investment choice. They also help you avoid increasing carbon credit costs.

### Improve resource efficiency

Combined heat and power (CHP) delivers outstanding efficiency of up to 95%. It consumes around one-third less primary energy than conventional systems. And by operating our H<sub>2</sub> technology in CHP mode, you also can help accelerate the energy transition by producing carbon-free heat.

### Supply security

Jenbacher engines are dispatchable, and therefore an ideal solution for balancing the intermittence of renewables like wind and solar, making the grid more resilient.

## THREE WAYS TO USE HYDROGEN

### with Jenbacher engines



#### H<sub>2</sub> in pipeline gas

All new Jenbacher plants are "Ready for H<sub>2</sub>". In addition, engine variants with a corresponding option can be operated with up to 25% (vol) of H<sub>2</sub> in the pipeline gas. As hydrogen availability increases, all new plants and most of the currently installed Jenbacher natural gas engines can be converted to run on 100% hydrogen.



#### H<sub>2</sub> locally admixed to pipeline gas

Up to 60% (vol) hydrogen content can be admixed to pipeline gas for use in specific versions of our Type 2, 3, 4, and 6 engines. Type 4 engines and CHP systems are available today as dual-gas-fuel solutions capable of running on 100% conventional gas, 100% hydrogen, or mixtures of pipeline gas and hydrogen.



#### 100% H<sub>2</sub> as an energy source

Jenbacher Type 4 engines and CHP systems are now available for operation exclusively on hydrogen. These plants are CO<sub>2</sub>-free by design.

# A POWERFUL portfolio



## Electrical output (kWel)

	Electrical output (kWel)								H <sub>2</sub> in pipeline gas		Gas <sup>1</sup> /H <sub>2</sub> engine	100% H <sub>2</sub>
	0	1,000	2,000	3,000	4,000	5,000	[...]	10,000	<5% (vol)	<25% (vol) <sup>2</sup>	0-100% (vol)	
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+

## Low-investment conversion to H<sub>2</sub>

If you already have a Jenbacher engine in your fleet, it likely is suitable for a "Ready for H<sub>2</sub>" upgrade. Already today, all new Jenbacher engines are "Ready for H<sub>2</sub>." "Ready for H<sub>2</sub>" means that your Jenbacher unit can basically be converted to operate with up to 100% hydrogen. Details on the cost and timeline for a future conversion may vary and need to be clarified individually. In addition, certain engine models are available with an option for running on up to 25% (vol) of H<sub>2</sub> in pipeline gas. Our Type 4 engines are already offered today for operation with 100% H<sub>2</sub>. In the future we will be offering even more engine types that can be operated with 100% hydrogen. Reach out to your Jenbacher representative to learn more about your specific upgrade options.



Discover the 190 MW Kiel coastal power plant, which theoretically could be converted today for operation with green hydrogen.

<sup>1</sup> Conventional gas

<sup>2</sup> Subject to specific modifications for certification of the fuel gas components. Modifications to the maintenance schedule for these components also may be required.



## 50 YEARS OF EXPERIENCE

with climate-neutral gases  
and hydrogen-rich fuels

INNIO has 50 years of experience converting alternative fuels into power, and around 10,000 of our Jenbacher engines delivered worldwide are designed to operate on climate-neutral gases like biogas. Although some Jenbacher engine solutions still are running on conventional fuels today, they can be converted to run on 100% hydrogen tomorrow. Some examples:

## 25 YEARS

using chemical  
process gas



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. The engines have achieved well over 200,000 operating hours.

## 13 YEARS

fueled by a  
hydrogen mix



**Hychico**  
Argentina

At the Hychico Diadema Wind Park and Hydrogen Plant in Argentina, green hydrogen has been produced using water electrolysis since 2008. The hydrogen is stored underground for research purposes. The plant's 1.4 MW Jenbacher J420 engine has generated electricity for more than 80,000 operating hours using a variable mixture of conventional gas and up to 42% (vol) of hydrogen.



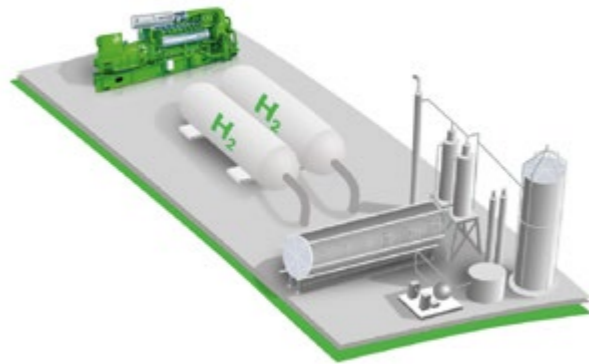
# 2020

## World's first 1 MW engine to run on up to 100% hydrogen commissioned in Germany



### HanseWerk Natur

HanseWerk Natur, an E.ON 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<sub>2</sub> – powerful proof that our Jenbacher Type 4 engines can operate exclusively on hydrogen.



»We have demonstrated that our Jenbacher combined heat and power plant from INNIO can operate reliably with 100% hydrogen. Going forward, this will be key to us as we cover peak loads and ride out periods of dark doldrums.«

Dr. Nikolaus Meyer,  
Managing Director, HanseWerk Natur GmbH

First-ever conversion to hydrogen in the field for a climate-neutral future:



# GREEN JENBACHER HYDROGEN TECHNOLOGY: a smart investment choice

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

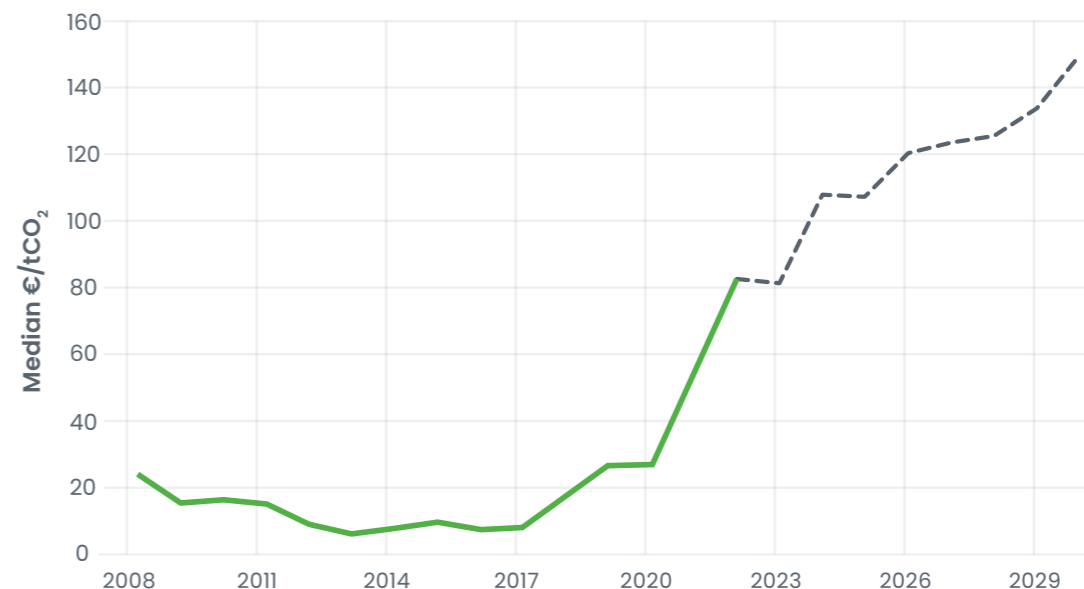
Some of the world's largest economies – the US, Japan, EU countries, China, and Canada, for example – have committed to large-scale investment in H<sub>2</sub> technology this decade with the belief that sufficient amounts of hydrogen will be available as a carbon-free fuel. By investing now in INNIO's Jenbacher "Ready for H<sub>2</sub>" technology, you will be equipped to quickly harvest the opportunity of a hydrogen-based economy.

And with the prospect of more stringent rules in emissions trading, Jenbacher H<sub>2</sub>-Engines will spare you the significant cost of CO<sub>2</sub> certificates. Below, you can see how CO<sub>2</sub> pricing within the EU emission trading system has risen sharply since 2015.

### CO<sub>2</sub> tax case and savings potential

The annual emissions of a 1 MW CHP plant running for 4,000 operating hours per year on conventional gas are 2,000 metric tons of CO<sub>2</sub>. When operating with 100% hydrogen, the same plant based on the current CO<sub>2</sub> price of around 80 €/ton from the EU Emission Trading System (ETS) would save a total of €160,000 per year.

EU Carbon Market from 2008 to 2029



Source:  
BloombergNEF;  
March 2023

# OUR COMMITMENT

to you

## Flexibility and experience you can count on

For the last 65-plus years, Jenbacher has been an innovator of power generation technology. Today's highly efficient Jenbacher systems deliver energy independence through an efficient, low emission, secure and cost-effective energy solution.

## 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 100 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 H<sub>2</sub> operation tomorrow

In addition, the same proven and economically viable INNIO equipment can be moved from conventional fuels today to full CO<sub>2</sub>-free H<sub>2</sub> operation tomorrow, once H<sub>2</sub> 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 12,000 engines are managed remotely, with more than 1.2 trillion data points evaluated 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<sub>2</sub> 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 60% 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. 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, INNIO's ESG Risk Rating secures again the number one position across more than 500 companies globally in the machinery industry assessed by Sustainalytics.\*

\*Rating took place in March 2023

## FIRED UP TO TAKE THE NEXT STEP?

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

Reach out today by completing the contact  
form on our Hydrogen website:  
[jenbacher.com/hydrogen](https://jenbacher.com/hydrogen)

Our Sales team  
will get back to you.

ready for  
H<sub>2</sub>  
HYDR GEN



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, we offer 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. INNIO is individual in scope, but global in scale. With our flexible, scalable, and resilient energy solutions and services, we enable 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 4,000 experts provides life-cycle support to the more than 55,000 delivered engines globally through a service network in more than 100 countries.

INNIO's improved ESG Risk Rating again secures the number one position across more than 500 companies globally in the machinery industry assessed by Sustainalytics.

For more information, visit [jenbacher.com/hydrogen](https://jenbacher.com/hydrogen) or [www.jenbacher.com](https://www.jenbacher.com)

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EVERYWHERE, EVERY TIME.



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In general, "Ready for H<sub>2</sub>," Jenbacher units can be converted to operate on up to 100% hydrogen in the future. Details on the cost and timeline for a future conversion may vary and need to be clarified individually.

