# JENBACHER POWER GENERATION SOLUTIONS WITH HYDROGEN

**WE ARE ON THE MOVE TOWARDS HYDROGEN**

**Presented by Nicolas Soboll**

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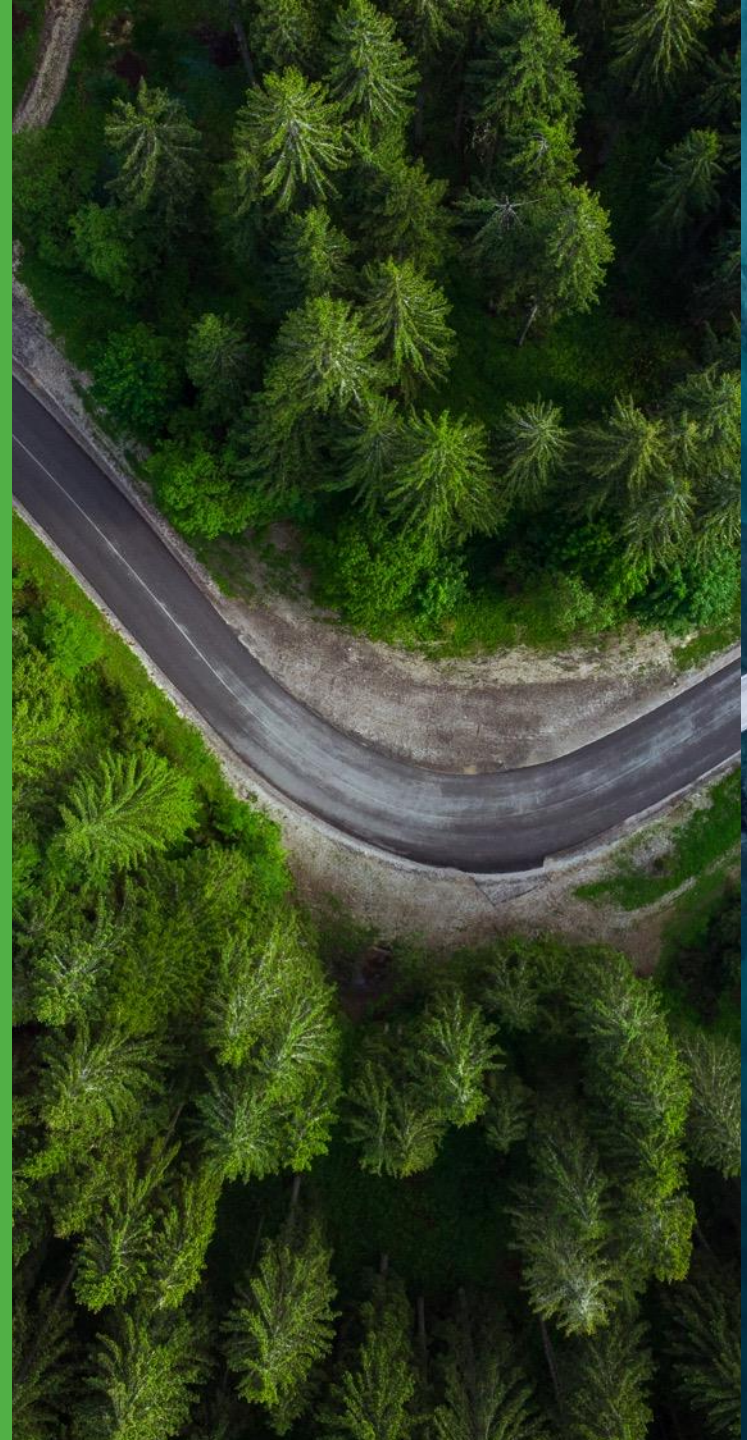

# MEGATRENDS DRIVE INNIO'S FUTURE GROWTH

## The three Ds of energy

Decentralization

Digitalization


Decarbonization

# READY FOR HYDROGEN – WHAT IT MEANS

## Jenbacher released our “Ready for H2” technology in July 2021


ready for $H_2$

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“**Ready for H2**”* means the Jenbacher engines can operate with up to 25% (vol) of hydrogen in pipeline gas and can be converted to 100% H2 operation.

A “**Ready for H2**” designed Jenbacher engine plant helps to reduce future H2 retrofit costs.

**Type 4** is already available for 100% H2 operation.



* Optional scope on demand.

# PROVEN EXPERIENCE WITH HYDROGEN & HYDROGEN MIXTURES

>95% $H_2$ as fuel

4 x 200,000 oh

$CO_2$ neutral

Traditional gas / hydrogen mixture

| Process gas (Krems) COD 1996 | Syngas (Mutsu) COD 2003 | Traditional Gas (Hychico) COD 2008 | Pure Hydrogen* 2021+ |
|---|---|---|---|
| $H_2$: ~15-17% (vol)<br>$CH_4$: ~1.5% (vol)<br>LHV: ~0.5 kWh/$m^3$ | $H_2$: ~30-40% (vol)<br>CO: ~25-30% (vol)<br>LHV: ~2.5 kWh/$m^3$ | $H_2$: ~0-42% (vol)<br>$CH_4$: ~100-58% (vol)<br>LHV: ~10-7 kWh/$m^3$ | $H_2$: … 100% (vol)<br>Pipeline Gas or Inerts<br>LHV: ~3 kWh/$m^3$ |

Commercial operation
(Challenges: gas quality variations)

Future

More than 250MW installed with syngas / process gases, 90 projects, 28 countries

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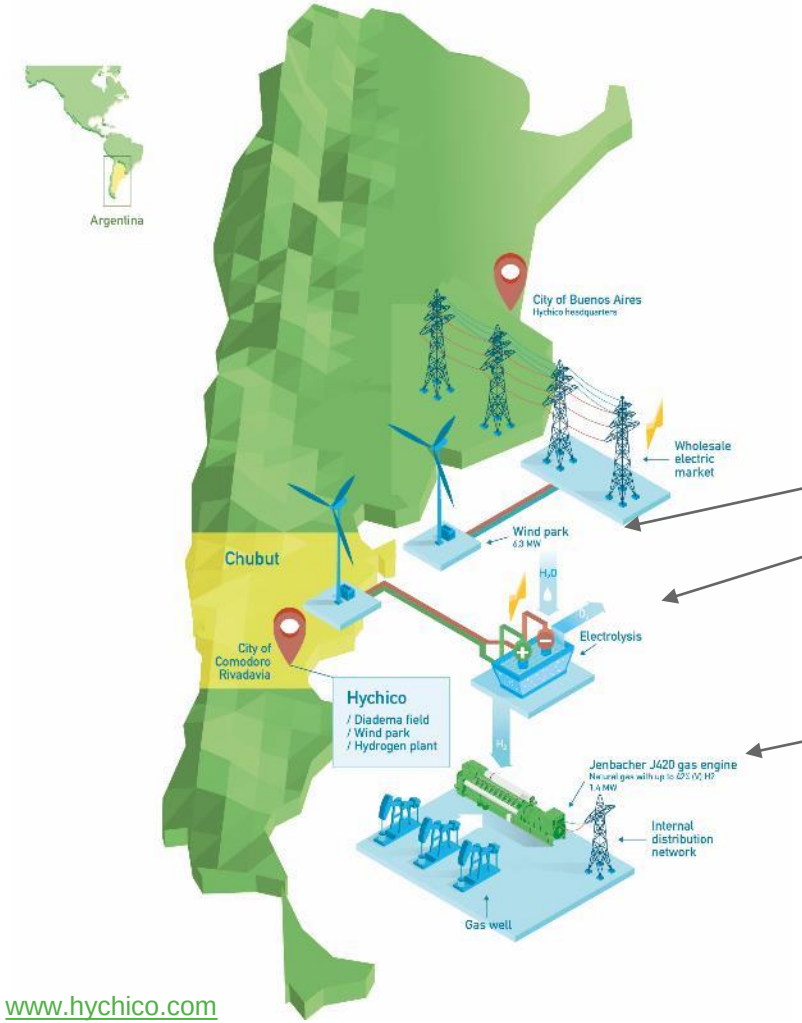
# HYCHICO, ARGENTINA SITE




## Hychico, Diadema Wind Park & Hydrogen Plant, Chubut Province, Argentina

### About the region:

Currently large oil & gas fields
2,000 GW wind power potential, compared to 600 GW global installations today
Ideal place for exporting green $H_2$ and e-fuels in the future

### Green $H_2$ demo:

6.3 MW wind park with **54.9% CF (2017), avg. >50%**
0.8 MW of electrolyzer (2 units), 120 $Nm^3/hr$ $H_2$
$H_2$ with high purity (99.998%), $O_2$ for local market
Underground $H_2$ storage research

**~80,000 oh**
since 2008

### J420 converts $H_2$ back to power:

Output: 1,415 $kW_{el}$
Main Fuel: Traditional gas MN >90
Operation with **controlled $H_2$ blending**
0-27% (vol) $H_2$: 1,415 kW
28-42% (vol) $H_2$: 1,415 to 1,180 kW


www.hychico.com

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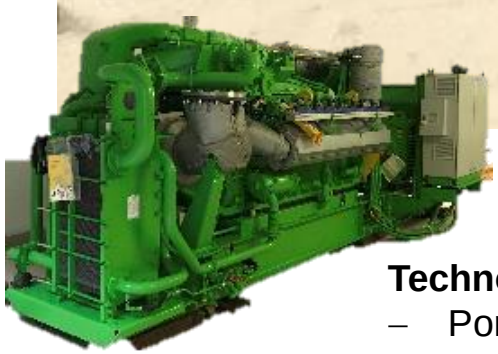
# HWN OTHMARSCHEN, HAMBURG, GER

## Retrofit Demo 2020: First MW gas engine with field conversion from traditional gas to hydrogen operation

| J416 | Traditional Gas (design 2019) | 20% (vol) $H_2$ admixing example (after retrofit) | 100% $H_2$ operation (after retrofit) |
|---|---|---|---|
| **Electrical output** | 999 kW | 999 kW | >600 kW |
| **Electrical efficiency** | 42% | ~42% | ~40% |
| **Total efficiency** | 93.5% | ~93.5% | ~93% |
| **$NO_x$ emissions** | <250 mg/Nm³ @ 5%$O_2$ | <250 mg/Nm³ @ 5%$O_2$ | <100 mg/Nm³ @ 5%$O_2$ |
| **$CO_2$ emissions** | 216 g/kWh$_{el}$ | 201 g/kWh$_{el}$ (-7%) | 0 g/kWh$_{el}$ (-100%) |



**Technology**

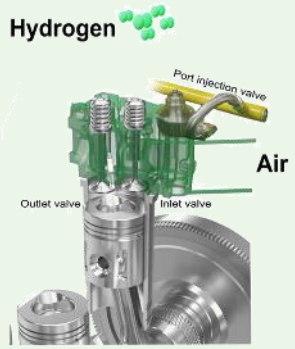
- Port injection (gas pressure 8+bar)
- Cylinder selective combustion control
- Wastegate for turbo charger

CO2 Emissions calculated with heat bonus method

# HYOSUNG HEAVY INDUSTRIES: $H_2$ ENGINE* CHP

## Ulsan, South Korea

| J420 | Pipeline Gas | 100% $H_2$ |
|---|---|---|
| **Electrical output** | 1,060 kW | 1,060 kW** |
| **Electrical efficiency** | 38.4% | ~38.4% |
| **Total efficiency** | ~89% | ~85% |
| **$NO_x$ emissions** | <250 mg/Nm³ @ 5%$O_2$ | <100 mg/Nm³ @ 5%$O_2$ |
| **$CO_2$ emissions** | 226 g/kWh$_{el}$ | 0 g/kWh$_{el}$ |
| **$H_2$ consumption** | | ~83 kg/h |




## Largest 60 Hz $H_2$ engine CHP plant in Asia

- Hydrogen as a byproduct of polypropylene production at Hyosung chemical
- Hyosung heavy industry is demonstrating the use of hydrogen for an IPP plant as an industrial CHP (with steam boiler)
- $H_2$ engine delivery in mid 2022
- $H_2$ engine installation and service provided by INNIO's Jenbacher authorized distributor RNP

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* Optional scope on demand.

# NORTHC DATACENTERS, EINDHOVEN, NL

## First data center with $H_2$ engines for emergency back-up

### NorthC Datacenters

- Small scale regional DC in Netherlands, Germany, & Switzerland
- 15 local DCs, with 10 in NL
- Carbon neutral by 2030
- DC Groningen (2022): first with standby $H_2$ fuel cell
- DC Eindhoven (2023): first with 6 x INNIO's Jenbacher JGC420 $H_2$ engines
- Going forward … new and replacement standby power based on $H_2$

NorthC Eindhoven

### Datacenter Eindhoven

- 6 MWe … standby power based on 6 x 1 MWe $H_2$ engines (JGC420)
- Replacing concept with multiple 1.5 – 2.0 MWe standby diesel generators
- Re-designing concept for UPS & cooling/chillers
- Dual fuel $H_2$ engines (traditional gas as back-up fuel)
- $H_2$ as main fuel from local $H_2$ storage until $H_2$ pipeline is available
- Pipeline gas as back-up fuel in case of longer grid failures

https://www.northcdatacenters.com/en/about-us/sustainable-data-centers/

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# READY FOR $H_2$* – JENBACHER PRODUCT PORTFOLIO

## Available products today and tomorrow


[1] Subject to required modifications for the certification of the fuel gas components — a modification of the maintenance schedule for such components may be required

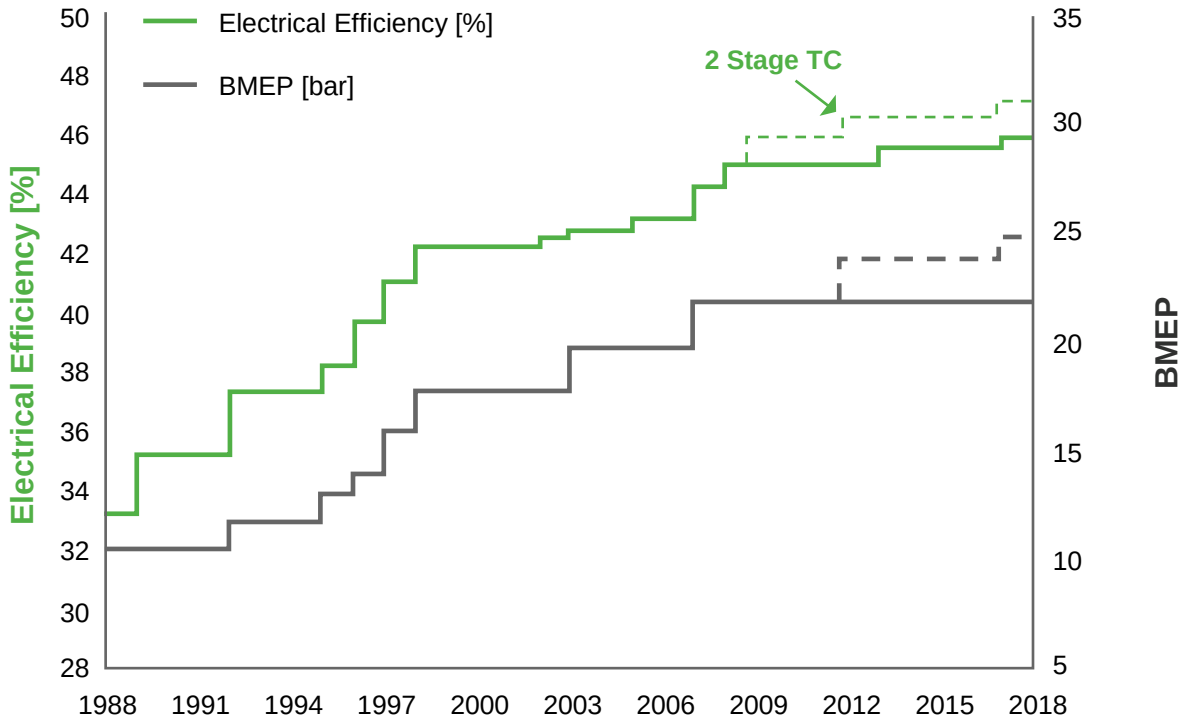
* Optional scope on demand

# THE WAY TO $CO_2$ FREE ENGINE TECHNOLOGY

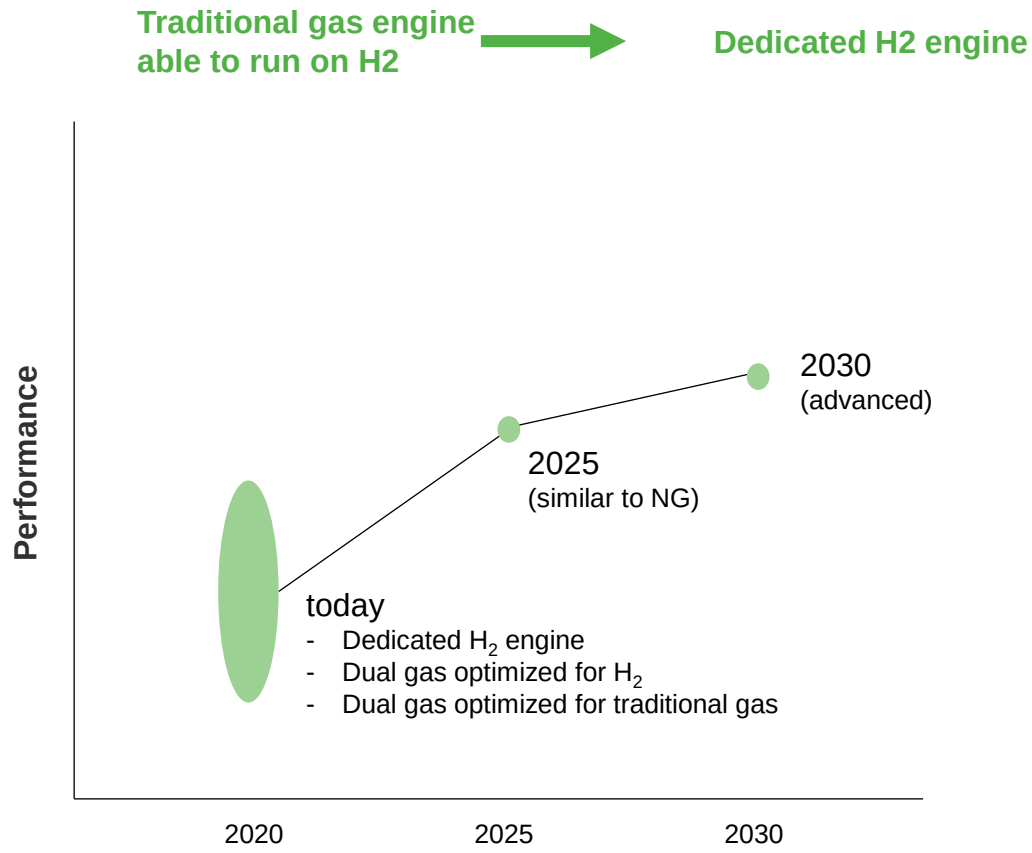
## Type 6 traditional gas … 30 years old and still evolving

Output/Cylinder 2.5 x

Efficiency 33 -> 47%




## H2-Engine performance will increase in the next years




BMEP … a measure for the specific cylinder output

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 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 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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