

STATIONÄRE GASMOTOREN VERBINDEN BETRIEBS- UND BRENNSTOFFFLEXIBILITÄT



www.innio.com

https://www.lec.at

EnInnov 2020, Graz

INNIO Jenbacher: Dr. Klaus Payrhuber, Dr. Stephan Laiminger

13. Februar, 2020

LEC: Prof. Dr. Andreas Wimmer, Dr. Jan Zelenka

Presenter: Dr. Klaus Payrhuber INNIO Jenbacher

- / INNIO is a leading technology provider of gas engines, power equipment, a digital platform and related services for power generation and gas compression at or near the point of use. With our renowned Jenbacher* and Waukesha* product brands.
- / INNIO pushes beyond the impossible and looks boldly toward tomorrow. Our diverse portfolio of reliable, economical and sustainable industrial gas engines generates 200 kW to 10 MW of power for numerous industries globally. We provide life-cycle support for more than 48,000 gas engines worldwide. And, backed by our service network in more than 100 countries, INNIO connects with you locally for rapid response to your service needs.
- / Headquartered in Jenbach, Austria, the business also has primary operations in Welland, Ontario, Canada, and Waukesha, Wisconsin, US.



February 20 EnInnov 2020, Graz

INNIO Products

Jenbacher* gas engines



Waukesha* gas engines



Technology	Gas engines (0.3-10.38 MW)	Gas engines (0.2-3.6 MW)
Target segments	Power generation	Oil & Gas Power generation
Benefits	 Electrical efficiency High total efficiency Application diversity Fuel flexibility Advanced monitoring and diagnostics 	 Hot/high BTU fuels capability High altitude and ambient capability Fast load acceptance Durability/reliability

The broadest gas-fired portfolio ... 220 kW to 10.38 MW





February 20 EnInnov 2020, Graz

INNIO Jenbacher supporting the "Energiewende"

International Trends ... "3 D's"













- High electrical efficiency
- >90% fuel utilization with CHP
- Pioneer with renewable fuels (biogas, etc.)
- Hydrogen as future carbon free fuel up to 60%(v) today 100% until 2021

- Power generation at the point of use
- Alternative to grid
- Balancing volatility of RES
- Flexible operation
- Hybrid with Solar PV
- Microgrids

- myplant ... engine monitoring
- Data analytics •
- Condition based maintenance
- Outage management
- Fleet management •
- Reliability, availability, performance •

Jenbacher^{*} products as an integral asset and key enabler for the energy transition





EnInnov 2020, Graz

Gas engines for data centers



About Data Center



Productions of ICT

9,000

Networks (wireless and wired) Consumer Devices (televisions,

computers, mobile phone)

Data Centers







Energy

February 20

EnInnov 2020, Graz

6

30%

29%

Type 6 gas engine family

	The second
-	
-	







Jenbacher Type 612

- 12 cylinder
- El. output: 2 MW
- El. efficiency 45.5%

 > 800 engines delivered

Jenbacher Type 616

- 16 cylinder
- El. output: 2.7 MW
- El. efficiency 45.5%
- > 1,000 engines delivered

Jenbacher Type 620

- 20 cylinder
- El. output: 3.3 MW
- El. efficiency 45.7%
- > 2,500 engines delivered

Jenbacher Type 624

- 24 cylinder
- El. output: 4.5 MW
- El. efficiency 47%
- 2-stage turbocharging
- > 500 engines delivered

In 45 seconds to full load

Standard start time 5 min. to full load – Lifetime 60+k oph until major overhaul





7

Power Generation for Data Centers

High Reliability

- "Built-in" storage with the natural gas grid
- Unlimited pipeline fuel supply
- Increased resiliency during natural or man-made disasters
- No storage costs
- No refueling
- Cleaner fuel



Providing critical reliabilityduring a grid failure: Natural gas generators are more reliable than diesel generators



The J620 gas engine solution



Scalable, innovative technology that opens the door to energy market participation for data centers





The J620 gas engine solution's emissions



Gas engines are allowed to run and can participate on the electricity market

CO2

NOx



February 20 EnInnov 2020, Graz

Providing Fast Power Generation for Data Centers



Fast-start generators reduce UPS/battery cost for data center



LCC

/ 20 EnInnov 2020, Graz

Decarbonization and Fuel Flexibility



Energy storage technologies





Decarbonization and new policies



JENBACHER

INNIQ

LCI

The role of Jenbacher gas engines in a renewable world





Outlook with Hydrogen



About decarbonizing natural gas with hydrogen

Hydrogen added to pipeline Natural Gas





		NG example	Hydrogen
CH4	Vol-%	97.6	0
C2H6	Vol-%	2	0
C3H8	Vol-%	0.4	0
H2	Vol-%	0	100
LHV	kJ/Nm³	36 730	10 800
WI	kJ/Nm³	48 704	41 000
MN	-	92	0
Stoichiom. air requ.	Nm³/Nm³	9.7	2.4
Laminar flame speed	cm/s	30	>100



>5% H₂ in pipeline gas ... we recommend a signal to gas engines about H₂ content



LCC

Jenbacher gas engine solutions for NG and H₂

Low MN engine

broadband product

<20%v H₂

NG engine efficiency optimized <5%v H₂



Version 01 For best efficiency MN >80 One NG quality

-> High CR -> Air/NG mixture (standard)

If MN changes or H₂ in NG

- Output derating fast
- + High efficiency at BL
- ~ Higher emissions possible

-> Lower CR

-> Air/NG mixture (standard)

If MN changes or H_2 in NG

+ Full output

Version 11

For flexible gas

Different NG qualities

MN >70 or >60

- Lower efficiency at BL
- + Emissions compliant

High H₂ engine operational optimized <60%v H₂ Pure H₂ engine dual gas engine (NG/H₂) 100%v H₂



Version xx For high H₂ admixing (<60%v) MN <40 NG and H₂ admixing

-> Lower CR -> Air/NG mixture (standard)

With NG operation

- + Full output
- ~ Lower efficiency at BL
- + Emissions compliant

Up to 60%(v) H₂ admixing

- ~ Lower output
- ~ Lower efficiency at BL
- + Emissions compliant



Version xx For 100% H_2 optionally MN 0 NG or H_2 operation

-> Lower CR

-> Air/NG mixture & Injection

With NG operation (mixture)

- + Full output
- ~ Lower efficiency at BL
- + Emissions compliant

$100\%(v) H_2$ operation (injection)

- ~ Lower output
- ~ Lower efficiency at BL
- + Lower Emissions

CR ... compression ratio



Optimization potential through mixture formation

3D-CFD simulation for mixture distribution at ignition timing





Towards dispatchable RES until 2050

Decentralized power generation and cogeneration



- Reliable energy supply for remote areas
- Supporting local power needs
- Avoiding transport and distribution losses
- 90% total efficiency
- Fast transients
- Jenbacher Types 2, 3, 4, 6, 9

Natural Gas, CNG/LNG

Oilfield power (associated petroleum gas)



- Reliability for rugged, remote applications
- Reducing global warming effects from CH4 emissions and flaring
- Emission regulations driving increased use of natural gas versus diesel-powered generator
- Jenbacher Types 2, 3, 4, 6
- Waukesha* Types VGF*, VHP*, 275GL*+

Natural Gas

dispatchable Renewables (dRES)

Biogas and waste-to-energy utilization



- Biogas, landfill gas, coal mine gas, special gases (steel gas, wood gas, process gases)
- Waste usage
- Alternatives to fossil fuels

Carbon free power and cogeneration





- Using renewable fuels such as hydrogen, methanol, synthetic nat. gas, ammonia, etc.
- Using conventional proven and affordable gas engine technology
- / Any conventional application

Jenbacher Types 2, 3, 4, 6, 9

Jenbacher* Types 2, 3, 4, 6

Renewable Gas

 H_2 / SNG / Methanol ...



