Two Specialists

No Compromise

KAWASAKI Gas Turbine Europe GmbH

Energynomics – 27th April 2023

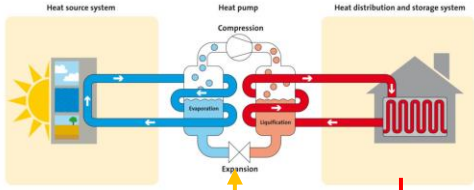
Kawasaki
Powering your potential

Cogeneration solution = energy efficiency solution = support for renewable sources

Renewable sources






Level of temp., availability of heat source ???

Heat

Heat over night and winter???

No elec. without battery storage !!!

Level of temp. ??

Electricity

Electricity for:
- Industrial process;
- Heat pumps;
- Electrolysers;
- DHS - Thermal substations.

Heat for:
- Industrial process;
- DHS.

Heat for:
- DHS;
- Industrial process.

CHP = COGENERATION = support for renewable sources

Fuel: NG, H2, Biomass, Biogas, Municipal Waste

European Union - Energy Approach based on 4D

Energy approach based on 4 pillars = 4D:

- 1st D = Decarbonization;
- 2nd D = Decentralization;
- 3rd D = Digitalization;
- 4th D = Distributed energy generation

Kawasaki Heavy Industries – Sections

Kawasaki Heavy Industries, Ltd.

- Ships & Offshore Structure Company

- Rolling Stock Company

- Aerospace Company

- **Energy System & Plant Engineering Company**
- Motorcycle & Engine Company

- Precision Machinery & Robots Company

Kawasaki Gas Turbine Europe GmbH
- Germany – Europe headquarter
- Romania – Representative office responsible for South – East Europe

Kawasaki Gas Turbine Asia Sdn. Bhd. (Malaysia)

Kawasaki Gas Turbine Asia Sdn. Bhd. - Jakarta Representative Office

Kawasaki Heavy Industries, LTD - Bangkok Office

Kawasaki Heavy Industries – Sections

Motorcycle & Engine 29.8%

Others 5.3%

Aerospace Systems 19.9%

FY '21
Total Sales
JPY1.5 Trillion
(EUR 11.1 Billion)

Rolling Stock 8.4%

Ship & Offshore Structure 4.3%

Precision Machinery & Robot 16.8%

Energy System & Plant Engineering 15.5%

Business year starts from Apr. 1 and ends on Mar. 31. As of the business year ending Mar. 31 2023.

KGE's Take

Working as one for the good of the planet!

Highly Focusing on Environmental Protection and Energy Savings

- **Reduction of emissions**
  - Global warming gas CO_2
  - Harmful gas NO_x, SO_x
- **Energy Saving**

Hydrogen – future fuel for energy production

Distributed Generator System

- **Provide highly efficient energy use**
- **Flexible and reliable**

to complement unstable renewable energy

Kawasaki Products & Services

Kawasaki Gas Turbine Europe

Products

Gas Turbines	Gas Engines
M1A-17D 1,816 kWel η = 28.1 %	**KG12** 5,200 kWel η = 49 %
M5A-01D 4,720 kWel η = 32.6 %	**KG18** 7,800 kWel η = 49.0 %
M7A-03D 7,810 kWel η = 33.6 %	**KG18-V** 7,800 kWel η = 49.5 %
L20A-01D 18,500 kWel η = 34.3 %	**KG18-T** 7,800 kWel η = 51 %
L30A-01D 34,300 kWel η = 40.3 %	

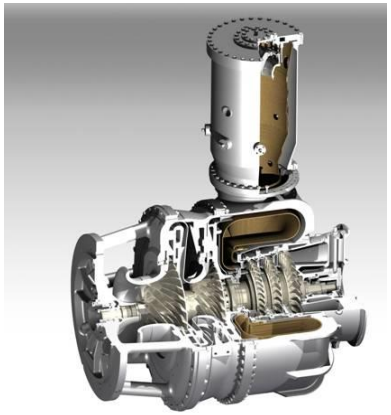
Services

Engineering	Implementation	Maintenance
Concept Engineering	Project Planning	Spare Parts Comsumables
Detailed Engineering	Customized Packaging	Full Maintenance
	Erection Commissioning	Remote Monitoring

Other Services

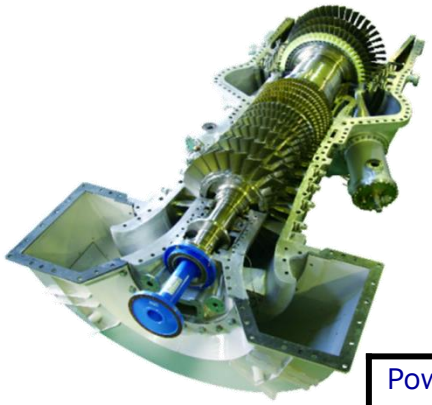
Kawasaki Gas Turbine Engine Models

M1A-17D



Power Output [kWe]	1,816
Ele. Efficiency [%]	28.1
Sat. steam 8 barg [t/h]	5
Heat recovered [kWth]	3,646
NO_x @ O_2 = 15% [ppm] CO @ O_2 = 15% [ppm]	< 9 50

M7A-03D

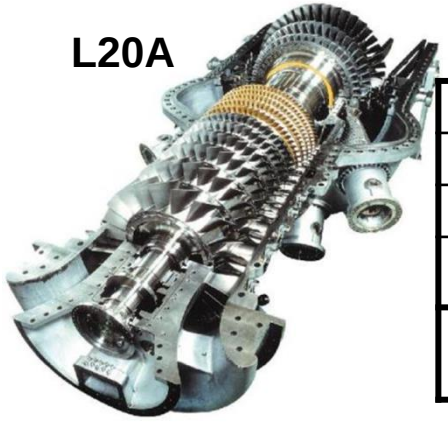


Power Output [kWe]	7,810
Ele. Efficiency [%]	33.6
Sat. steam 8 barg [t/h]	16.4
Heat recovered [kWth]	12,471
NO_x @ O_2 = 15% [ppm] CO @ O_2 = 15% [ppm]	< 9 10

M5A-01D

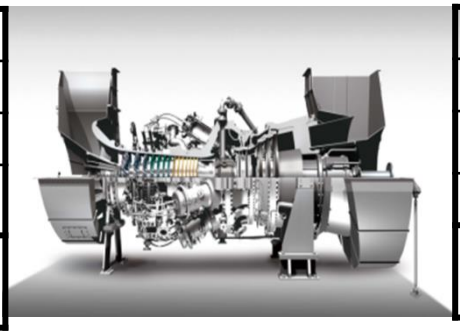
Power Output [kWe]	4,720
Ele. Efficiency [%]	32.6
Sat. steam 8 barg [t/h]	11
Heat recovered [kWth]	7,723
NO_x @ O_2 = 15% [ppm] CO @ O_2 = 15% [ppm]	15 15

L20A



Power Output [kWe]	18,500
Ele. Efficiency [%]	34.3
Sat. steam 8 barg [t/h]	37
Heat recovered [kWth]	28,550
NO_x @ O_2 = 15% [ppm] CO @ O_2 = 15% [ppm]	15 25

L30A



Power Output [kWe]	34,380
Ele. Efficiency [%]	40.3
Sat. steam 8 barg [t/h]	55
Heat recovered [kWth]	7,723
NO_x @ O_2 = 15% [ppm] CO @ O_2 = 15% [ppm]	15 / 9 25

Parameters for ISO conditions

Kawasaki Gas Engine Models

KG 18V

Power Output [kWe]	7,800
Ele. Efficiency [%]	49.5
Heat recovered [kWth]	5,000
Exhaust Gas Temperature [°C]	320
NOx @ O_2 = 0% [ppm] CO @ O_2 = 0% [ppm]	200 50
Methane number	> 65

KG 12

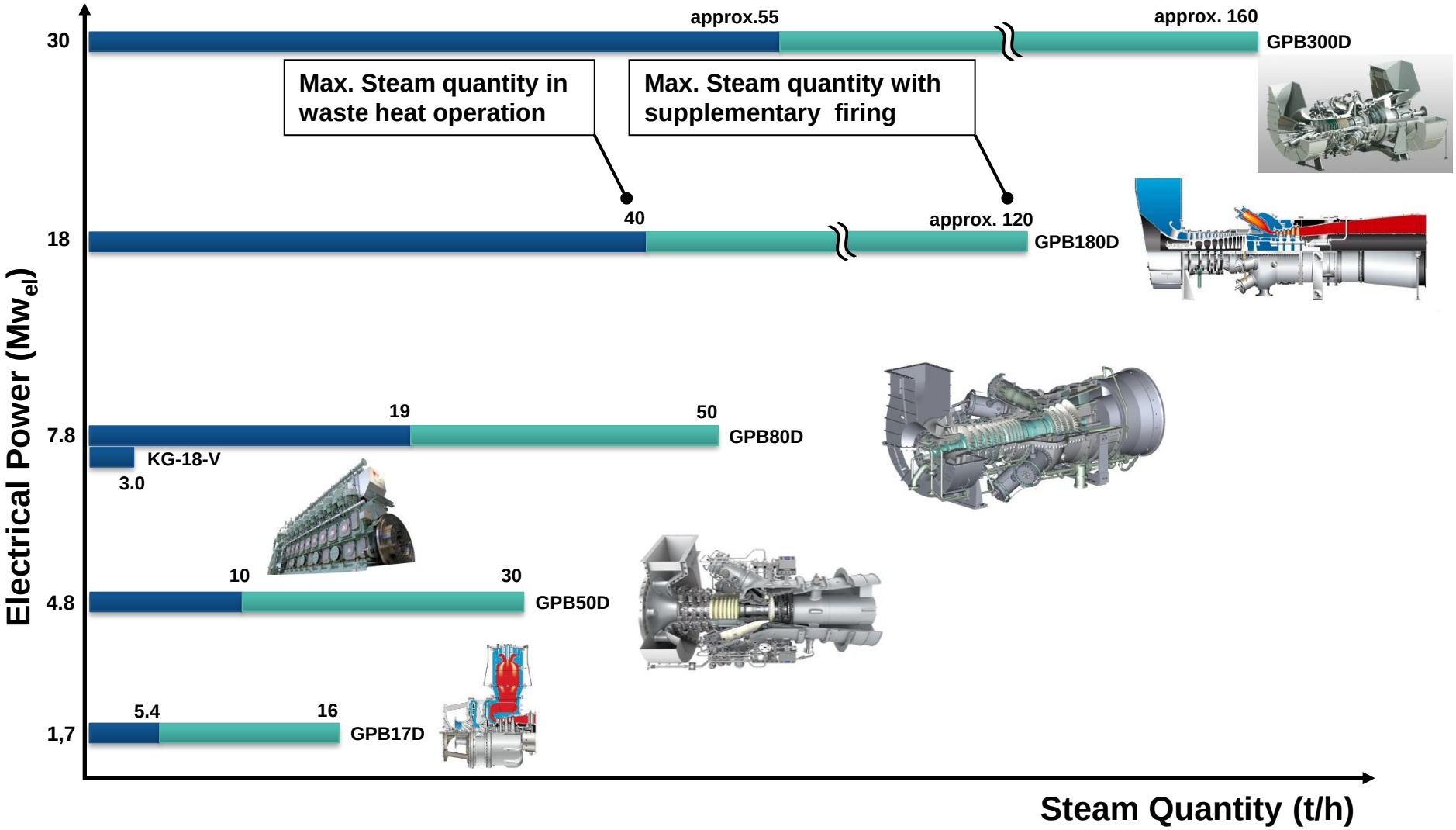
Power Output [kWe]	5,200
Ele. Efficiency [%]	49
Heat recovered [kWth]	3,000
Exhaust Gas Temperature [°C]	320
NOx @ O_2 = 0% [ppm] CO @ O_2 = 0% [ppm]	200 50
Methane number	> 65

KG 18T

Power Output [kWe]	7,800
Ele. Efficiency [%]	51
Heat recovered [kWth]	3,500
Exhaust Gas Temperature [°C]	285
NOx @ O_2 = 0% [ppm] CO @ O_2 = 0% [ppm]	250 50
Methane number	➢ 65

Parameters for ISO conditions

Performances in CHP



KGE market – request of electricity and steam / hot water / child water

Typical applications:

Pulp and paper

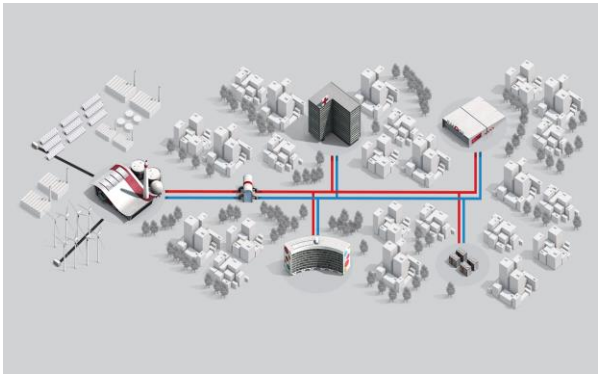
Medicines / cosmetics

Refinery / Chemistry

Food and Beverage

Automotive / Tires

District Heating



Universities

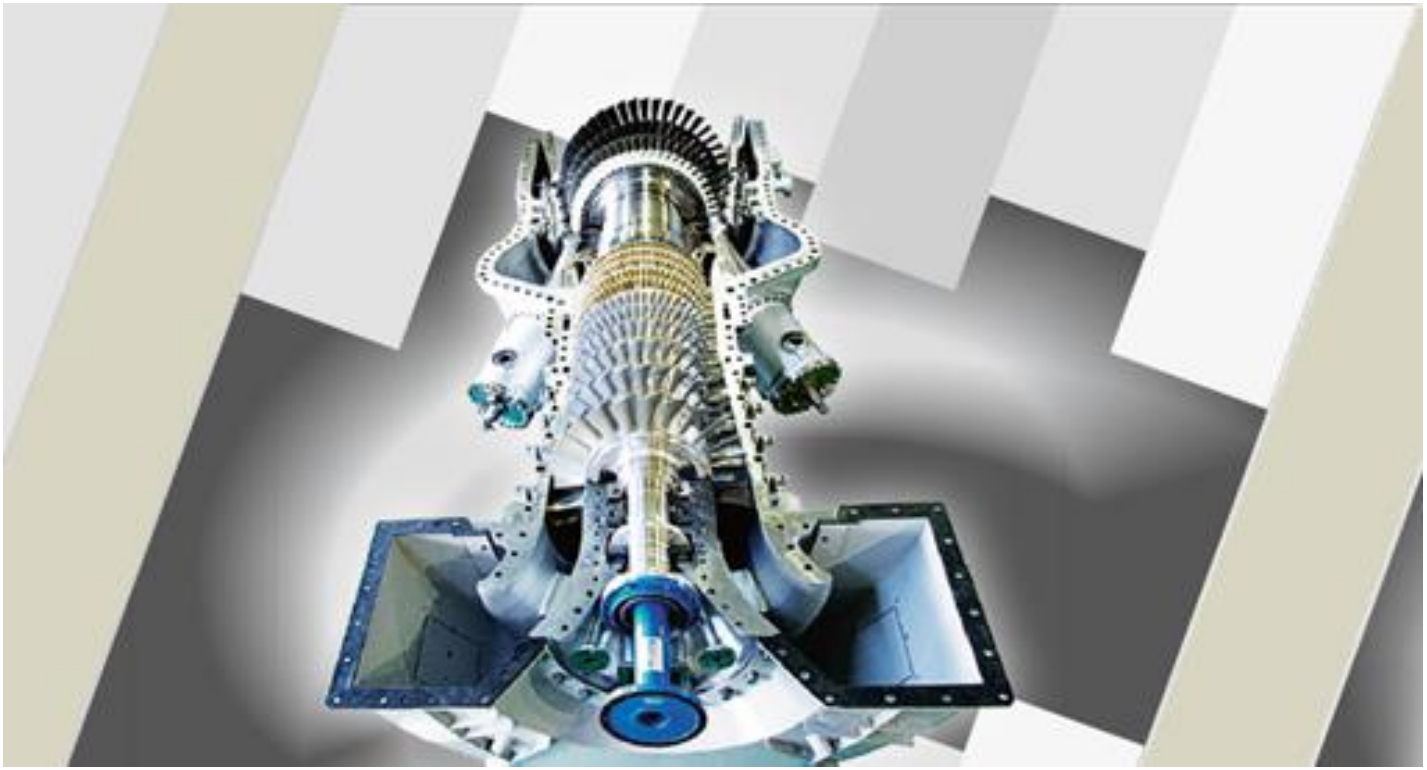
Hospitals

Hotels

Airports

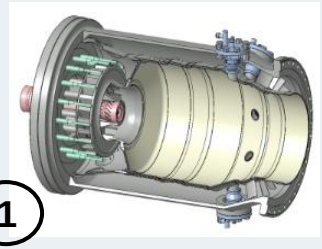
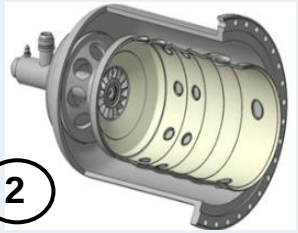
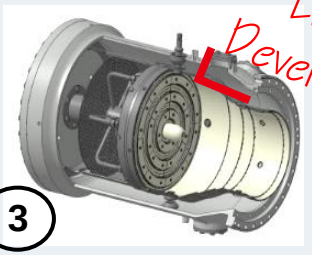
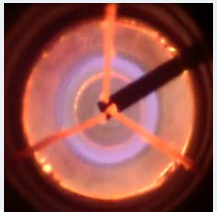
H2 – future fuel as alternative to classic fuel

Kawasaki Heavy Industries Hydrogen Road Map



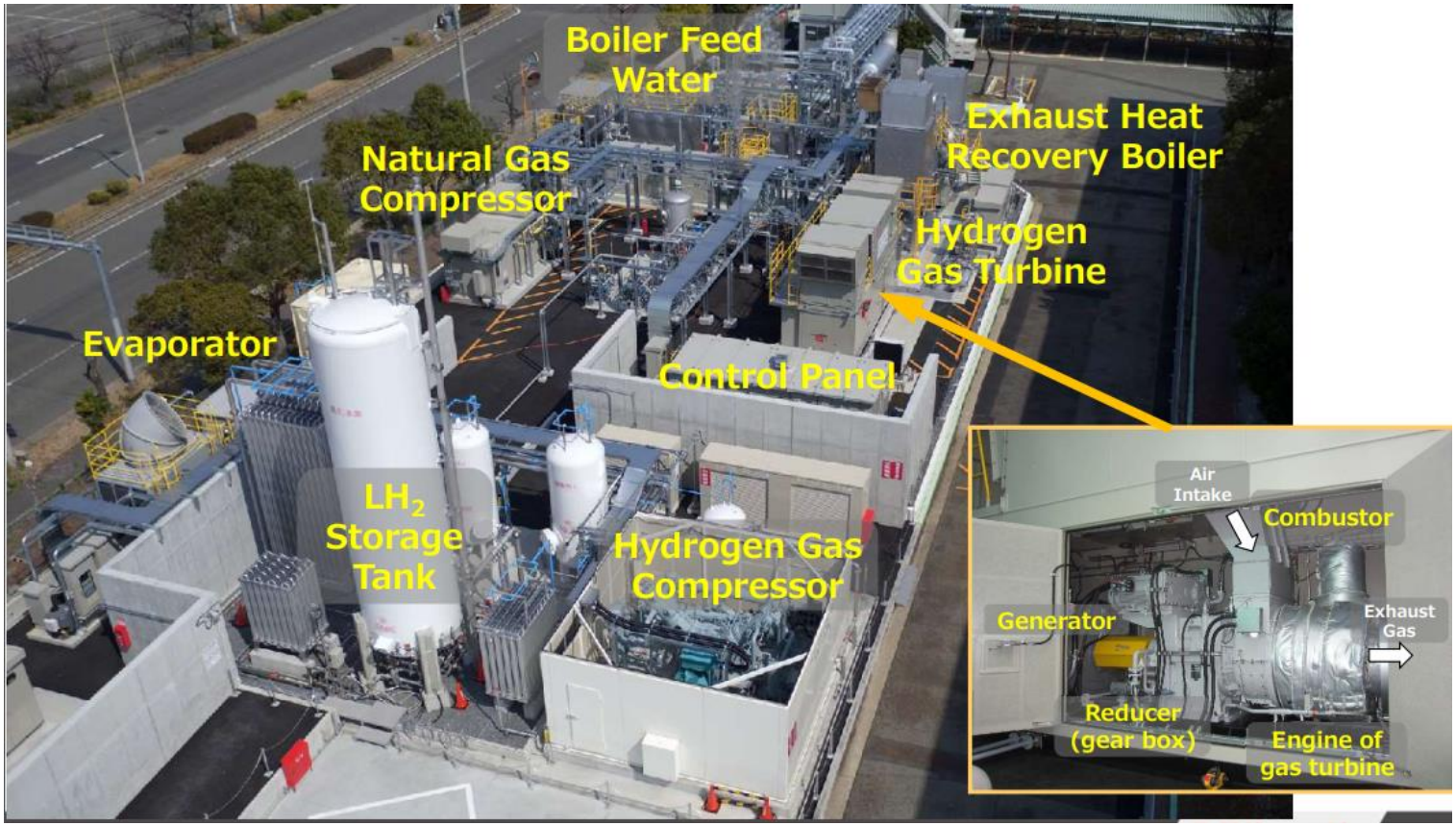
Developments for Hydrogen Gas Turbines @ KHI

Overview of Combustor Developments

Combustor Configuration	DLE Combustor for Natural Gas	Diffusion Flame Combustor	DLE Micro-Mix Combustor
NOx Reduction	**“Dry”**	**“Wet” Water/Steam**	**“Dry”**
	 1	 2	 3 Latest Development
H2 Content	**0-30vol%**	**0-100vol%**	**50-100vol%**
Status	Final Combustor Test, 2021 	Final Combustor Test, 2016 Applied to KOBE Demonstration Plant, 	Final Combustor Test, 2018 Applied to KOBE Demonstration Plant, 

H2 – future fuel as alternative to classic fuel

World's First 100% H2-CHP Plant at Kobe Harbor



H2 – future fuel as alternative to classic fuel

INNOVATIONSPREIS
DER DEUTSCHEN
GASWIRTSCHAFT

Press Release

Innovation Award: Gas industry honors forward-looking energy projects

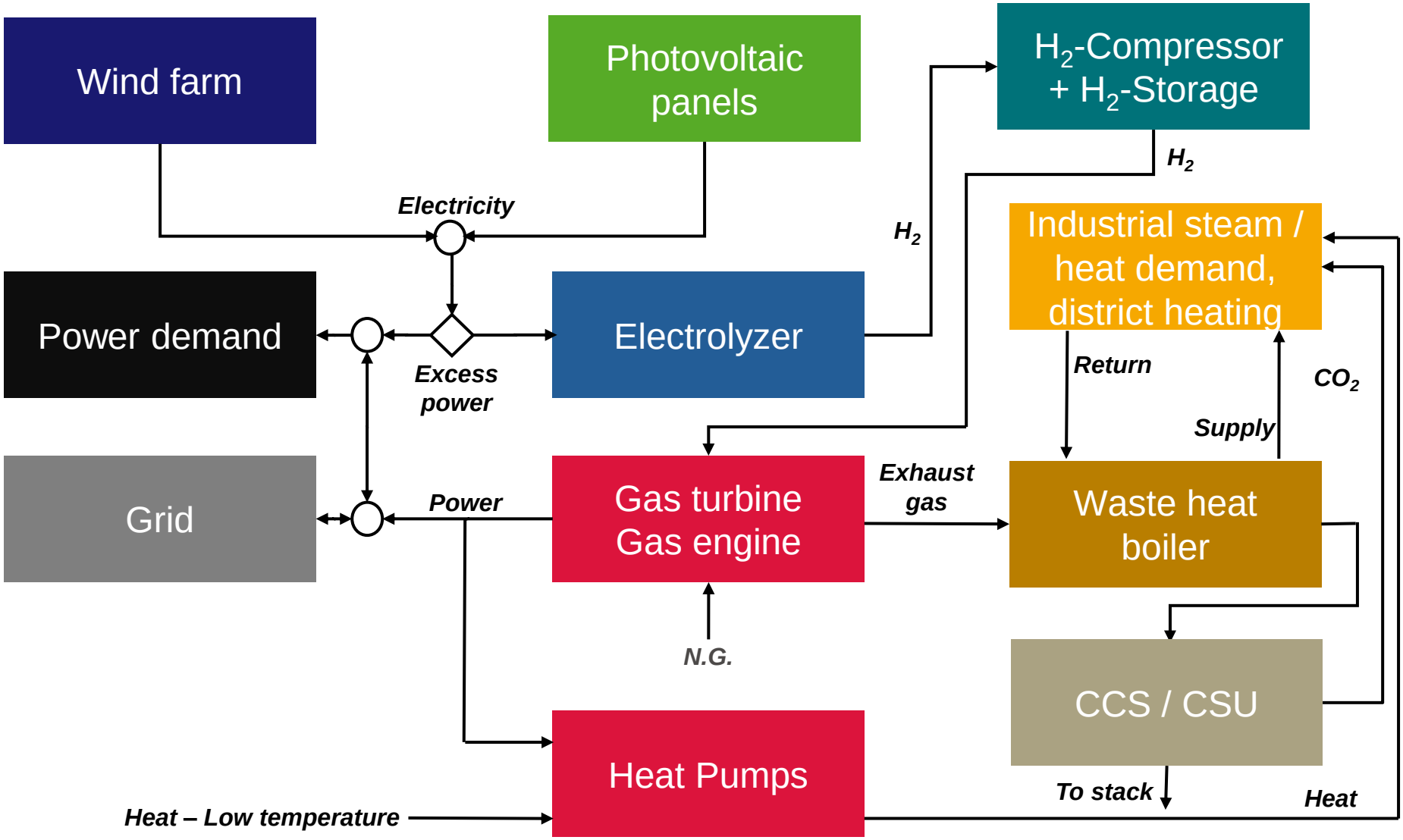
- Four projects were honored in the categories of application-oriented research, sustainable generation, intelligent infrastructure and efficient application technology.
- Jury chairman Prof. Behrendt: "The winning projects demonstrate innovative ideas, have the courage to change and show that the gas industry is actively working on solutions for tomorrow.
- ENERGY-HUB Wilhelmshaven honored as a gamechanger

Berlin, October 12, 2022 - Under the patronage of the Federal Minister of Education and Research, Bettina Stark-Watzinger, the Innovation Award of the German Gas Industry was presented today for the 22nd time. The award is sponsored by the three industry associations BDEW, DVGW and Zukunft Gas, as well as the competence partner ASUE. Wintershall Dea supports the Innovation Award as a partner.

Kawasaki Gas Turbine Europe GmbH wins the INNOVATION AWARD OF THE GERMAN GAS INDUSTRY 2022 with its DLE H2 Micro-Mix Burner

Kawasaki Gas Turbine Europe GmbH has won the Innovation Award of the German gas industry in the category "Efficient Application Technology".

Future – Hybrid Plants



Kawasaki will pursue "manufacturing that makes the Earth smile."

“Global Kawasaki”

Kawasaki
Powering your potential