

# Hydrogen Road of Kawasaki Heavy Industries

Development of Innovative Hydrogen Combustion Systems  
for Industrial Gas Turbines

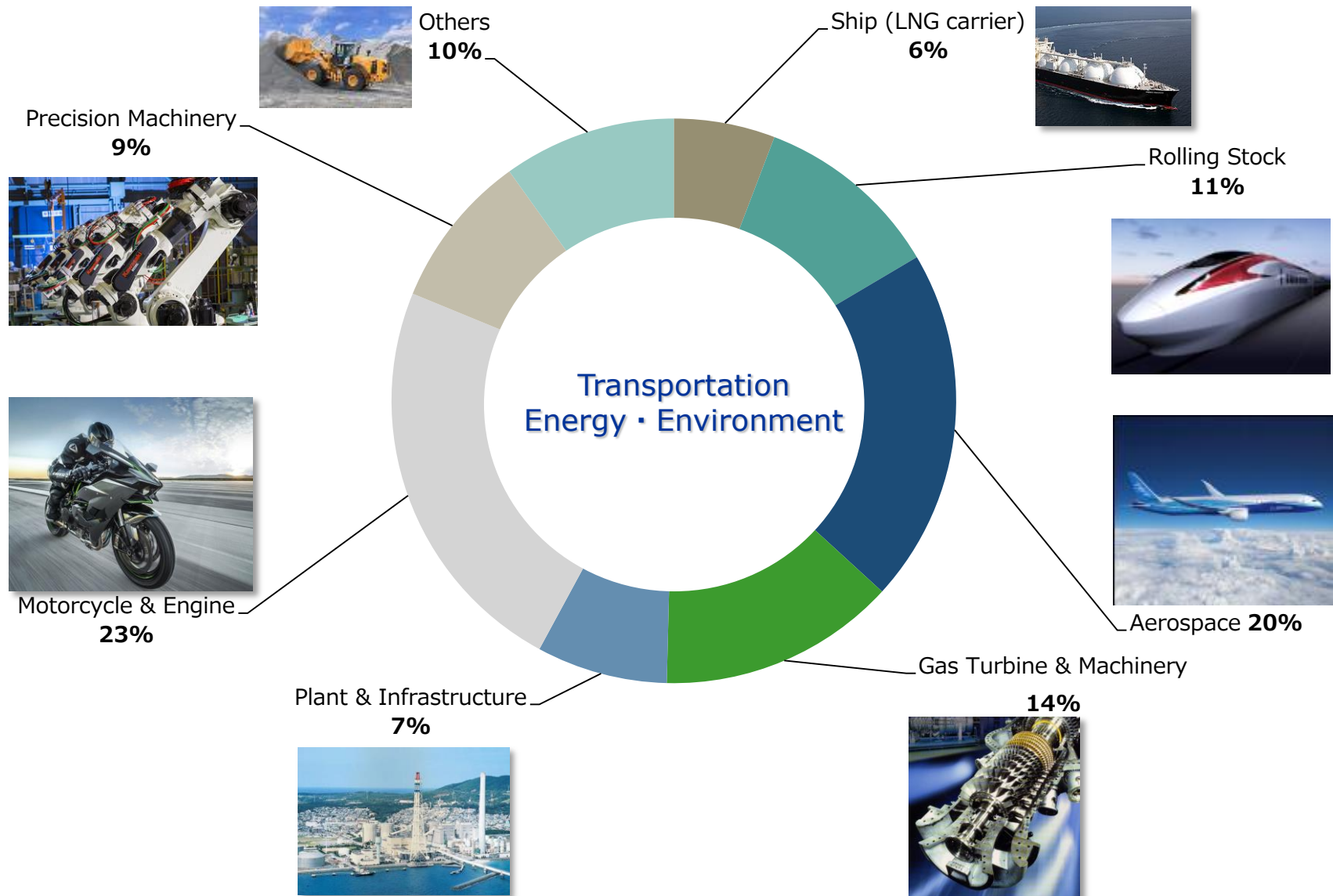
Dr.-Ing. Nurettin Tekin

7. Energie-Effizienz-Netzwerktreffen

Wasserstofftechnologien – Entwicklung und Perspektiven,

21 November 2019, Leer, Germany

# Kawasaki Heavy Industries – Segments

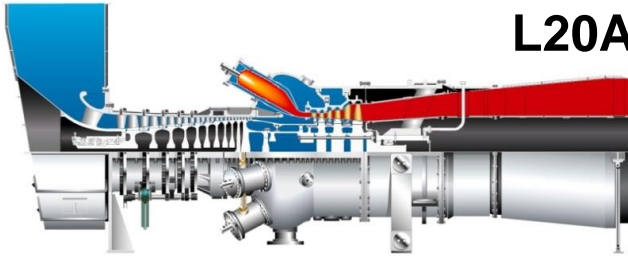


# Kawasaki Gasturbine Europe (KGE/KHI)

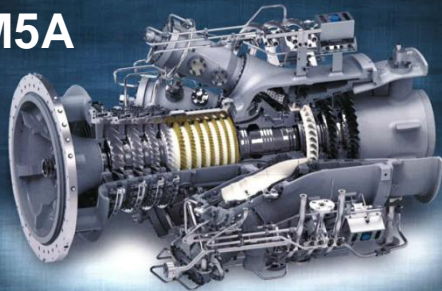
M1A



L20A



M5A

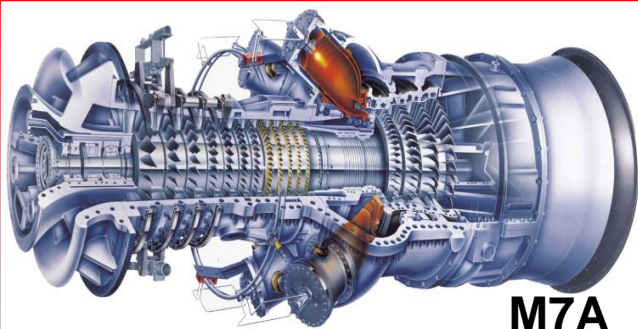


## Gas Engines

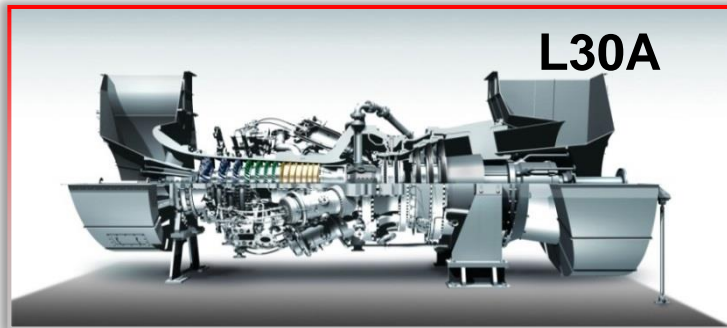
❖ KG-18-V: 7,800 kW<sub>el</sub> - 49.5 % - 4,420 kW<sub>th</sub>

❖ KG-12-V: 5,200 kW<sub>el</sub> - 49.5 % - 2,990 kW<sub>th</sub>

M7A

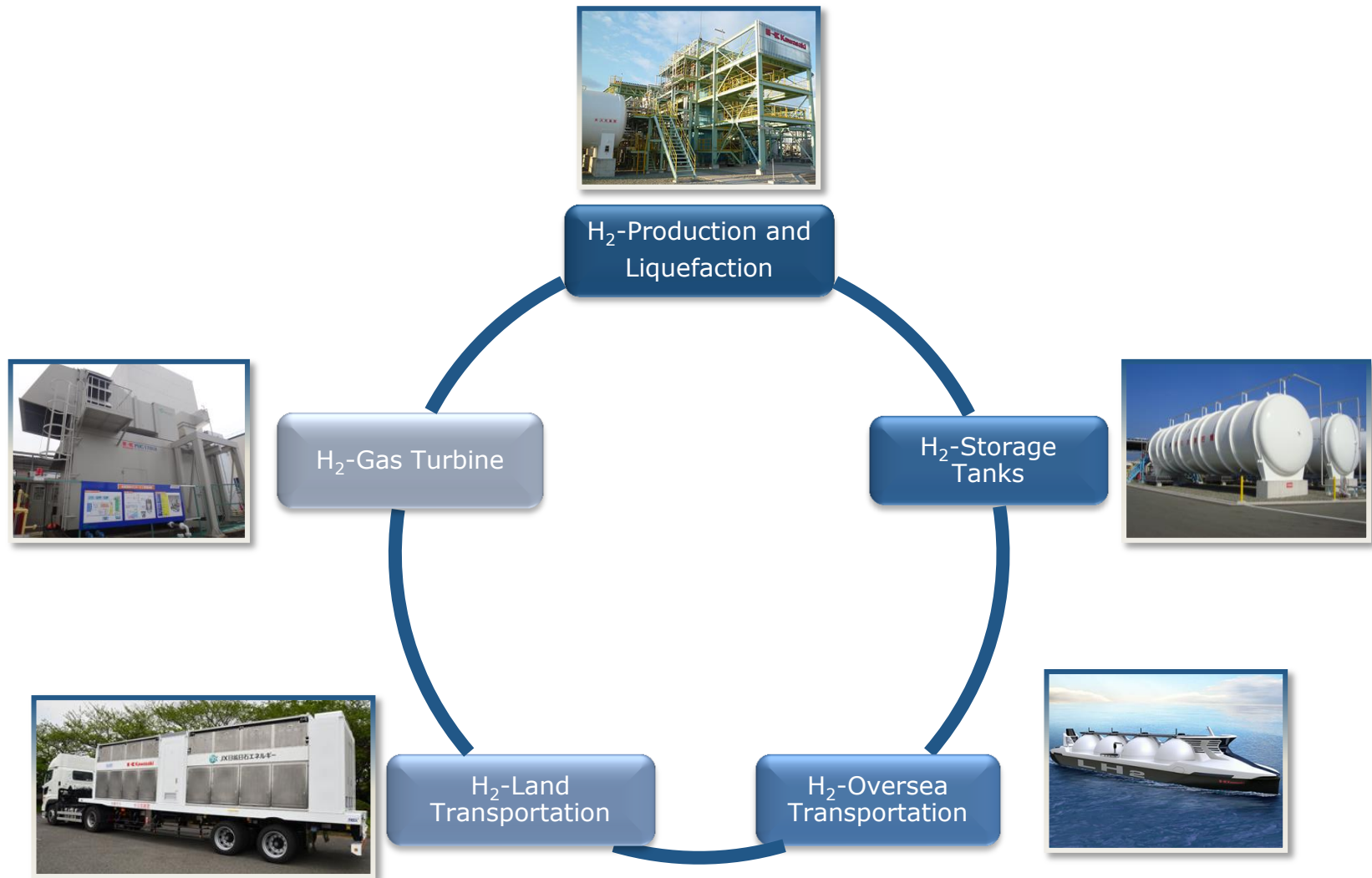


L30A



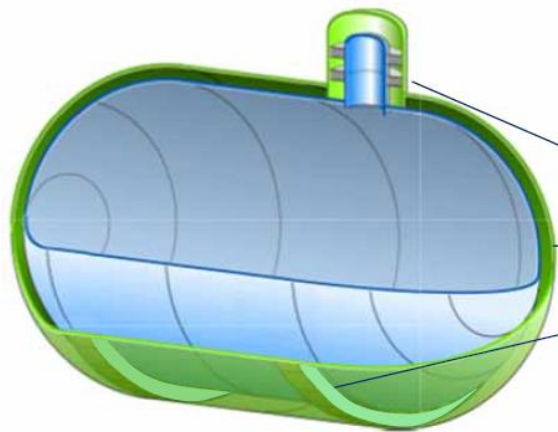
# Hydrogen Way of Kawasaki Heavy Industries (KHI)

## Products for H<sub>2</sub>-Supply-Chain



# Liquefied Hydrogen Carrier Ships

For realization of the world first  
liquefied hydrogen  
carrier ship



Cargo tank

**HySTRA**

<https://youtu.be/vzzwqT-2SJk>



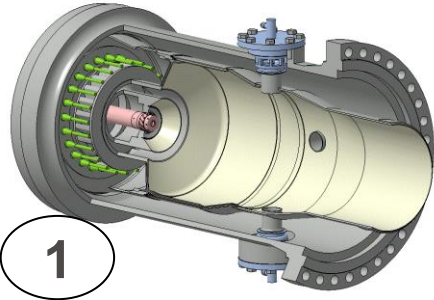
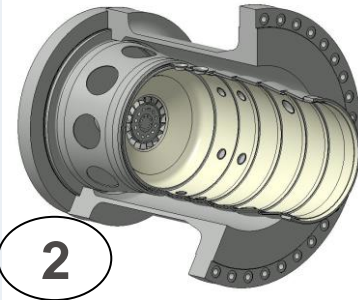
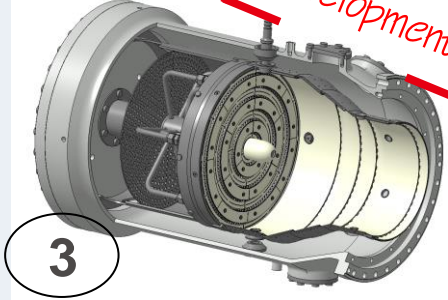



- Unique dome structure to keep vacuum
- Vacuum dual shell with stainless steel
- Highly insulated support structure



# Hydrogen Way of Kawasaki Heavy Industries

# Developments for Hydrogen Gas Turbines @ KHI

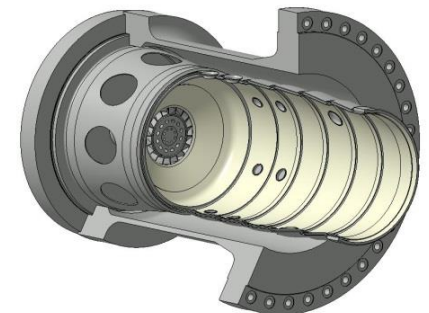
## Overview of Combustor Developments

Combustor Configuration	DLE Combustor for Natural Gas	Diffusion Flame Combustor	DLE Micro-Mix Combustor
NOx Reduction	"Dry"	"Wet" Water/Steam	"Dry" <i>Latest Development</i>
			
Max. H2 Content	60vol%	100vol%	100vol%
Status	Under Engine Demonstration in Akashi Works 	Final Combustor Test, 2016 Applied to KOBE Demonstration Plant, 2018 	Under Combustor Developments 

# World's First H2-Power Plant at Kobe Port



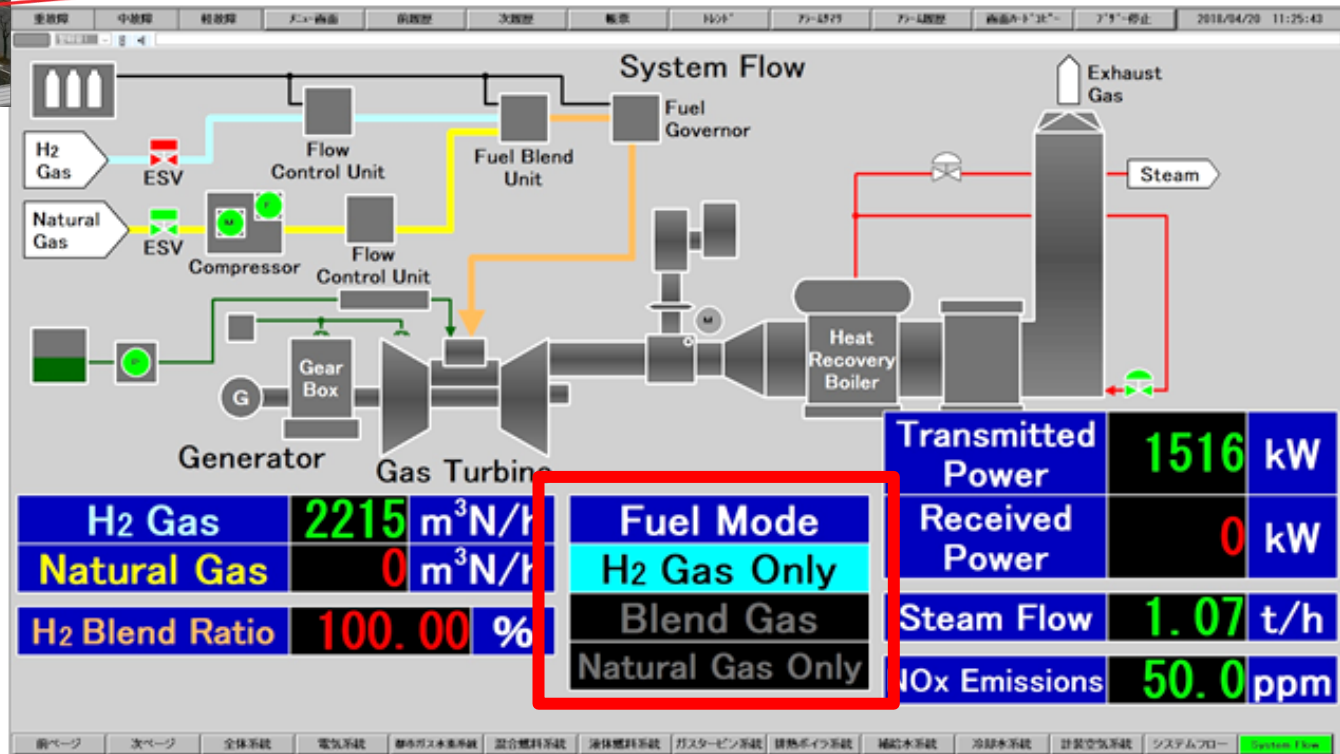
Diffusion



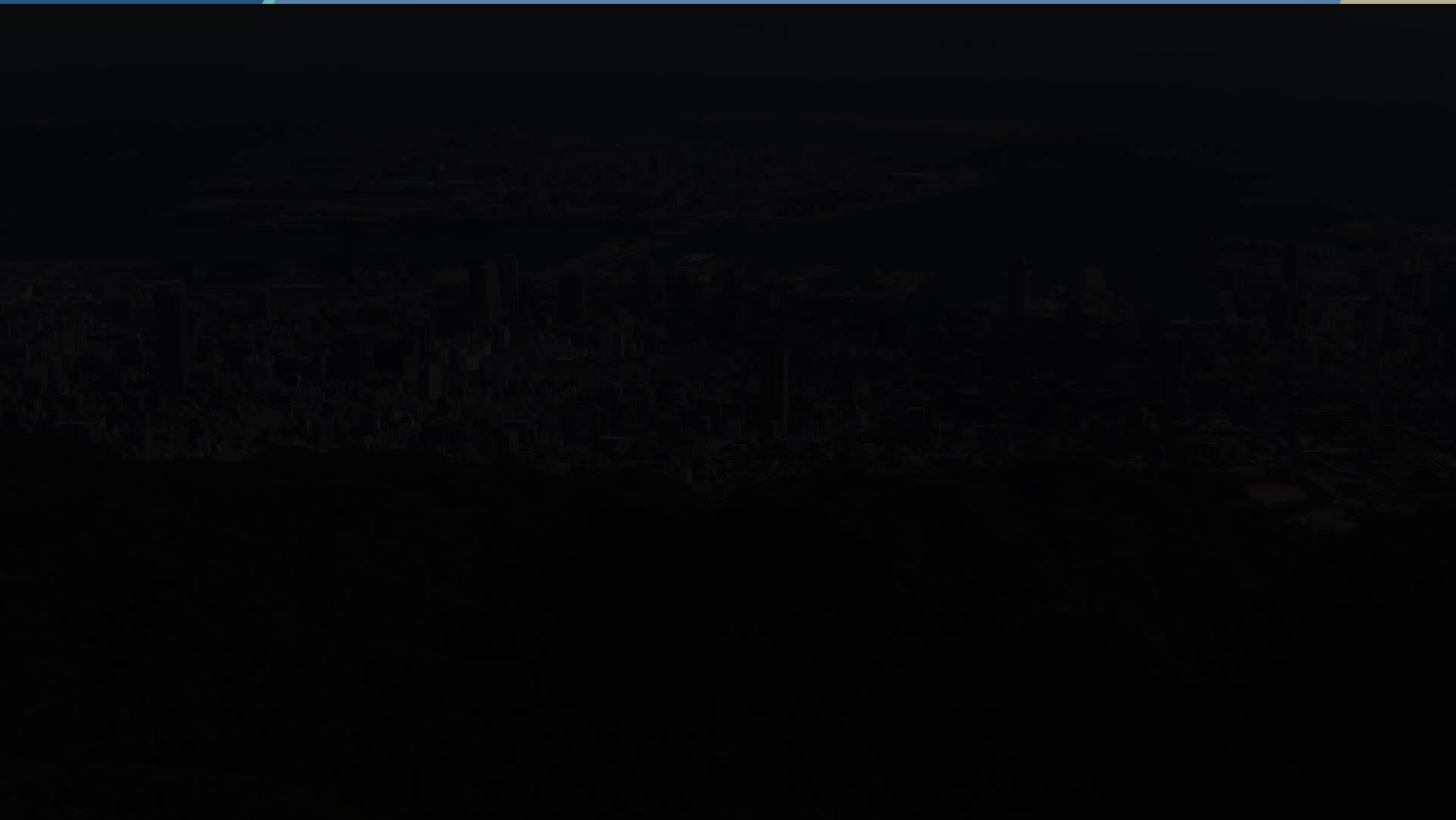
# World's First H2-Power Plant at Kobe Port



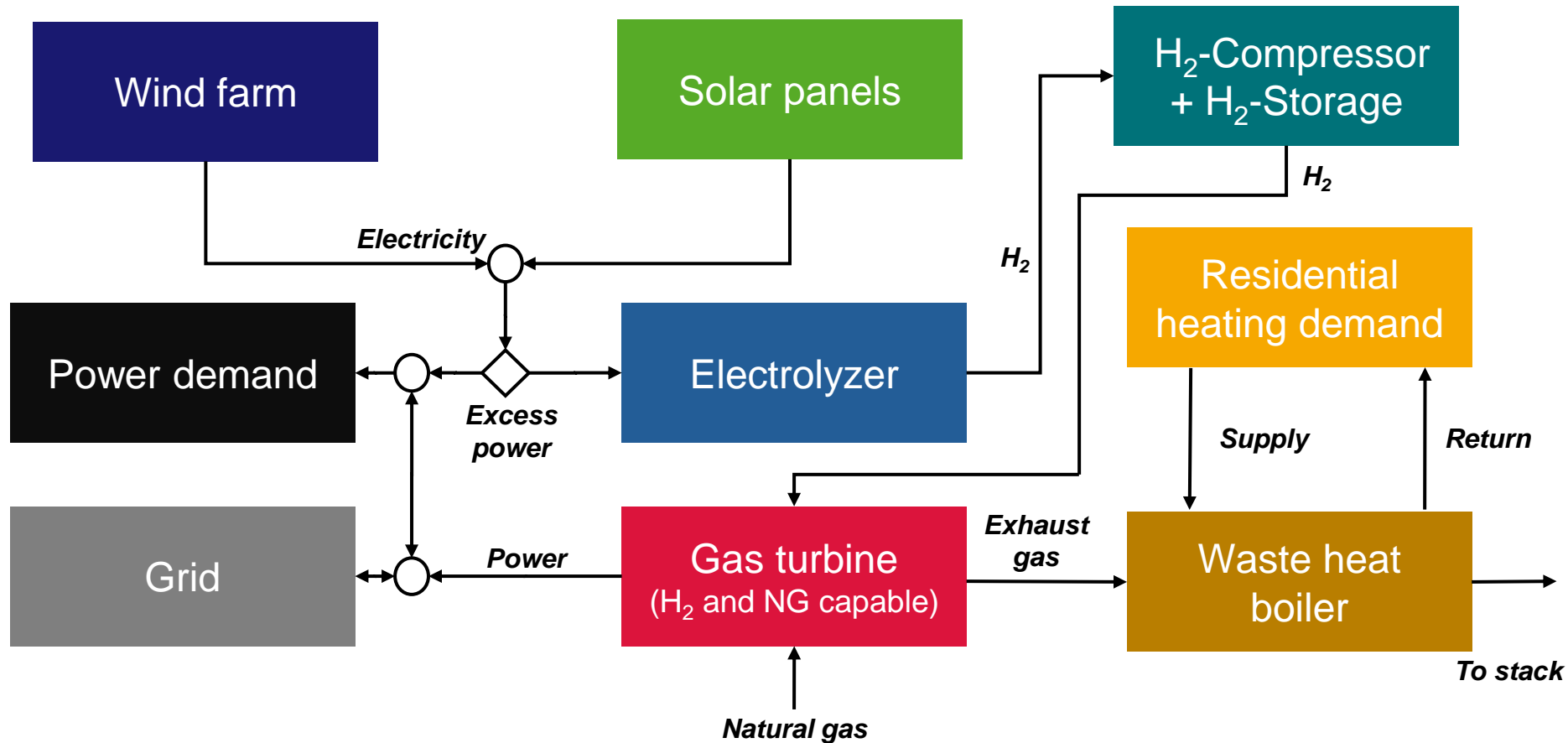
## User Control Interface



# World's First H2-Power Plant at Kobe Port



# Innovative Power Plant with Renewable Energy Supply



# Überschuss-Strom

Verteilung der Einsparmaßnahmen nach Energieträgern im Gesamtjahr 2018 und Gesamtjahr 2017

Energieträger	Ausfallarbeit in GWh	Prozentuale Verteilung	Geschätzte Entschädigungs- ansprüche in Euro		Ausfallarbeit in GWh	Prozentuale Verteilung	Geschätzte Entschädigungs- ansprüche in Euro	
			Gesamtjahr 2018				Gesamtjahr 2017	
Wind (onshore)	3.890,54	72,0%	339.811.734	53,5%	<div>Weltweite Produktion [Mrd. Nm3/a]</div> <div>600</div> <div>Europäische Union</div> <div>80</div> <div>Deutschland</div> <div>19</div>			
Wind (offshore)	1.356,33	25,1%	263.983.819	41,5%				
Solar	110,47	2,2%	25.473.250	4,0%				
Biomasse einschl. Biogas	35,74	0,7%	5.888.909	0,9%				
KWK-Strom	2,47	0,0%	173.421	0,0%				
Deponie-, Müll- und Grubengas	0,60	0,0%	54.748	0,0%				
Laufwasser	0,52	0,0%	48.669	0,0%				
Energieträger unbekannt	0,01	0,0%	300	0,0%				
Gesamt	5.402,67	100%	635.436.856	100%	5.517,98	100%	609.975.214	100%

5.4TWh

0.65

3

kWh

Nm3

=

1.2Mrd Nm3

Weltweite Produktion [Mrd. Nm<sup>3</sup>/a]

600

Europäische Union

80

Deutschland

19

0.65

5.4 TWh

\*

3

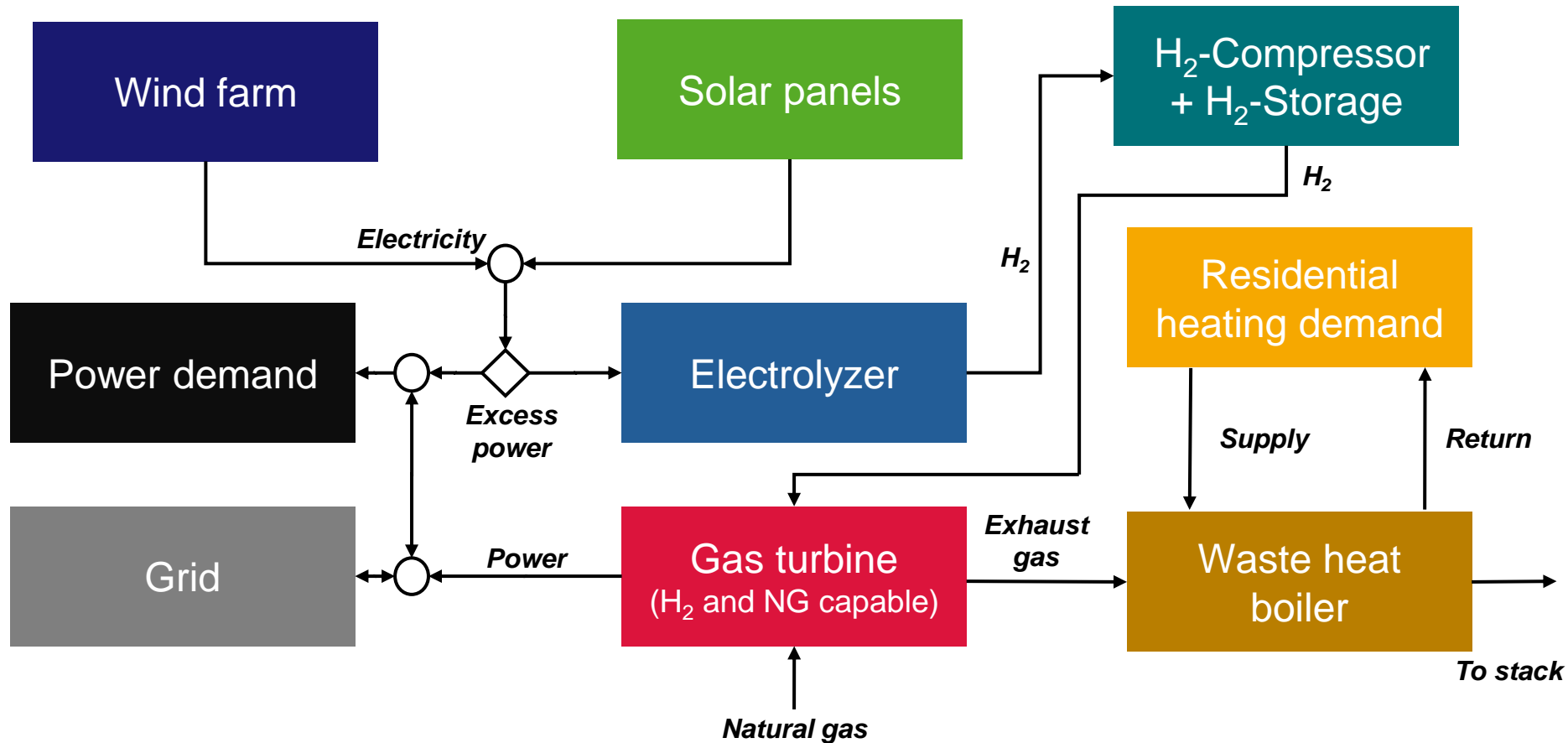
kWh  
Nm<sup>3</sup>

=

1.2 Mrd Nm<sup>3</sup>

Quelle: Monitoringreferat der Bundesnetzagentur

# Innovative Power Plant with Renewable Energy Supply



世界の人々の豊かな生活と地球環境の未来に貢献する  
“Global Kawasaki”