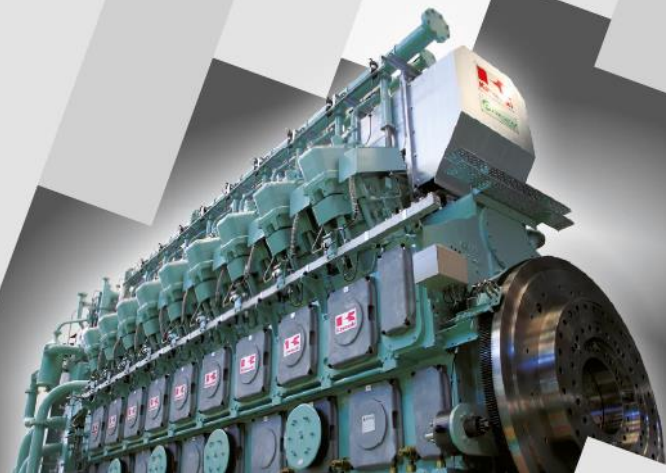
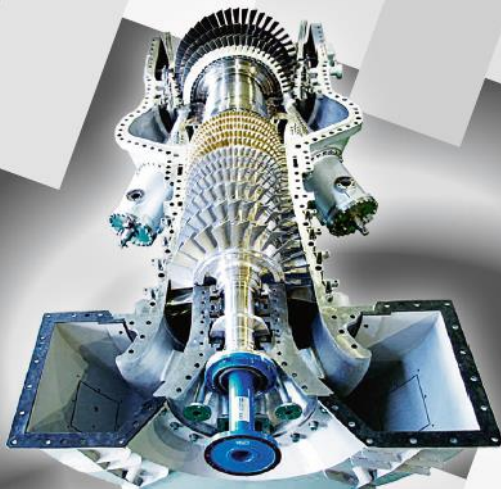


Two Specialists

No Compromise



KAWASAKI Gas Turbine Europe GmbH

CHP and Combined Cycle-Plants

General Company Presentation

 **Kawasaki**
Powering your potential

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
Company**



Kawasaki Gas Turbine Europe GmbH

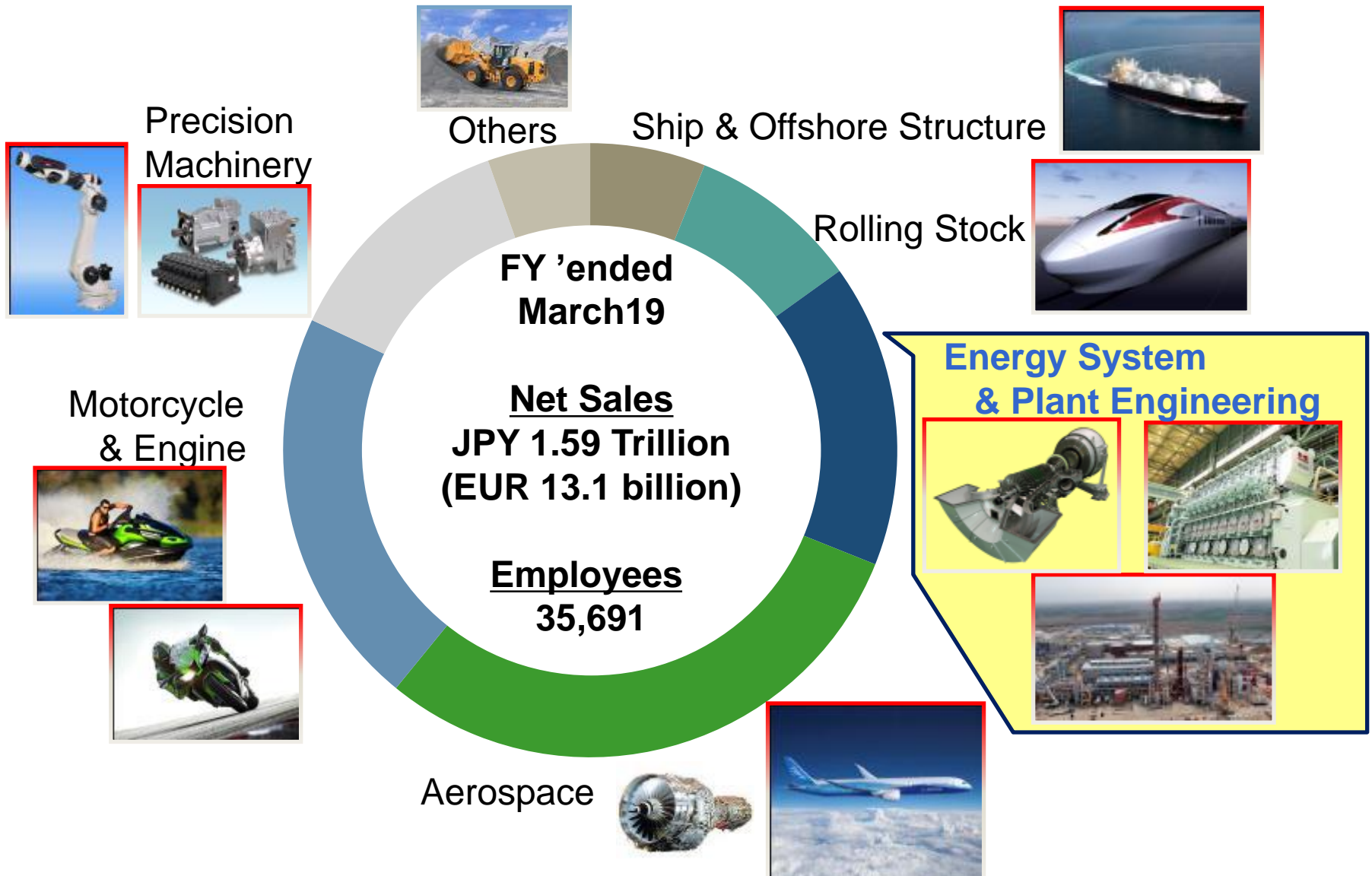
- Germany – Europe headquarter
- Romania – Representative office responsible for South – East Europe

**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 – Product Segment Overview



Planning of cogeneration power plants

Potential clients of cogeneration

➤ Industry

Pulp and paper



Medicines and cosmetics



Refinery / Chemistry



Food and beverages industry



Automotive and tyres



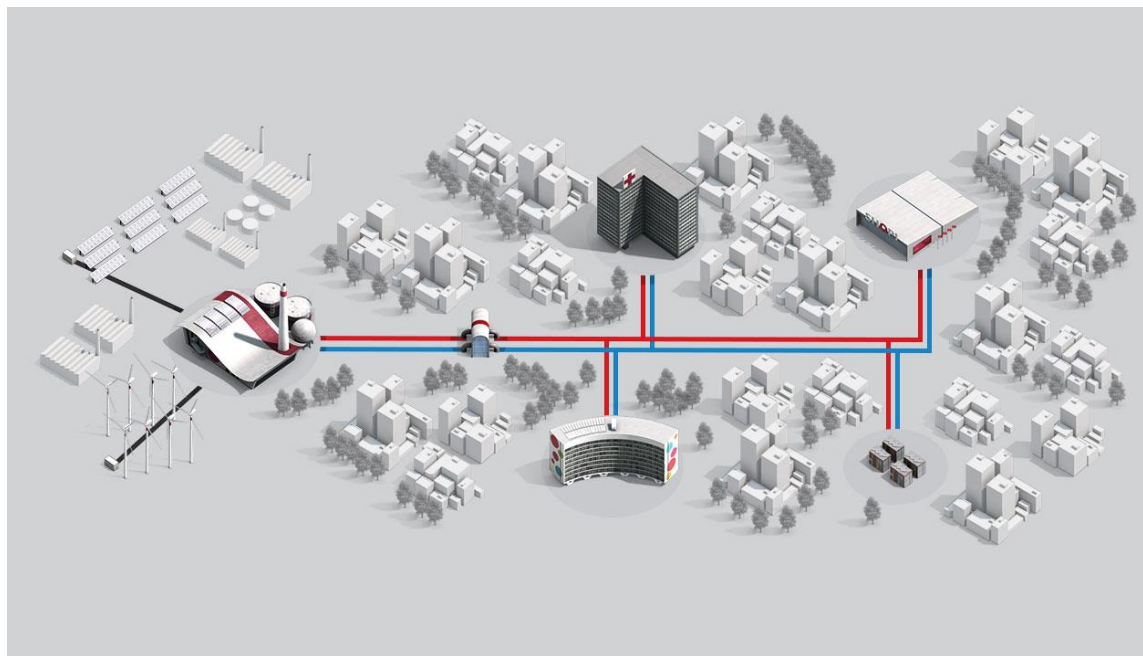
Ceramics



Planning of cogeneration plants

Potential clients of cogeneration

➤ District Heating



➤ Services with own small cogeneration unit:

Universitary campus

Hospitals

Hotels

Airports

Kawasaki Products & Services

Kawasaki Gas Turbine Europe · Kawasaki Heavy Industries



Products



Services

Gas Turbines

M1A-17D
1,816 kWel
 $\eta = 28.1 \%$

M5A-01D
4,720 kWel
 $\eta = 32.6 \%$

M7A-03D
7,810 kWel
 $\eta = 33.6 \%$

L20A-01D
18,500 kWel
 $\eta = 34.3 \%$

L30A-01D
34,300 kWel
 $\eta = 40.3 \%$

Gas Engines

KG12
5,200 kWel
 $\eta = 49.0 \%$

KG12-V
5,200 kWel
 $\eta = 49.5 \%$

KG18
7,800 kWel
 $\eta = 49.0 \%$

KG18-V
7,800 kWel
 $\eta = 49.5 \%$

Engineering

Concept Engineering

Detailed Engineering

Implementation

Project Planning

Customized Packaging

Erection Commissioning

Maintenance

Spare Parts Consumables

Full Maintenance

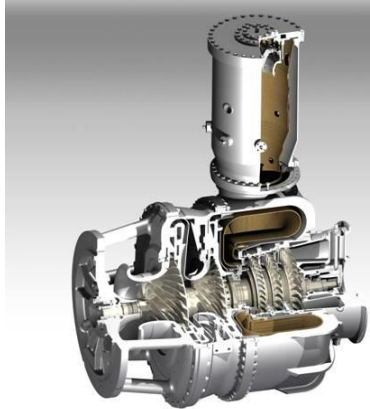
Remote Monitoring

Other Services

**Low-interest loans
(i.e. governmental loans)**

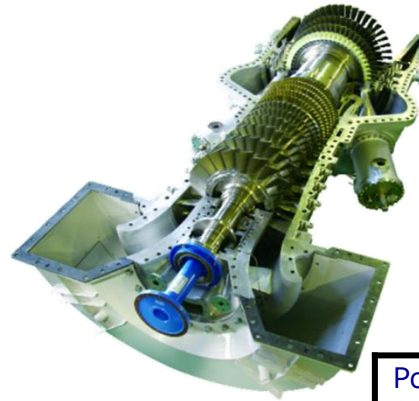
Kawasaki Gas Turbine Engine Models

M1A-17D



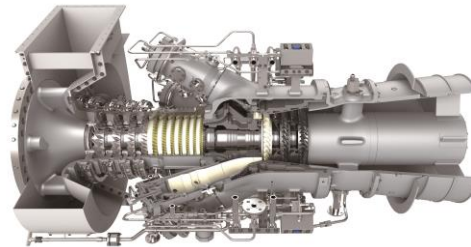
Power Output [kWe]	1,816
Ele. Efficiency [%]	28.1
Sat. steam 8 barg [t/h]	5
Exhaust Gas Temperature [°C]	522
NO _x @ O ₂ = 15% [ppm]	< 9
CO @ O ₂ = 15% [ppm]	50

M7A-03D



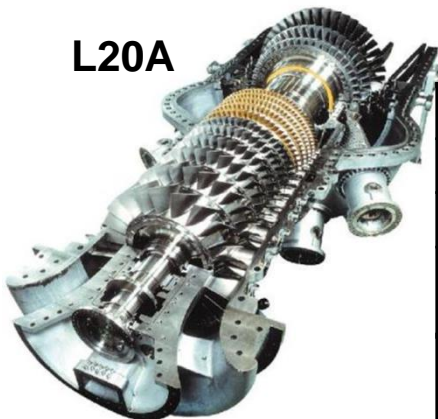
Power Output [kWe]	7,810
Ele. Efficiency [%]	33.6
Sat. steam 8 barg [t/h]	16.4
Exhaust Gas Temperature [°C]	523
NO _x @ O ₂ = 15% [ppm]	< 9
CO @ O ₂ = 15% [ppm]	10

M5A-01D



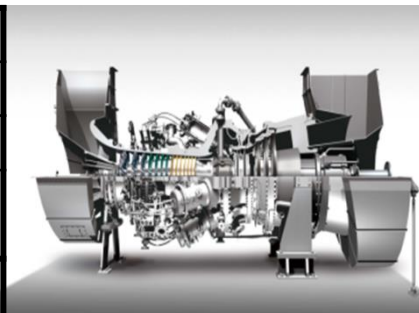
Power Output [kWe]	4,720
Ele. Efficiency [%]	32.6
Sat. steam 8 barg [t/h]	11
Exhaust Gas Temperature [°C]	511
NO _x @ O ₂ = 15% [ppm]	15
CO @ O ₂ = 15% [ppm]	15

L20A



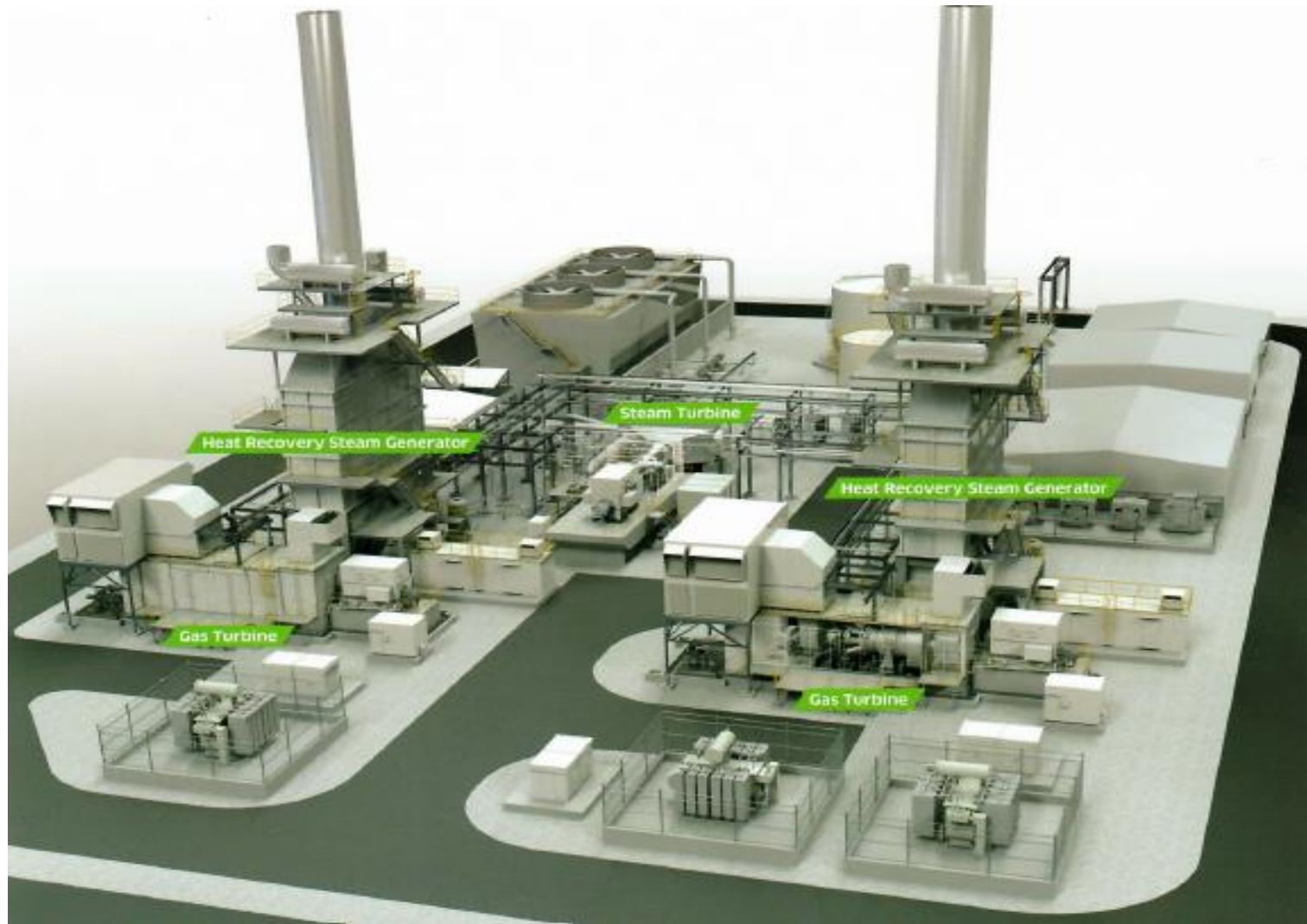
Power Output [kWe]	18,500
Ele. Efficiency [%]	34.3
Sat. steam 8 barg [t/h]	11
Exhaust Gas Temperature [°C]	542
NO _x @ O ₂ = 15% [ppm]	15
CO @ O ₂ = 15% [ppm]	25

L30A



Power Output [kWe]	34,380
Ele. Efficiency [%]	40.3
Sat. steam 8 barg [t/h]	55
Exhaust Gas Temperature [°C]	502
NO _x @ O ₂ = 15% [ppm]	15 / 9
CO @ O ₂ = 15% [ppm]	25

Kawasaki Gas Turbine (KHI) – 100 MW CCPP (combined cycle power plant)



Kawasaki Gas Turbine (KHI) – 100 MW CCPP (combined cycle power plant) - performances

■ Combined Cycle Performance Data (Reference)

	1 on 1	2 on 1	2 on 1 (Reheat)
CC Electric Output [MWe]	44.7	89.9	101.5
CC Heat Rate [kJ/kW-hr]	6,650	6,620	6,520
CC Electrical Efficiency [%]	54.1	54.4	55.2
Number of Gas Turbines	1	2	2
Bottoming Cycle Type	2PNRH	2PNRH	3PRH

Condition

Inlet Air Temperature : 15 deg-C

Atmospheric Pressure : 101.3 kPa

Fuel Type : Natural Gas (100% CH₄)

LHV of Fuel : 35.9 MJ/Nm³

2PNRH : Two Pressure Non-reheat

3PRH : Three Pressure Reheat

Kawasaki Gas Engine Models

KG – 18 – V



Power Output [kWe]	7,800
Ele. Efficiency [%]	49.5
Exhaust Heat [kWth]	4,000
Exhaust Gas Temperature [°C]	320
NOx @ O ₂ = 0% [ppm]	200
CO @ O ₂ = 0% [ppm]	50
Methane number	> 65

KG – 12 – V



Power Output [kWe]	5,200
Ele. Efficiency [%]	49.5
Exhaust Heat [kWth]	2,700
Exhaust Gas Temperature [°C]	320
NOx @ O ₂ = 0% [ppm]	15
CO @ O ₂ = 0% [ppm]	15
Methane number	> 65

Energy efficiency and cogeneration solution

Energy efficiency solutions into Kawasaki cogeneration solutions

1. Electricity production growth at the level of gas turbines using

- ❖ Evaporative coolers: the combustion air entering the filter house will pass through a wetted media

- Useful in dry environments;
- Useful for a limited period of time: $t_{amb} > 15\text{ }^{\circ}\text{C}$;

GPB 80D – 7.8 MW in ISO cond.

for 3365 hours / year and 240 m a.s.l.:

Electricity production

with Evap. Cooler: 24,268 MWh

without Evap. Cooler: 22,341 MWh

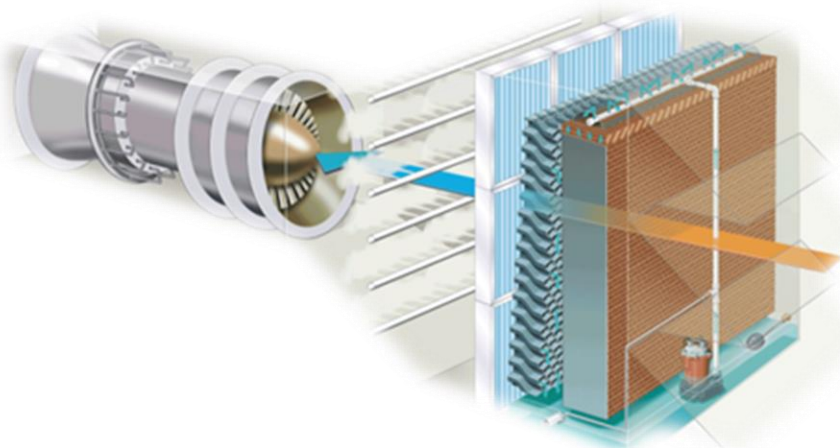
↑ 8%

Electrical efficiency

with Evap. Cooler: 32.63 %

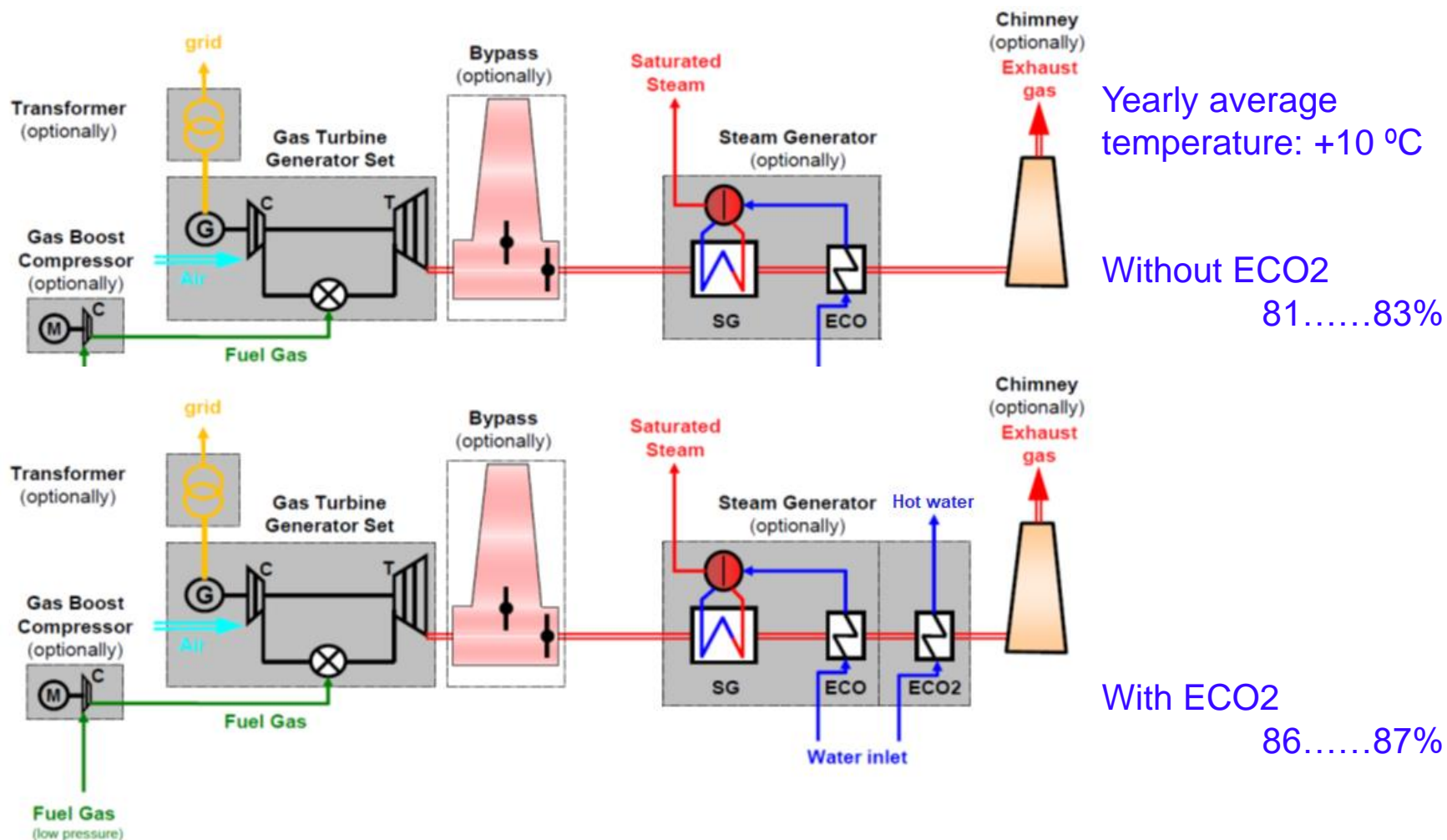
without Evap. Cooler: 31.65 %

↑ + ~1%



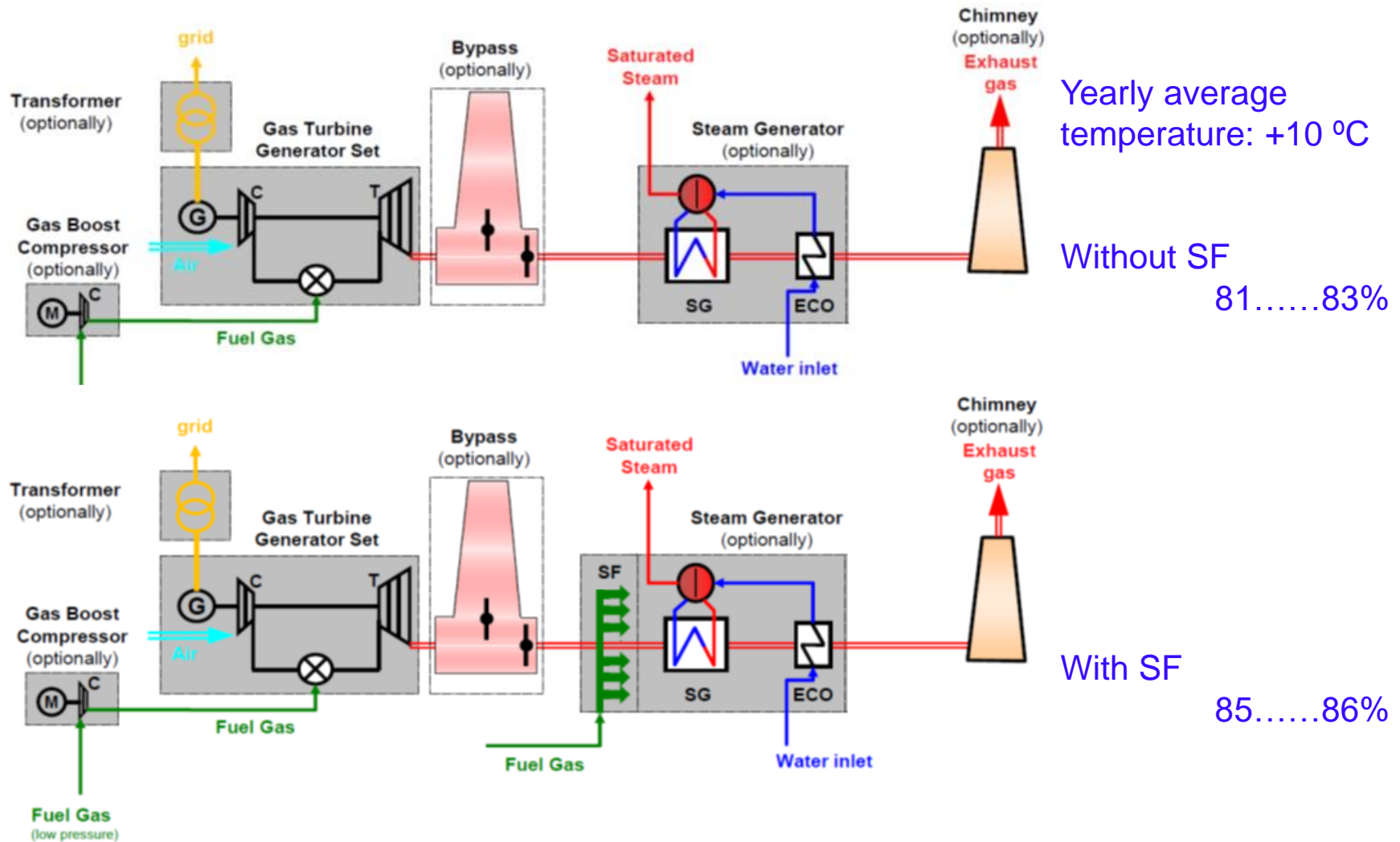
Energy efficiency and cogeneration solution

2. Overall Efficiency increasing by using second economiser (ECO2)

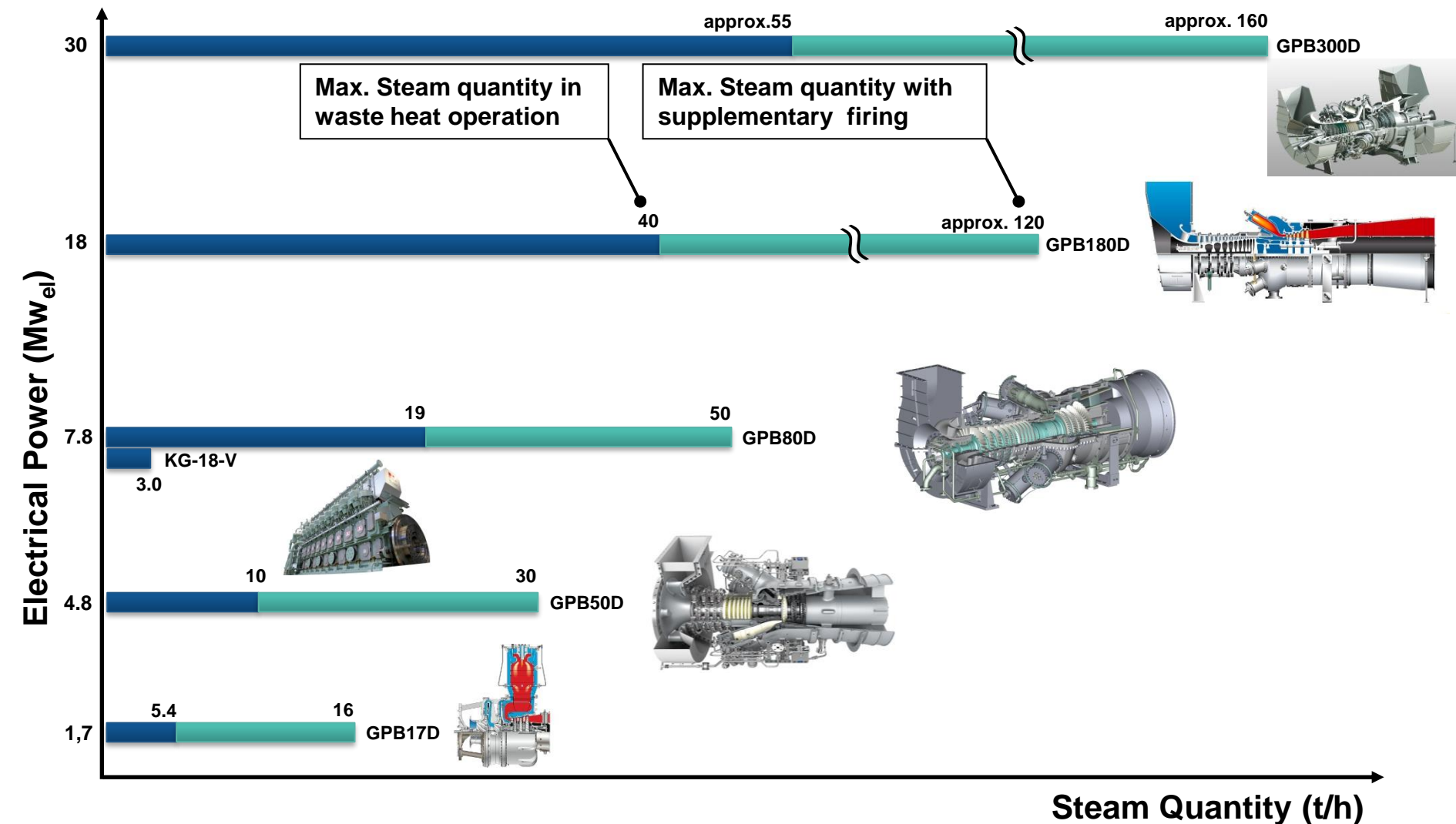


Energy efficiency and cogeneration solution

3. Overall Efficiency increasing by using supplementary firing (SF)



Energy efficiency and Kawasaki cogeneration solutions

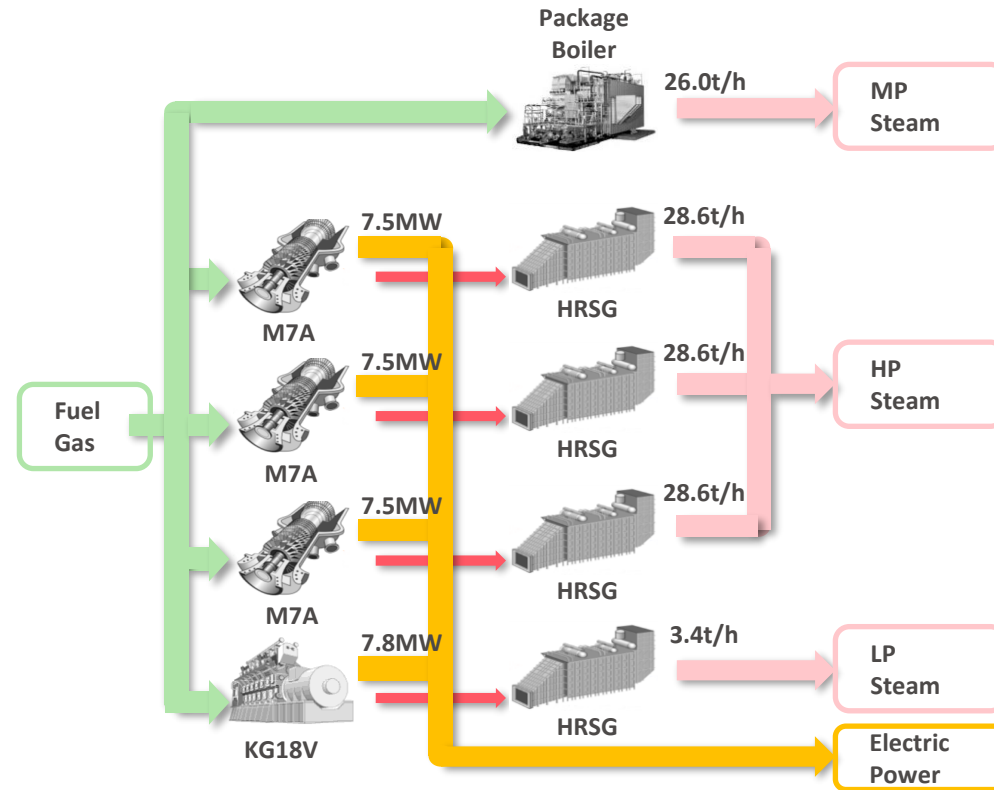


Hybrid CHP for Chemical Industries (JPN)

Example of installation

GPB80 GT and KG-18 GGE, Japan

CHP Package	GPB80D + Gas Engine
Output	M7A (7.5MW) x 3 units KG-18-V (7.8MW) x 1 unit 26t/h Package Boiler

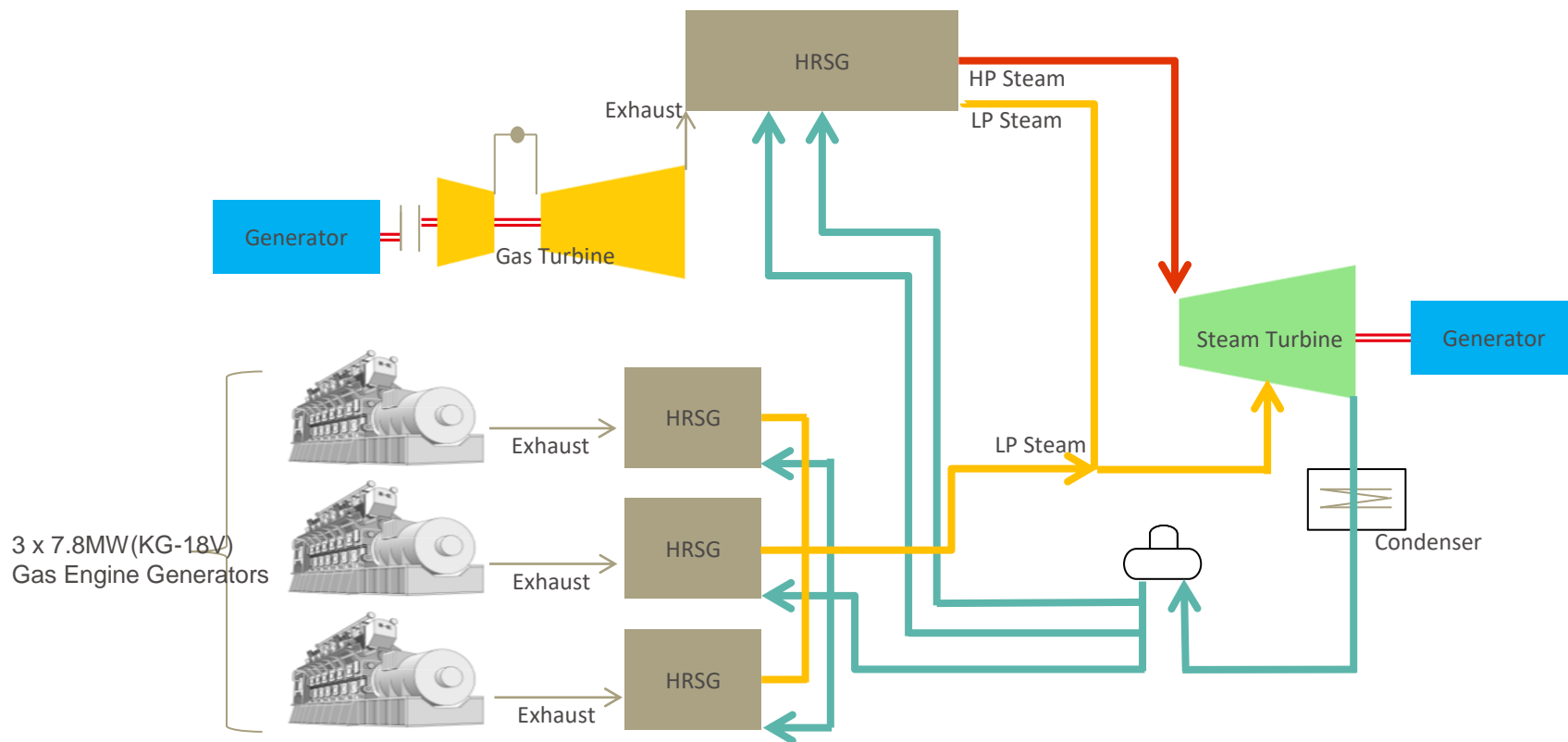


LP : Low Pressure
MP : Medium Pressure

Hybrid CHP for Industrial Park (THA)

Optimal Configuration for load alteration (Peak/Off-peak) By Hybrid Combined Cycle (Gas Turbine & Gas Engines + Steam Turbine)

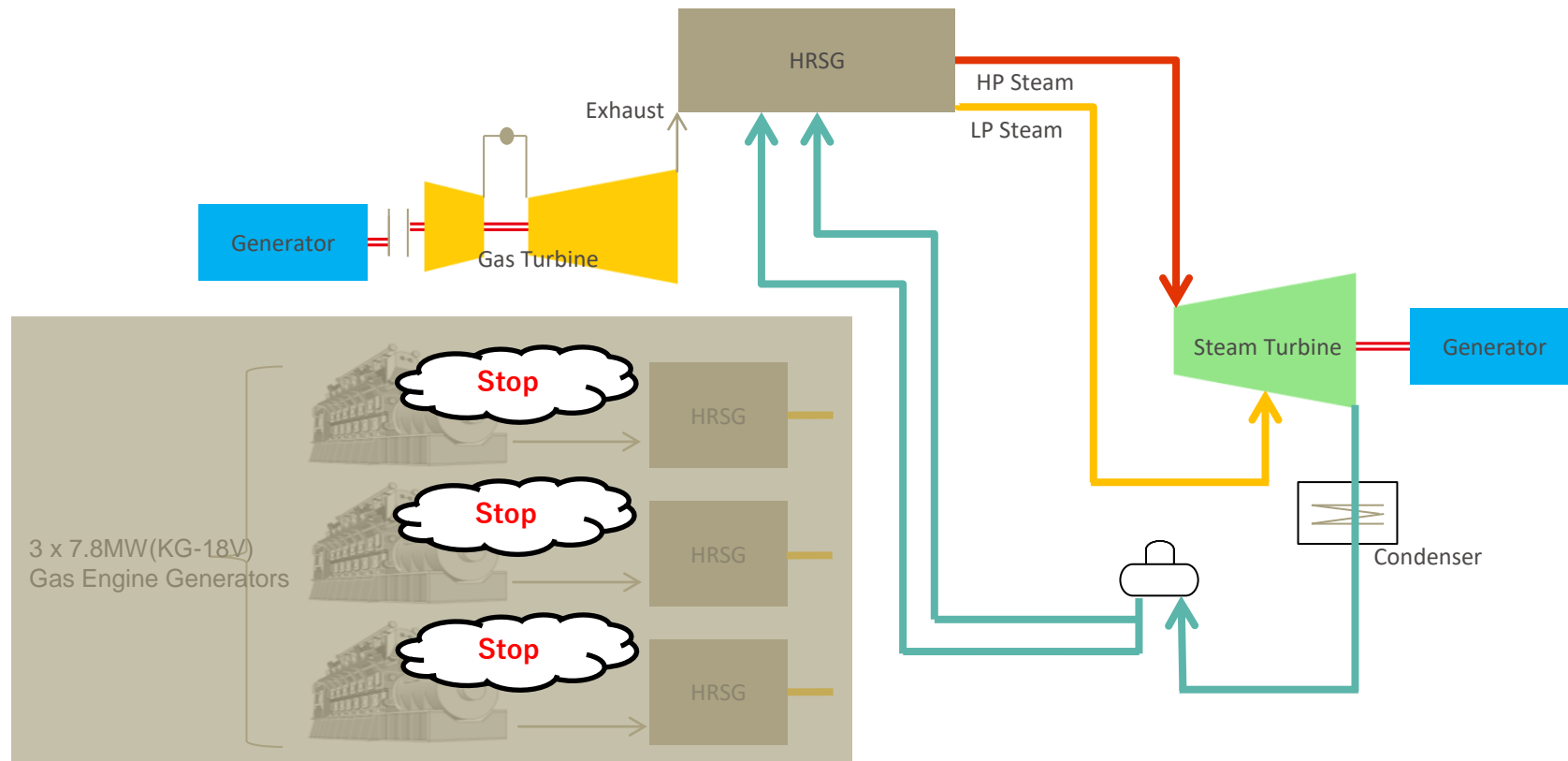
~Peak (Day) Time~



Hybrid CHP Reference for Industrial Park (THA)

Optimal Configuration for load alteration (Peak/Off-peak)
By Hybrid Combined Cycle (Gas Turbine & Gas Engines + Steam Turbine)

~Off-Peak (Night) Time~



Energy efficiency and Kawasaki cogeneration solutions

According with:

- ❖ Project type:
 - energy efficiency;
 - new cogeneration facility production;
- ❖ Electricity Demand and Thermal Demand;
- ❖ Type of Thermal Demand (heat, steam, hot gases, child water);
- ❖ Strategy of Business;
- ❖ Flexibility and Redundancy in operation;

**Kawasaki products, services and solutions
cover all cogeneration application
with a size between 1.5 MWe and 100 MWe**

Joetsu Green Power Project for Nihon Techno / J



Model	KG-18-V
Unit Output	7,800kW
No. of Unit	14
Total Output	109.2MW

110MW Nihon Techno Sodegaura Green Power (JPN)

Gas Engine Features

49.5% Electrical Efficiency - The World Best Performance

Achieved excellent electrical efficiency by optimized design of combustion chambers and individual cylinder control

Environmental Friendly

NOx emission : Less than 200 ppm (@O₂ = 0%)

High Partial Load Performance and Wide Continuous Operating Range

Operating range is 30% ~ 100% / Keep high efficiency at partial load

*suitable for peak operation

Quick Start Up

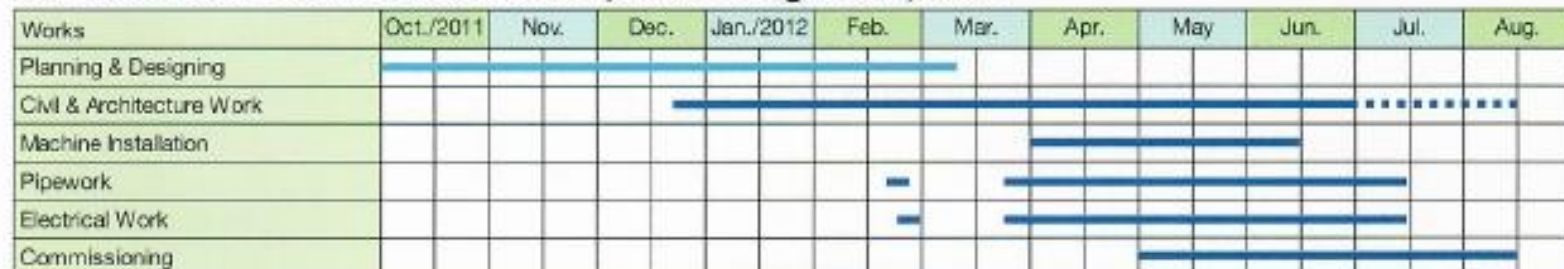
Within 10 minutes to 100% load from start order

*suitable for peak operation

Less Impact by Ambient Conditions

Stable output in hot climates / at high altitude

Construction Period: December 19, 2011 - August 15, 2012

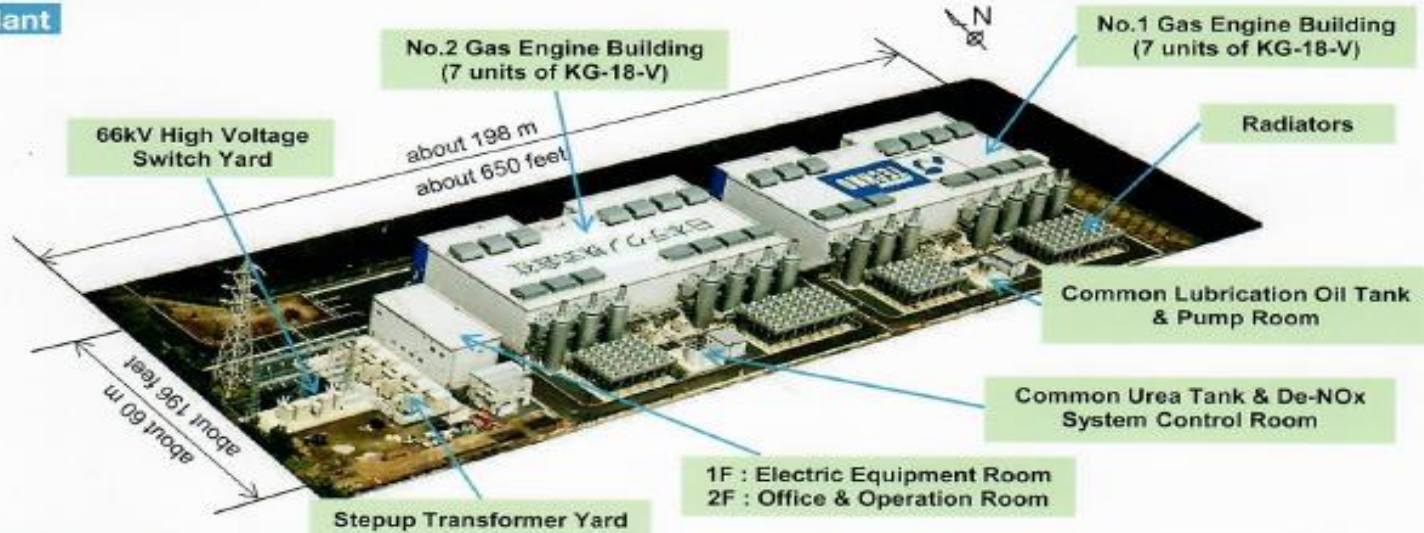


110MW Nihon Techno Sodegaura Green Power (JPN)

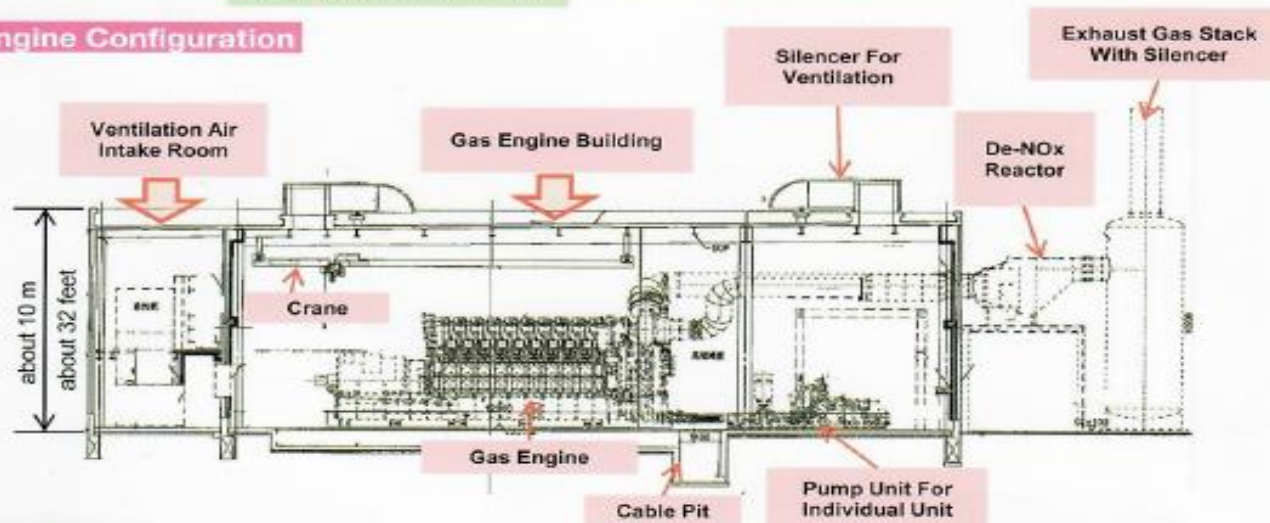
Plant outline

< Total site area : 12,430.24 m² (3.07acre) >

Plant



Each Engine Configuration



How KGE Team Works

- KGE provides individual consultancy from early beginning of CHP project – ***The customer will never walk alone;***
- KGE provides the optimal solution according with the customer energy and economical requirements – ***Maximum profit and flexibility in Operation;***
- KGE, for each project, simulates the performances of running machines according with customer energy consumption – ***Guaranteed Performance;***
- KGE designs them solutions according with site conditions – ***Customized Solution;***
- KGE, together with them partners, can provide ***Financial Solutions;***

How KGE Team Works

- KGE can offer extended scope of supply – ***Engineering, Procurement,***
- KGE provides project management, as well as detailed engineering – ***Partnership with Customer,***
- KGE provides all the activities for project implementation – ***Erection, Commissioning and Start-up;***
- KGE provides full maintenance for long term, spare parts and remote monitoring – ***Sustainable Cooperation with Our Customer is Warranted.***

Kawasaki Hydrogen Road Map

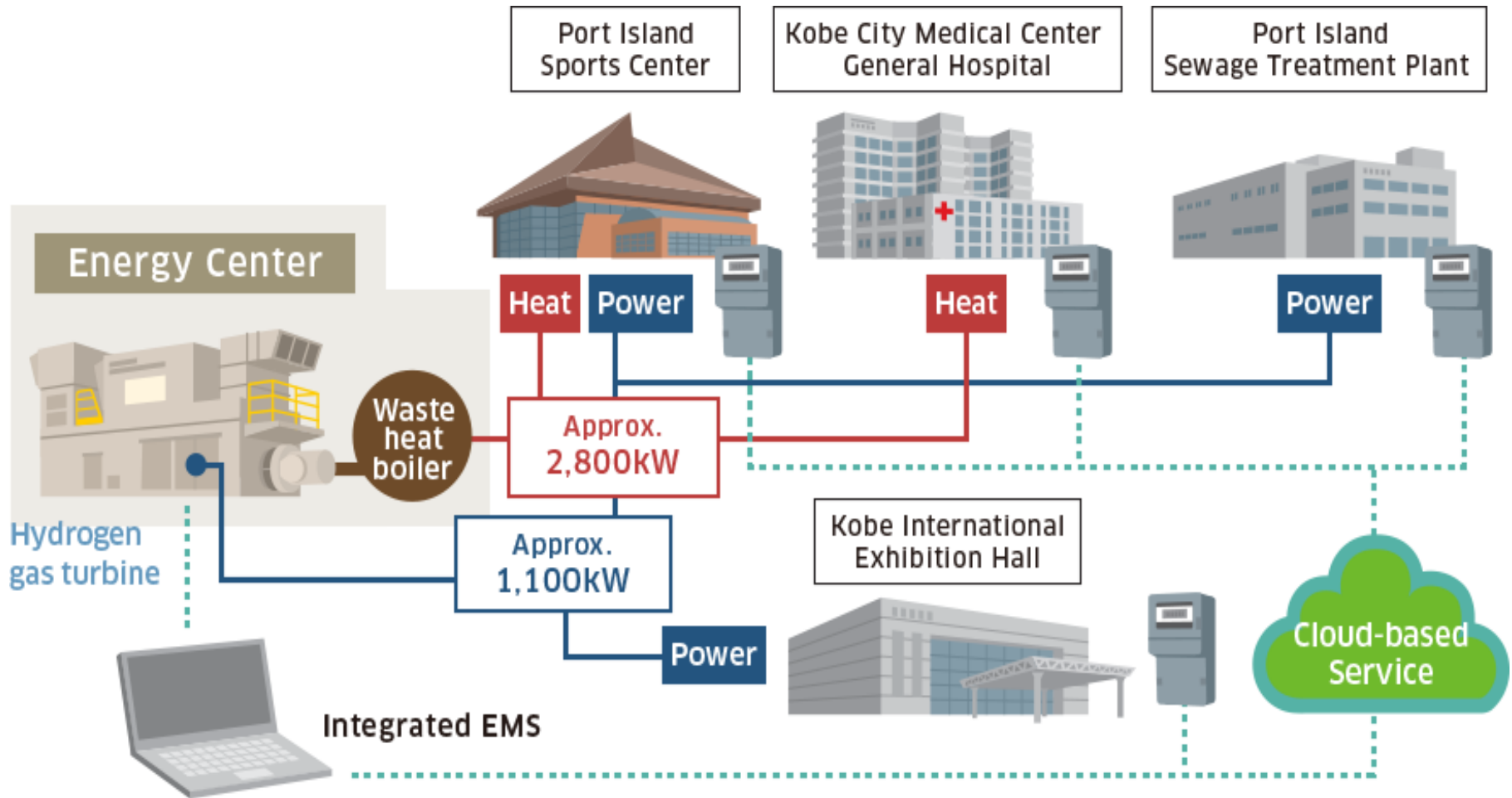
KOBE city



Development of Smart Community Technology by Utilization of Cogeneration System with Hydrogen Gas Turbine

Kawasaki Hydrogen Road Map

The first attempt in the world to supply electric power and heat generated from hydrogen gas turbine to an actual urban area



Kawasaki Hydrogen Road Map

**Gas Turbine CHP Plant using
100% Hydrogen as a fuel**

Power Generation: 1.7 MWe



Partners:

- Obayashi
- Kawasaki
- Kobe City
- KEPCO
- Iwatani
- Osaka University

Supported by NEDO

Thank you for your attention!

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

“Global Kawasaki”

M. Sc. Eng Cristian Athanasovici
Business Development Manager