



POWERING EVERYONE

GE's Distributed Power Customer Event 2016





Natural gas applications – best practice Cogeneration / Trigeneration

Natural gas-fueled CHP

- More than 7,000 of GE's natural gas-fueled cogeneration units* with an electrical output of approximately 11,000 MW worldwide
- Highly efficient generation of power, heat and cooling
- Reduces transmission losses
- Enhanced total efficiency – greater than 90%
- Reduces fossil fuel use and greenhouse gas emissions



*as of 2016

What is CHP?

The combined simultaneous production of electricity and heat from a single fuel source.

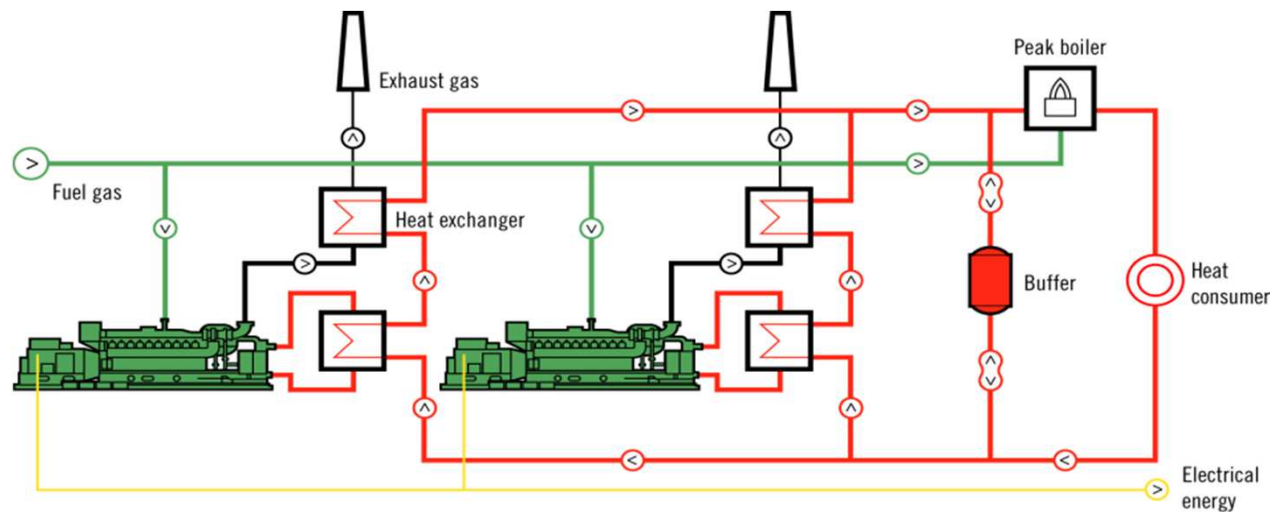
In Engine case, CHP is the recovery of waste heat during power generation in order to make hot water or steam or cooling.

The Term “**Cogeneration**” is used interchangeably with CHP.

CHP Application may Include:

Electricity
Steam
Hot water
Process Heat
Cooling and Refrigeration
Drying

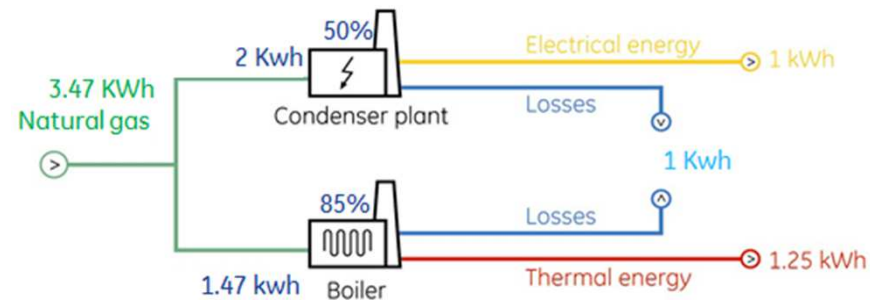
Heating Application



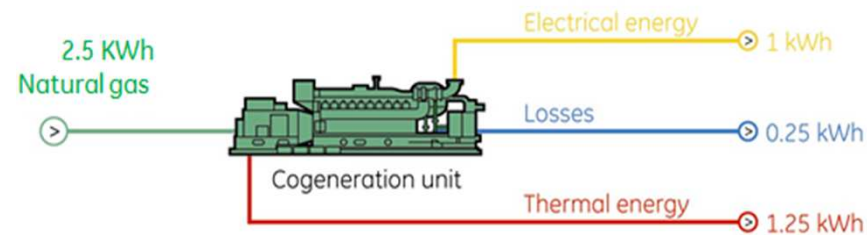
Why CHP?

- ✓Reduced fuel to process
- ✓Less purchased Electricity
- ✓Very high efficiency
- ✓Greenhouse Gas Savings
- ✓Back up Power support
- ✓Reliability

Conventional System



Cogeneration



2/3 of the fuel in conventional systems is wasted
CHP Saving 40-60% compared to Energy required for Conventional System

Where CHP/Trigen ?

1) District Heating & Cooling

- Incentives: Feed in tariffs
fuel tax exemptions

(Utilities,
Municipal Utilities)



2) Supply of buildings

- Incentives: Feed in tariffs
fuel tax exemptions

(Hospitals, Airports,
Shopping Malls,
Universities, Hotels)



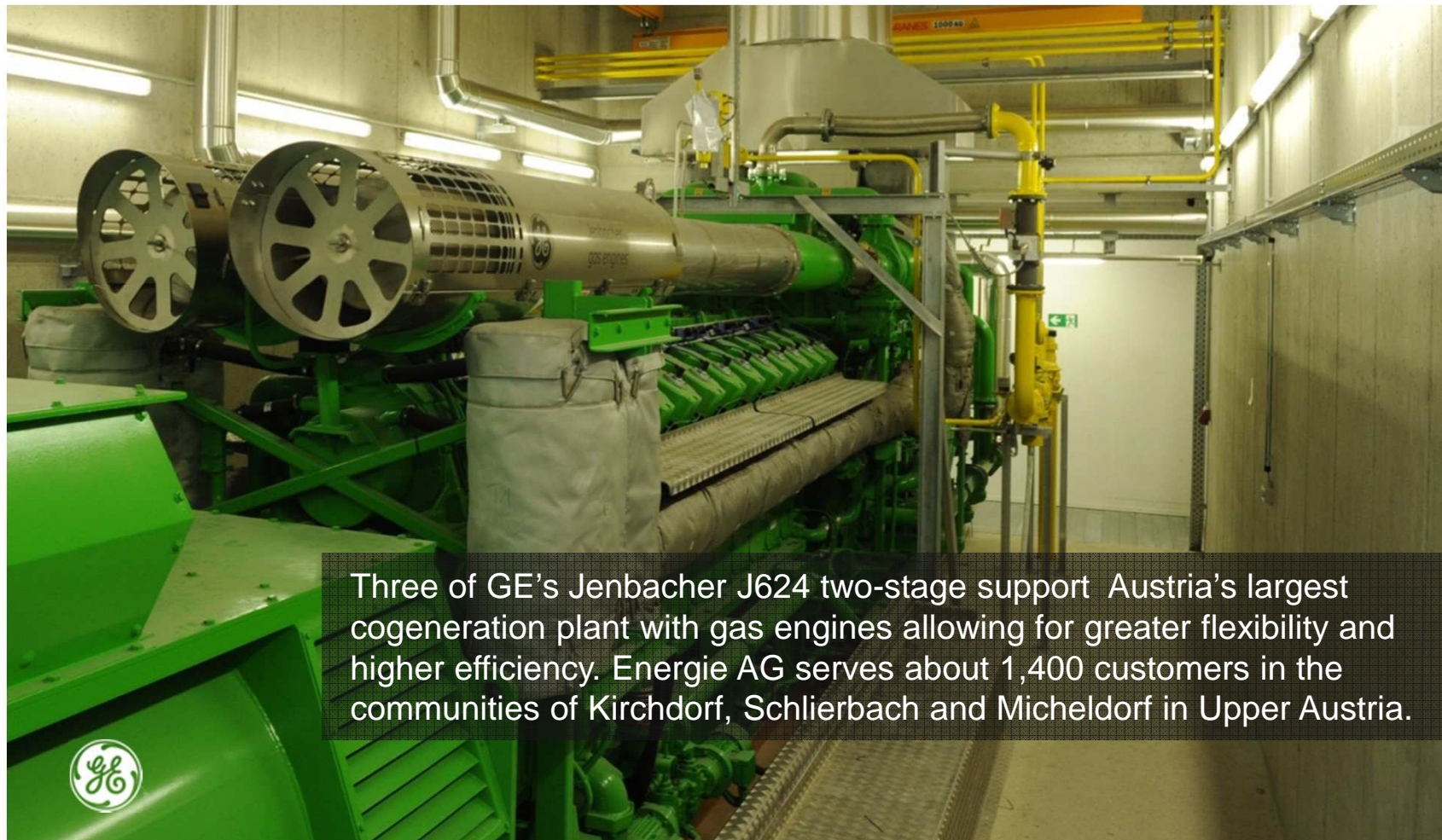
3) Industries

- Incentives: Feed in tariffs,
fuel tax exemptions,
investment credits,
import duty exemptions

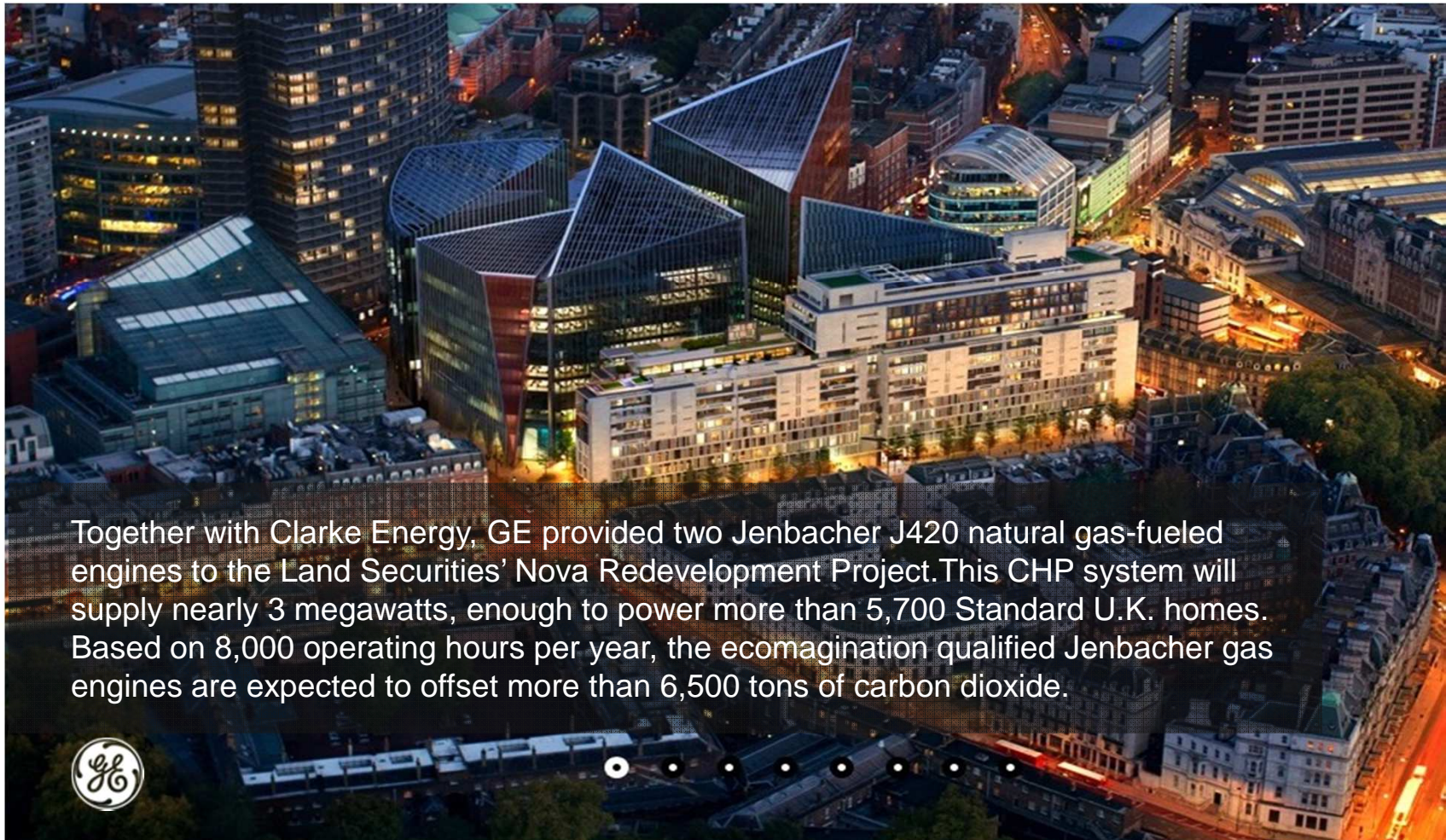
(Textile, Chemical,
Food, Beverage,
Greenhouse...)



New technology offers significant output and a higher total efficiency for CHP applications



Victoria Circle development with Jenbacher gas-fueled engines in London, UK



Together with Clarke Energy, GE provided two Jenbacher J420 natural gas-fueled engines to the Land Securities' Nova Redevelopment Project. This CHP system will supply nearly 3 megawatts, enough to power more than 5,700 Standard U.K. homes. Based on 8,000 operating hours per year, the ecomagination qualified Jenbacher gas engines are expected to offset more than 6,500 tons of carbon dioxide.



Guy's & St Thomas' Hospitals

Client: Guy's & St Thomas' Hospitals Trusts

Location: Central London, UK

Equipment: 2 x JMS620GS-NL

Success factors:

- Service support and local infrastructure
- Flexibility of heat recovery circuits
- Design innovation to meet space constraints

The Shard

Natural gas

Combined heat and power

1 x JGMC 416 GS-NL

CHP – Shopping Malls



Mall of Indonesia (MOI) – 5 x J620

Tunas Batam Shopping Mall - Indonesia – 1 x J624

Lonjas Shopping – Brasil – 1 x J420

Shopping Rio Center Lar – Brasil – 1 x J320

Shopping Center Roszakert – Hungary – 1 x J420

Shopping Centre Mom Park – Hungary – 1 x J320

Shanghai Resort Zone (Disneyland) – 5 x J624

Plaza Indonesia (9 x JGS 620 / 9 x 2.7MW)

Lugner City – Vienna – Austria – 1 x J320

M-Preis – Innsbruck – Austria – 1 x J416

CHP enabling further business growth

Helping Coca Cola to reduce CO₂-emissions

Coca-Cola Hellenic Bottling plants throughout Europe use GE's Jenbacher CHP engines, reducing operational costs and eliminating up to 40% of their annual emissions. For instance, in Coca Cola Hellenic's Romania bottling facility two J620 engines are supplying a total of 6 MW.



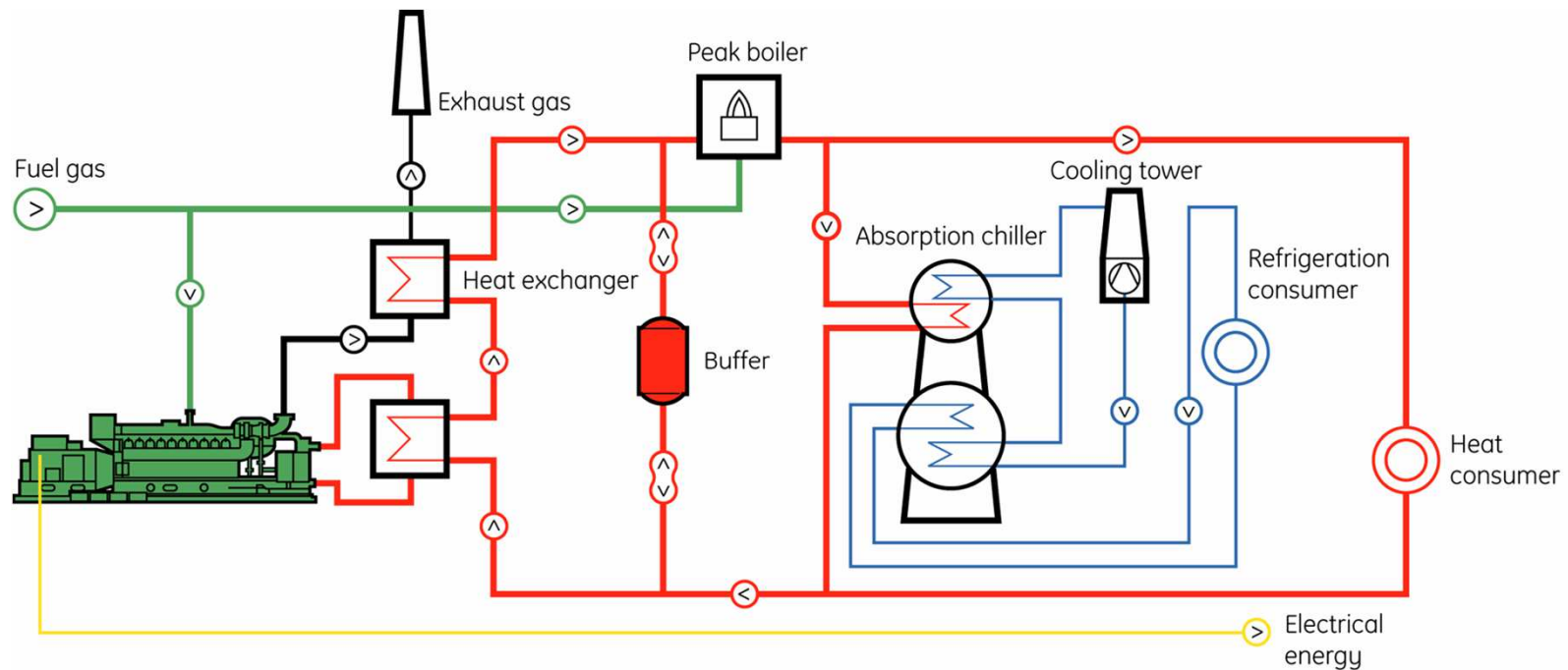
Supporting BMW's energy needs

25 of GE's type 4 and type 6 natural gas-fueled Jenbacher cogeneration systems with an overall efficiency of 83+% and an el. output of ~80+ MW support production work at auto manufacturer BMW* Group's production facilities in Germany and Austria.

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Trigeneration with Jenbacher gas engines



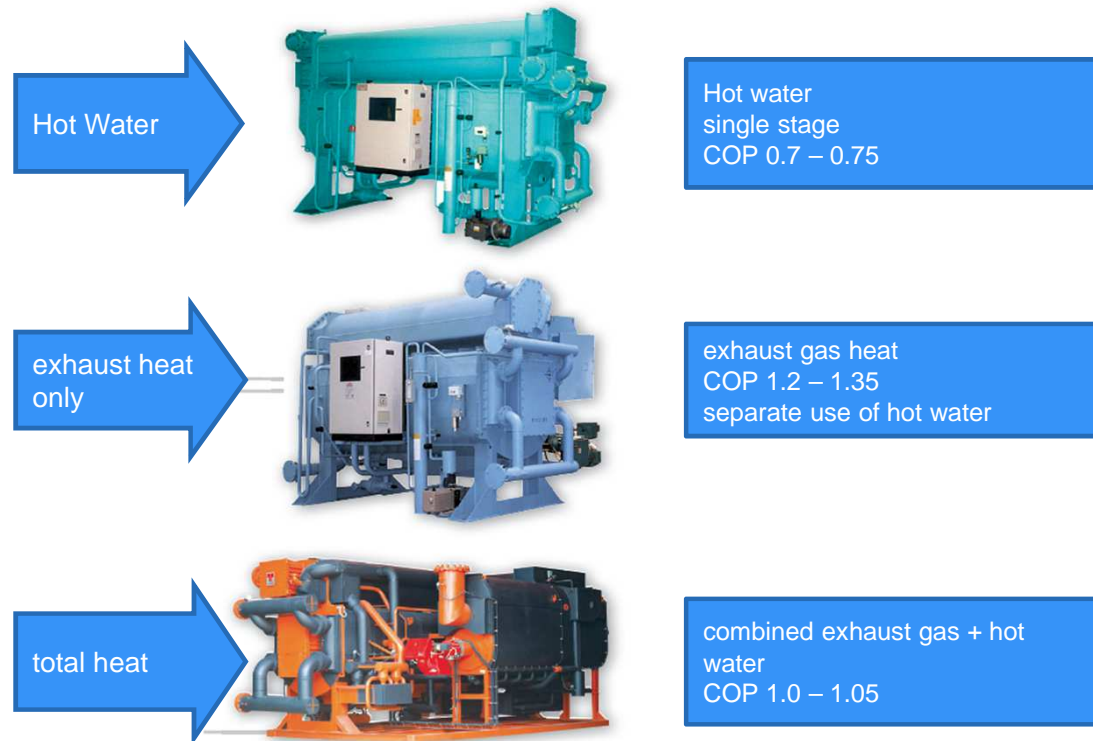
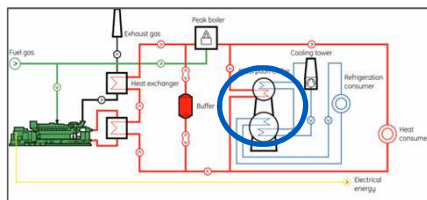
Absorption chillers - capabilities

Advantages

- Driving power = heat
- Low operating costs
- Electrical energy required: approx. 1% of refrigeration capacity
- Few moving parts => Low servicing and maintenance costs
- Increased annual utilisation ratio of cogeneration plants
- Very good behaviour under part-load
- CFC-free refrigerants

Disadvantages

- Relatively high capital costs
- Low power density, large volume of construction
- High recooling capacity



Source: Trane/Thermax

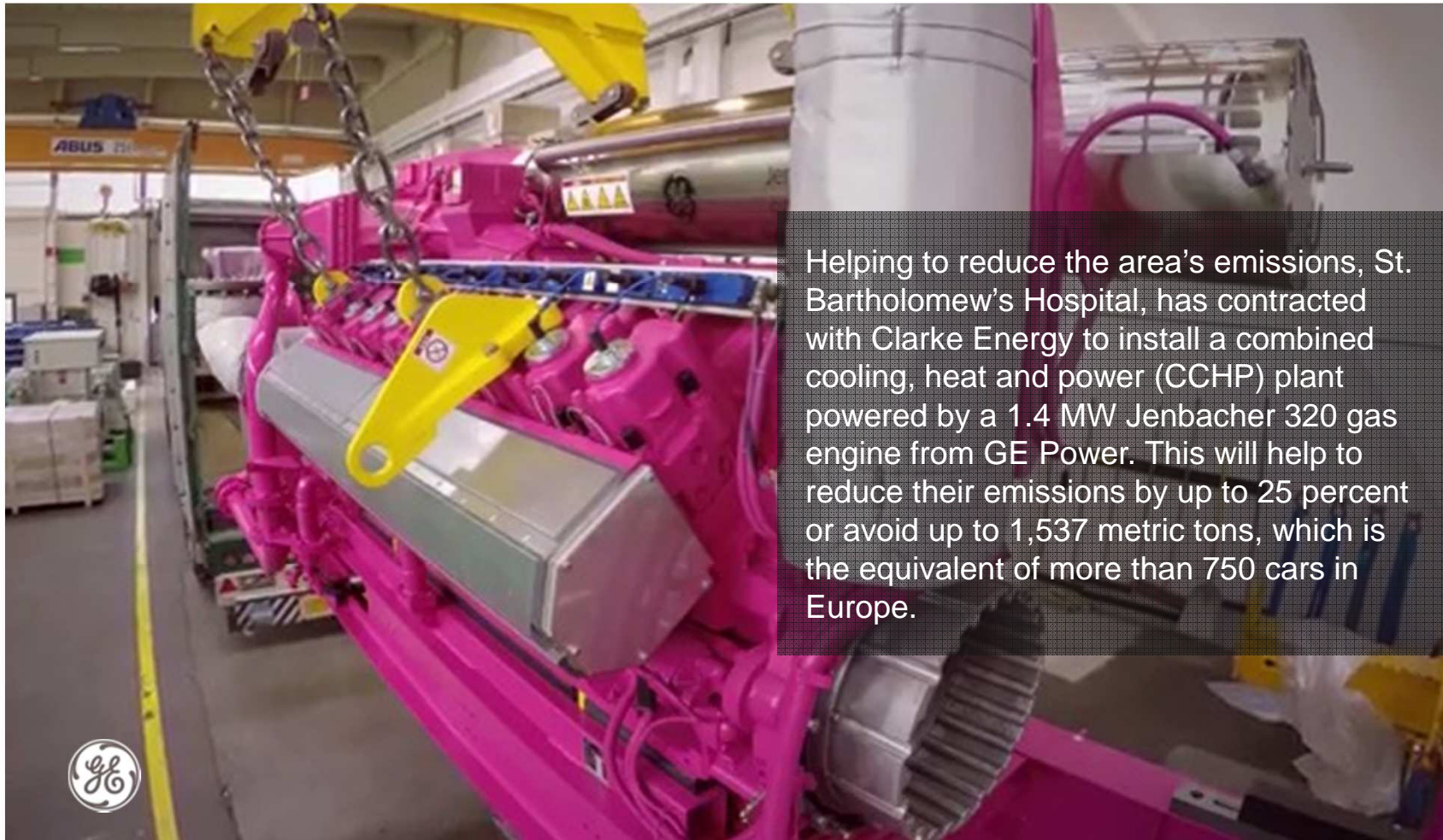
Maximum energy efficiency with trigeneration at Cologne/Bonn Airport

Four of GE's Jenbacher type 6 gas engines surpassed 115,000 operating hours and generated about 46,000 MWh of electricity annually, displacing the equivalent of 360,000 tons of CO₂ since 1999.

* according to the airport's 2007 annual report



Trigeneration at St. Bart's Hospital in London, UK



Industrial CHP - Steam

Altınmarka, Turkey



No. of units and engine type: 2 x J320

Fuel: Natural gas

Electrical output: 2,096
kW

Thermal output: 2,308
kW

Application:
Steam utilization

Ceramic Industry - Cellisa Barcelona, Spain



2 x JMS 320 GS-N.L

Power output:

1,844 kW el.

2,656 kW th.



Sales Monzón, S.A. - Salt Drying Monzón, Spain



3 x J316 / 3 x J320 / 8 x J616

Plant output:

14,458 kW el.

18,890 kW th.



Driving innovation ... the world's first 24-cylinder gas engine

The world's first Jenbacher 4 MW 24-cylinder gas engine of GE is powering one of the largest commercial tomato greenhouses in the Netherlands, offering an economic supply of onsite electrical and thermal power while also employing the engines' cleaned exhaust gas as a fertilizer.



Proven solutions ... onsite power and heat for Russian greenhouse

GE's Center of Excellence for greenhouse applications, based in the Netherlands, supplied three natural gas-fueled Jenbacher JMS 612 gas engines to support the first 5.4 MW Russian greenhouse cogeneration plant in Dmitrov.

