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Stop Flaring and Venting — Utilization of Associated Petroleum Gas with Gas Engines

Thomas Elsenbruch, GE Power & Water Jenbacher gas engines, Marketing

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Jenbacher Background

A leading manufacturer of gas-fueled reciprocating engines for power generation.

- Acquired by GE in May '03…100% gas-fueled recips
- Manufacturing/HQ in Jenbach, Austria
- Employees: 1,800 total; 1,400 in Austria

- **Power range from 0.25MW to 4MW**, 4 platforms / 11 products
- **Fuel flexibility**: Natural gas or a variety of renewable or alternative gases (e.g., landfill gas, biogas, coal mine gas)
- **Plant configurations: Generator sets, cogeneration systems, container solutions**

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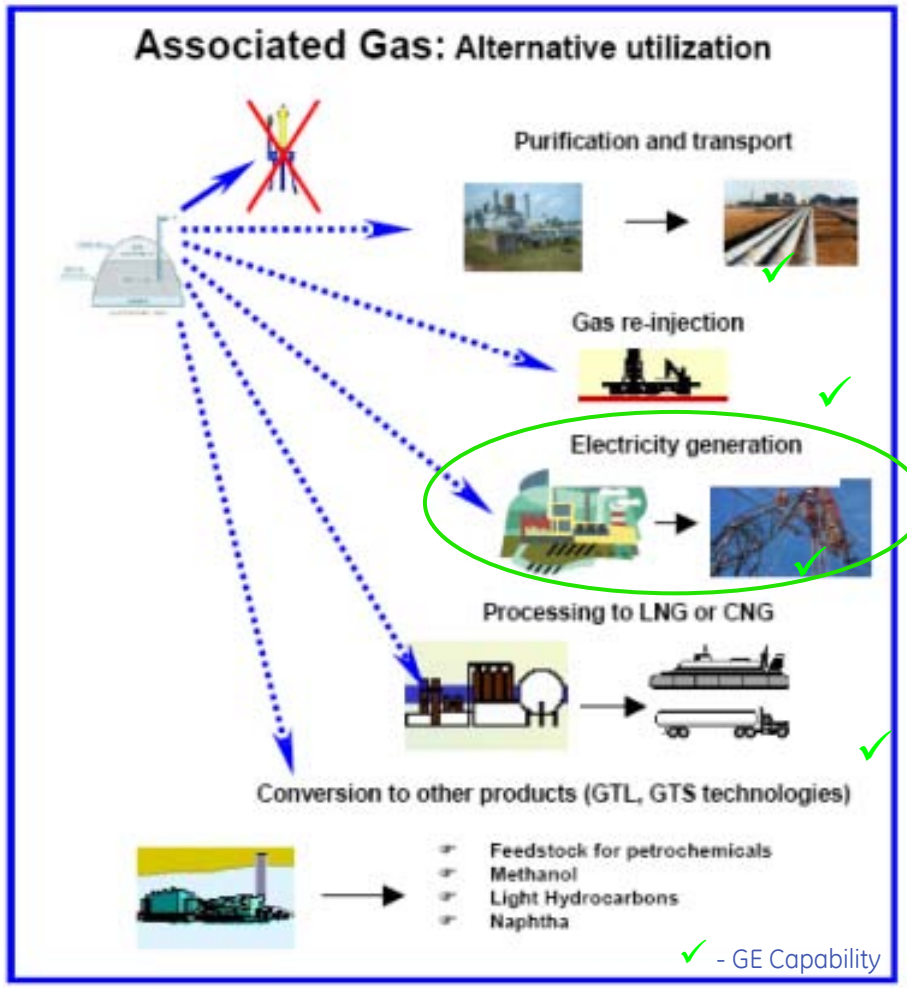
How to utilize associated gas ?



Many solutions for APG utilization are available

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Source= EU-Russia technology center (on Internet)

Important Gas Properties

Heating Value

Calorific value and thermal value **indicate the energy content of a gas.** The former can be differentiated from the later only through the heat of vaporization of the water resulting from combustion, the water is in liquid form after it has already liberated its condensation heat.

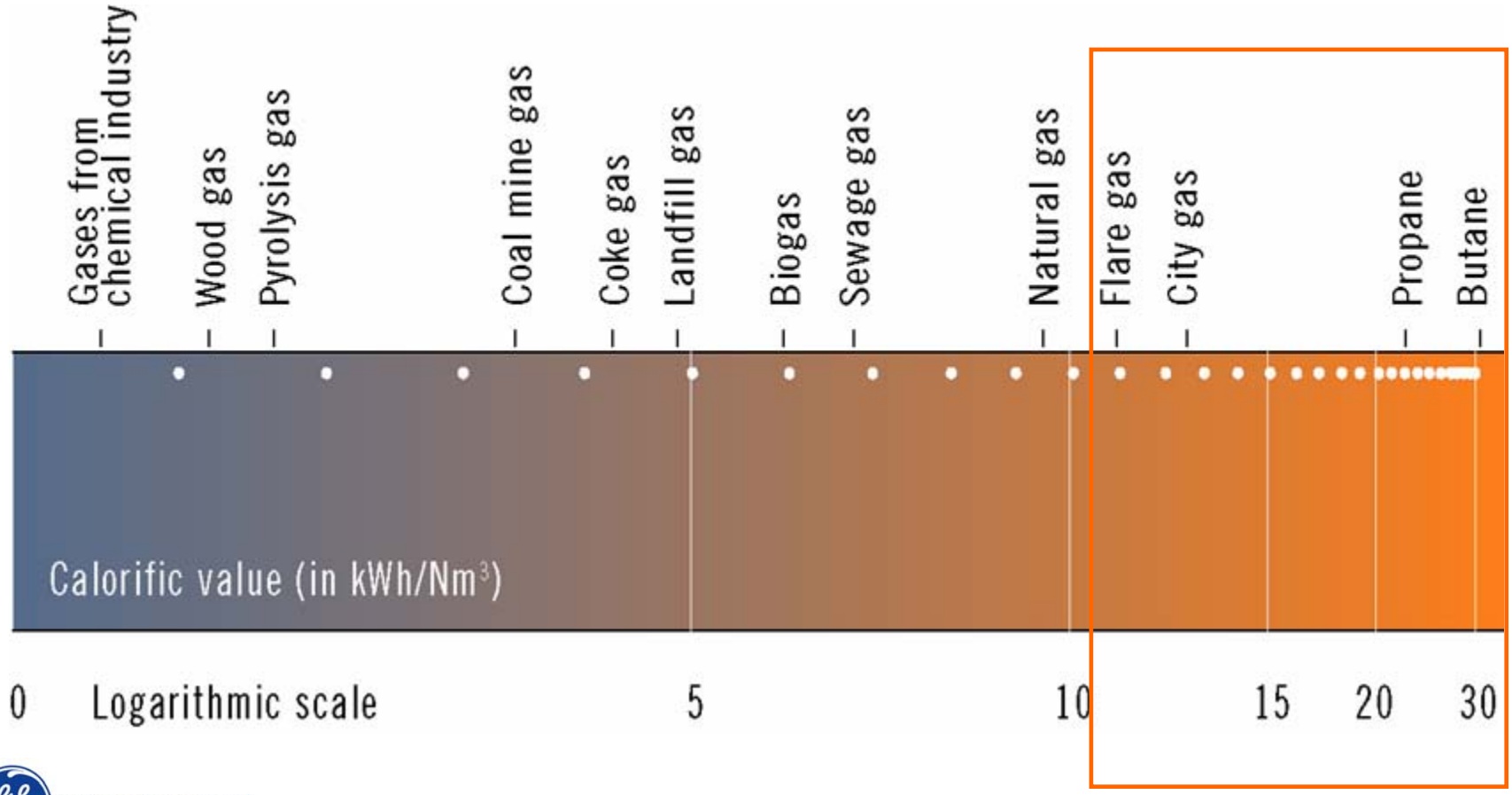
Methane Number

Determinant parameter for knocking resistance of a gas. It is **comparable to** the **Octane Number** of gasoline and indicates the percentage methane volume ratio of a methane-hydrogen mixture which, in a test engine and under controlled conditions, indicates the same knocking resistance as the gas to be tested.

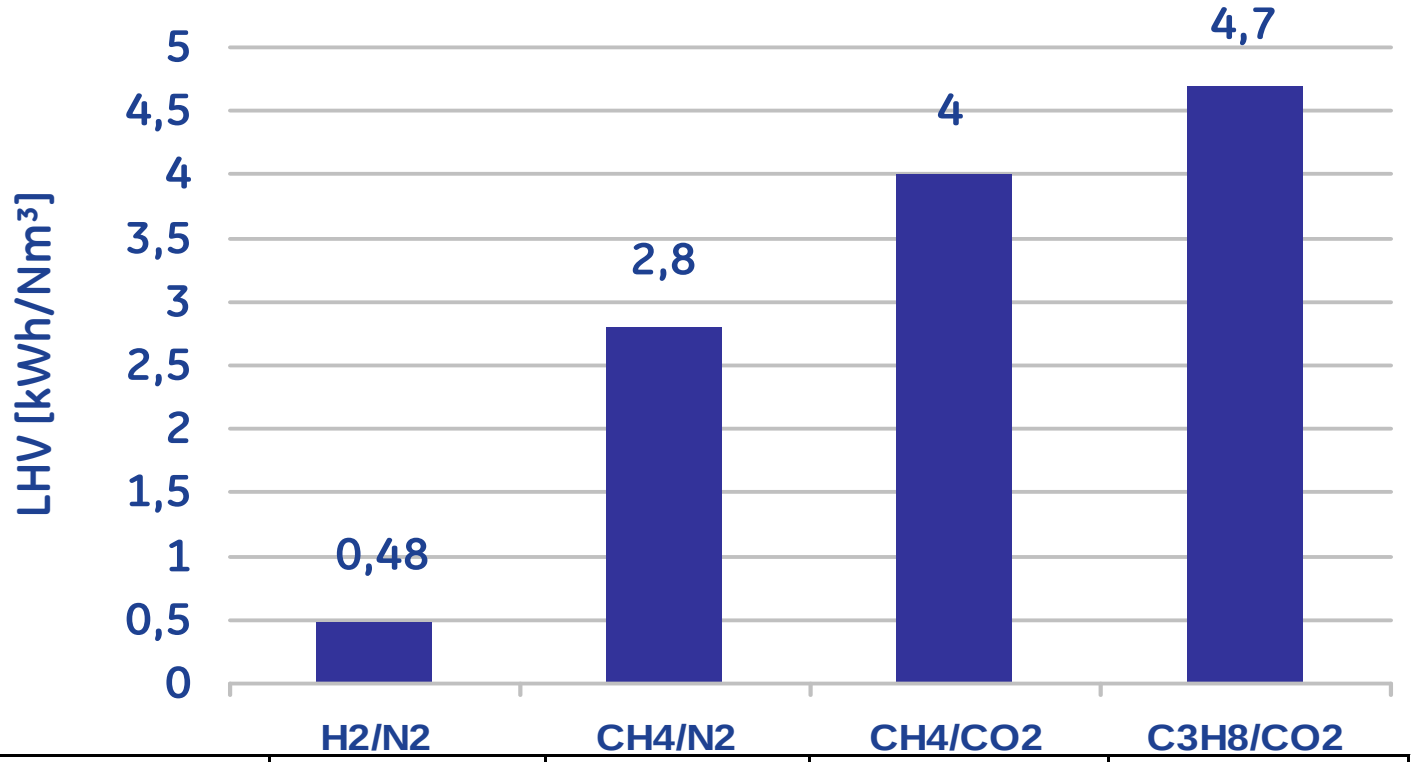
Laminar Flame Speed

Laminar flame speed is the speed at which the oxidation takes place.

Lower Heating Value
range of gases used in Jenbacher gas engines



Combustion Limits/LHV



Mixture	H_2/N_2	CH_4/N_2	CH_4/CO_2	C_3H_8/CO_2
Volume [%]	16/84	28/72	40/60	18/82
LHV [kWh/Nm³]	0.48	2.8	4.0	4.7

Combustibility depends on the combination of composition and NOT on the heating value of the gas

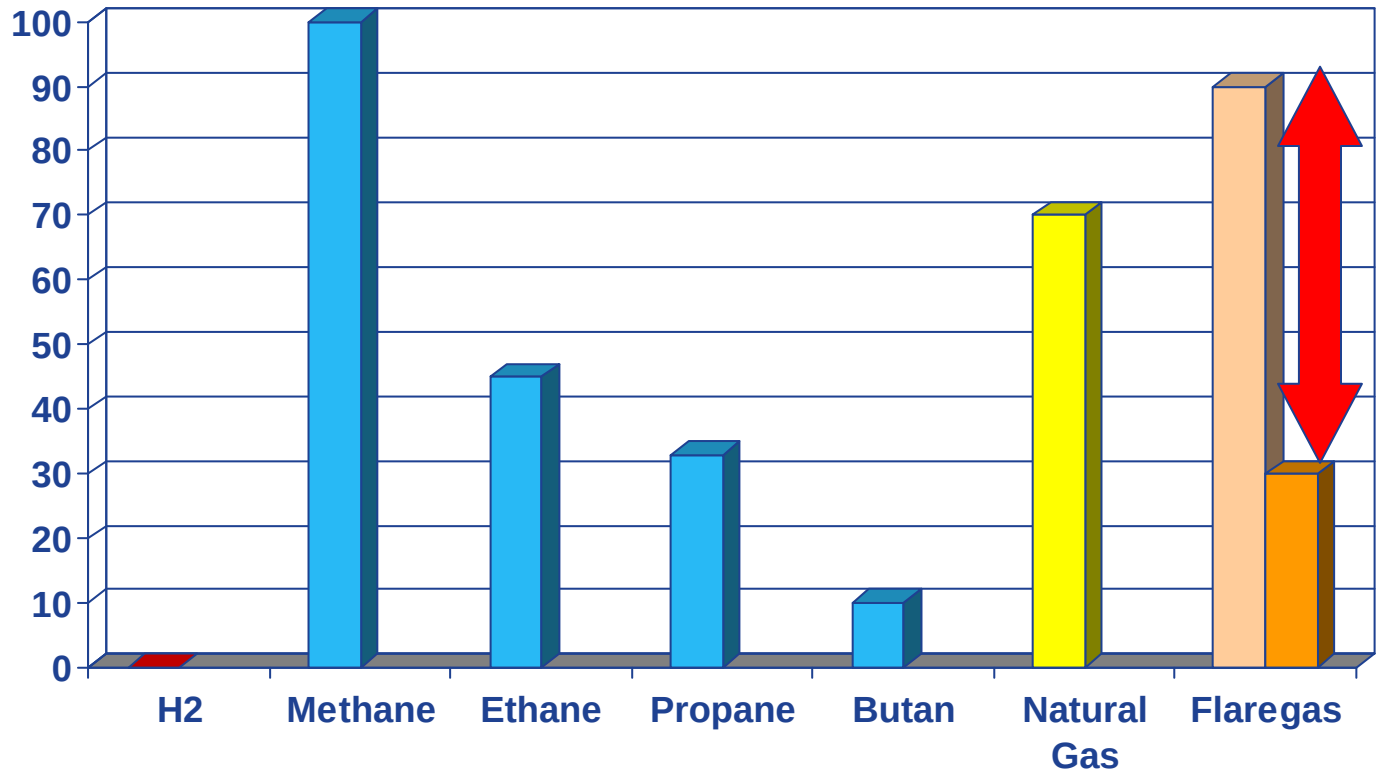
Characteristics of Flare gas

Gas composition:	**main constituents**
• Methane CH_4	40 - 90%
• Ethane C_2H_6	2 - 20%
• Propane C_3H_8	1 - 15%
• Butane C_4H_{10}	1 - 10%
• Carbondioxid CO_2	1 – 40%
• Methane numbers:	30 - 65
• Lower Heating Value [kWh/Nm³]:	11 - 20
• In case of high contents of H2S, desulphurization is needed	

Associated gas varies in composition & flow over time

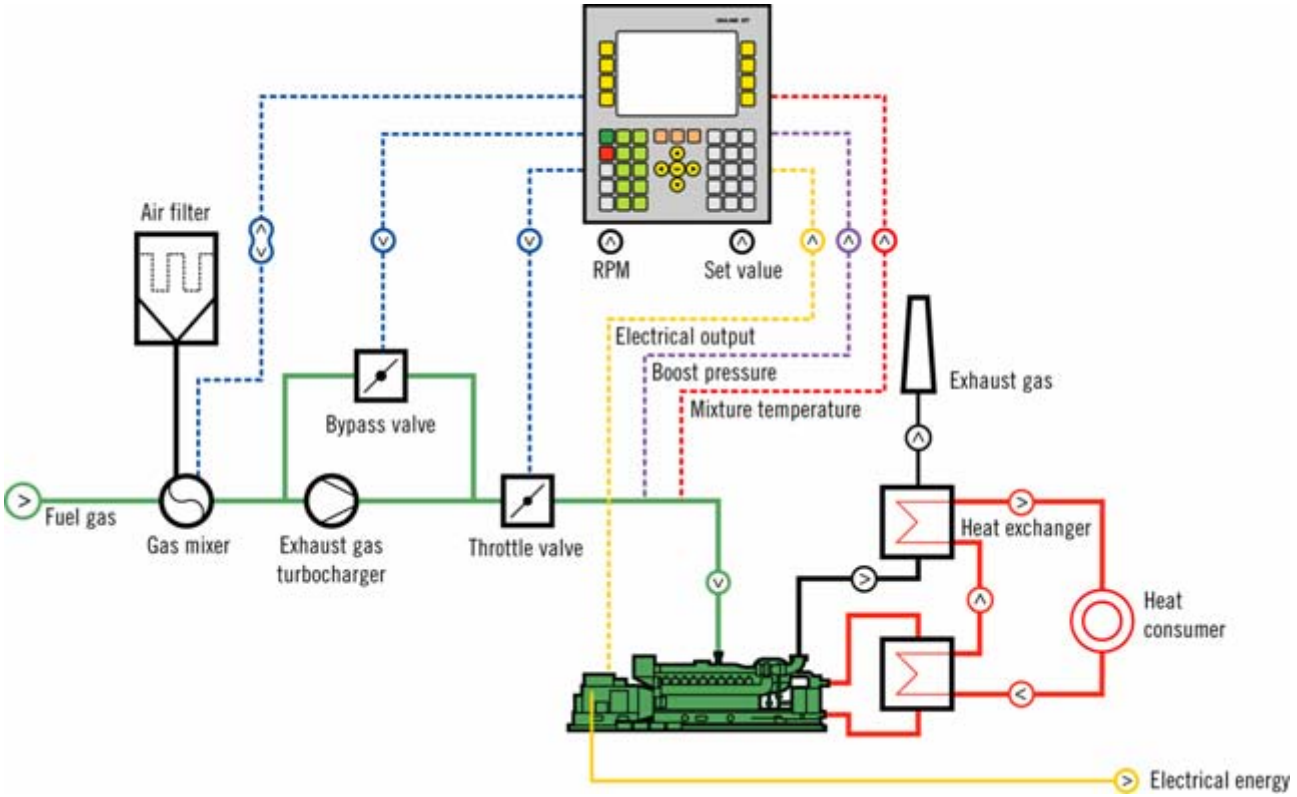
» High flexibility in operation and control necessary

Methane Number



Methane Number is the main limiting factor for the achievable output of Flare gas Applications

LEANOX® - Lean-burn combustion control



- Sensors in non critical measurement ranges (pressure, temperature, deposits...)
- Reliable and durable compliance with exhaust emission limit at changing operational conditions (fuel gas compositions...)
- Controlled combustion and subsequently controlled stress of various components (valves, cylinder heads, spark plugs...)

Main requirements for applications in the oil and gas industry

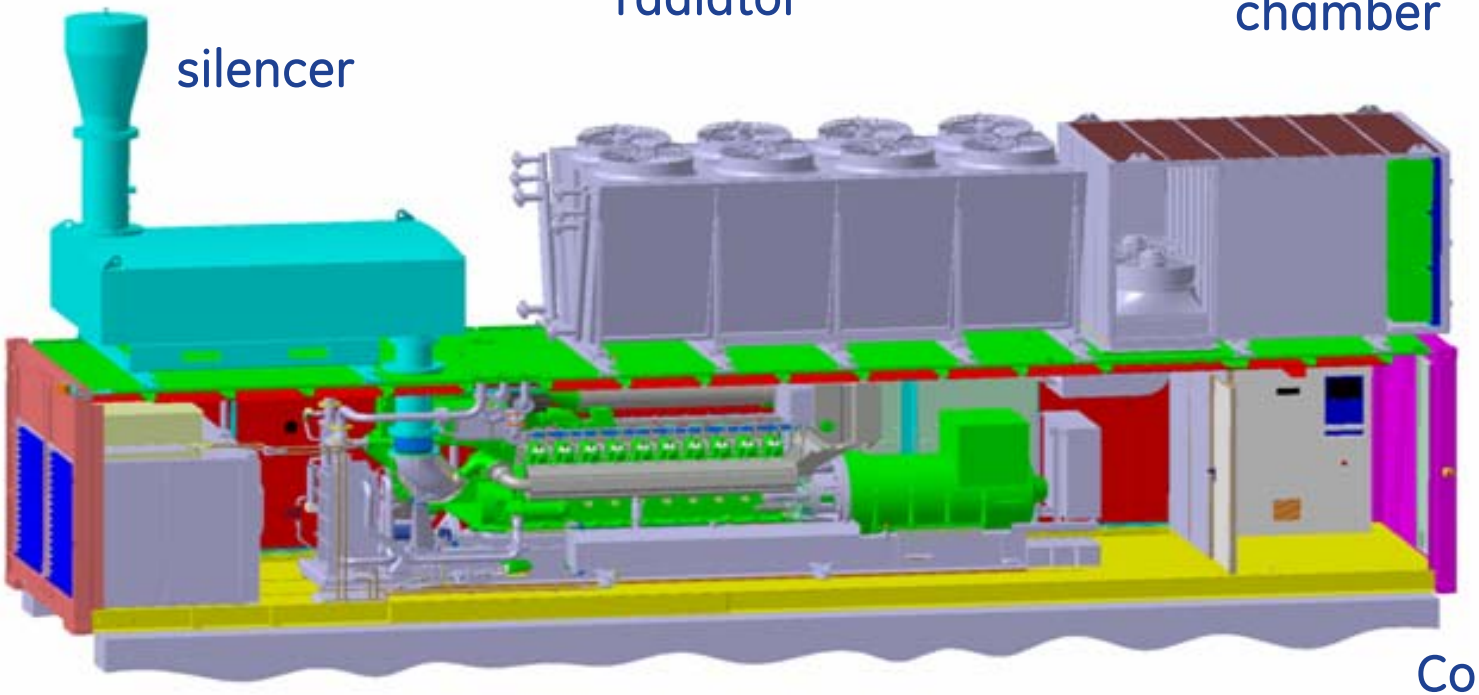
Operation with associated petroleum gas (flare gas)

- Fuel flexibility
- Stable island operation
- Operation at low Methane numbers

Operation in hazardous environment

- Gas engines can not be operated in ATEX zones 0-2
- Enclosures must be built accordingly
- Ventilation systems to ensure CH4 dilution
- Spark arrestors in exhaust gas systems

Container design concept

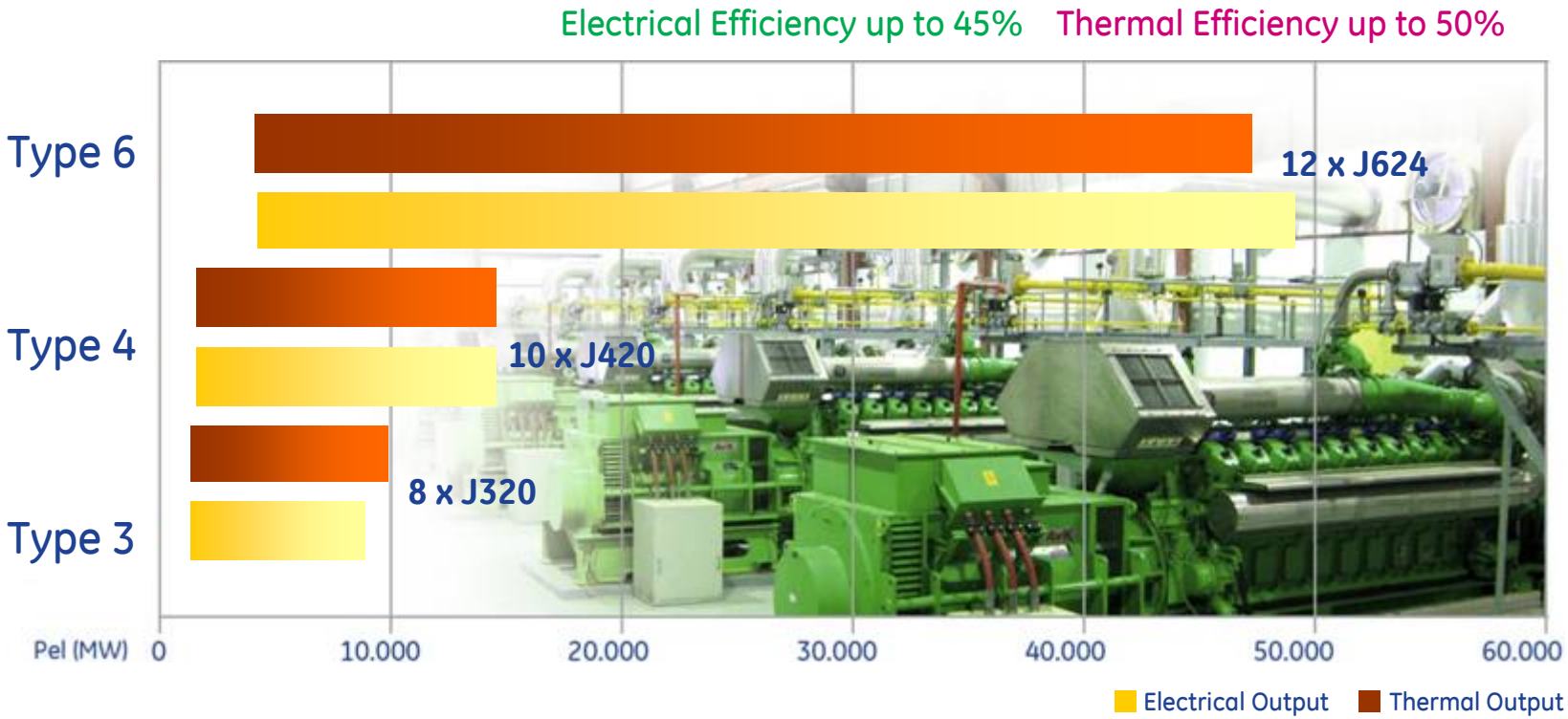


Features of Jenbacher container-concept

- Pressurized ventilation => good dilution in case of gas leakage (safety concept)
- All components on the container roof =>small footprint
- Separated control room
- Optimisation of air flow for best cooling results
- Minimal number of interfaces
- Sound attenuation levels of 65 dB(A) and lower possible
- Best accessibility for maintenance via double doors
- Special versions for full heat recovery (cogeneration) available

Power plant output range

Product line 2010 (50Hz) – Natural gas NOx ≤ 500 mg/m³$_N$



Additional benefits with multiple engine approach

- High fuel efficiency: engines constantly running at nominal load and efficiency
- Availability and reliability: stable electrical output
- Flexibility: scheduled maintenance in sequence

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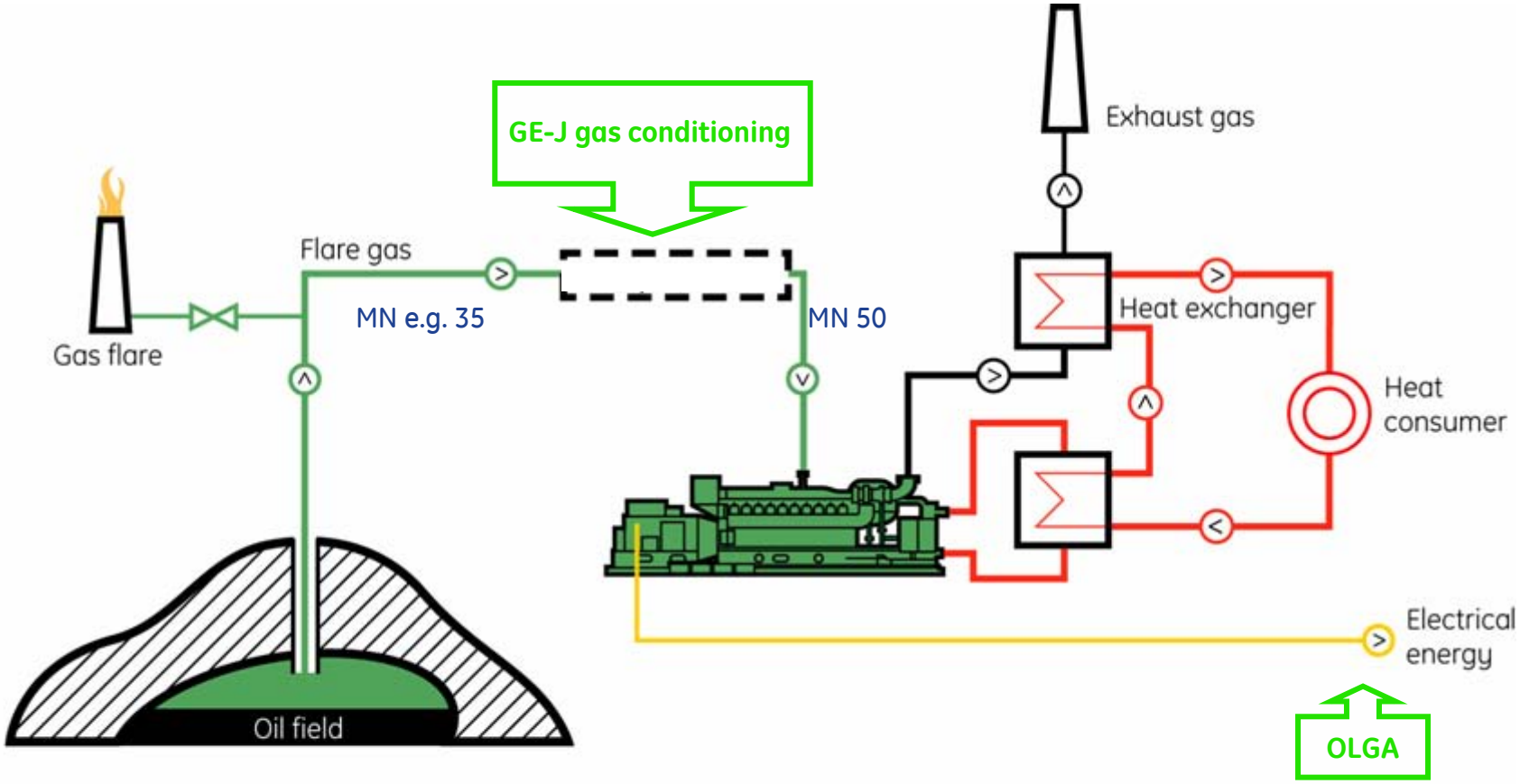
GE–J APG Solutions



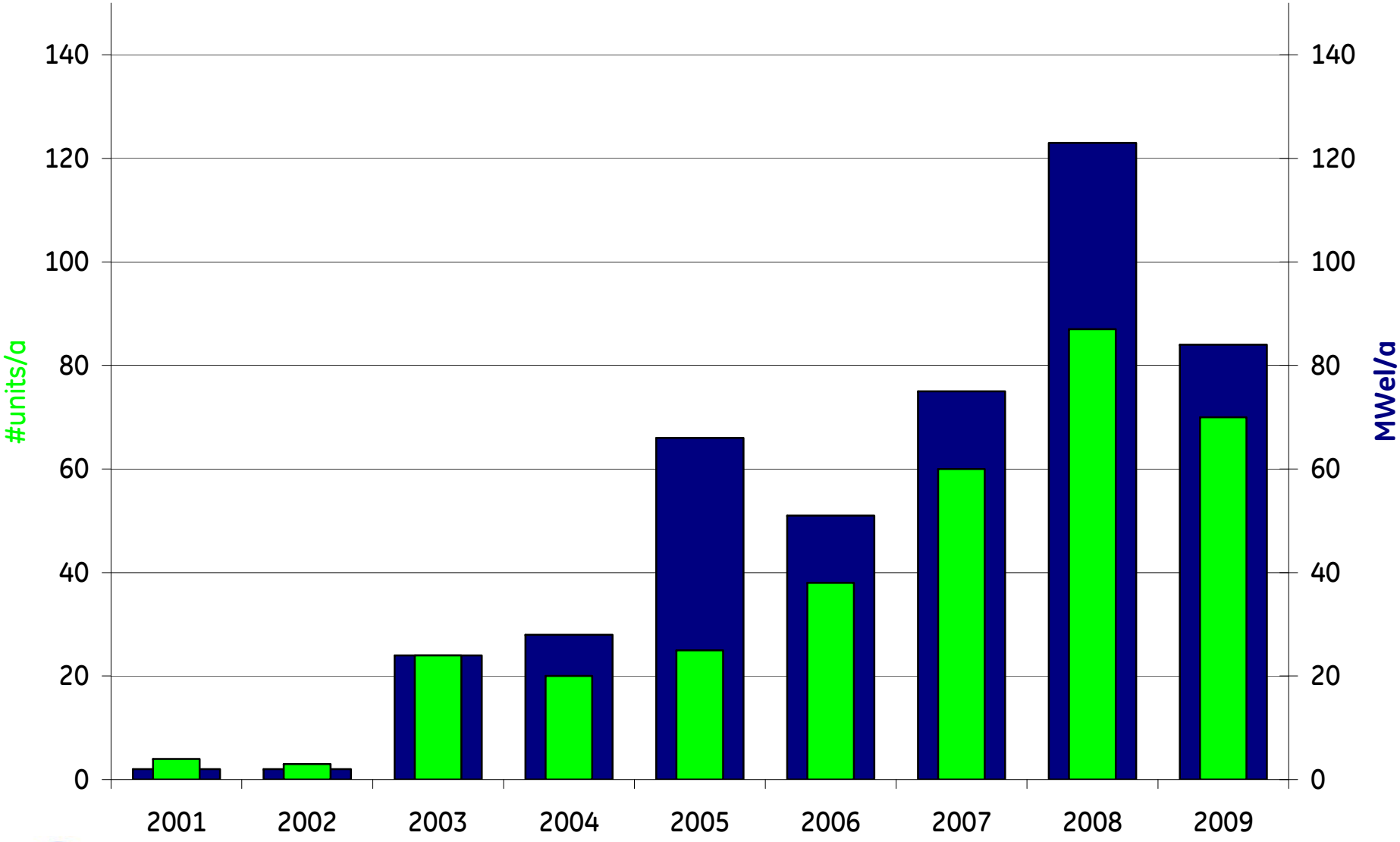
- Safe removal of condensate is very important
- Additional removal of higher HCs beneficial
- Load management necessary for island mode improvement

Typical standard condensate removal

Reference List Associated Petroleum Gas

Customer	Project	Deliv. Date	Country	Town	Type	P_{el} [kW]	P_{therm} [kW]
Petrobras	Rio Ventura	09/96	BRA	RioVentura	1 JGS 612 GS-S.LC	1,164	1,708
Uraineftegas	Uraineft 1-6	12/03	RUS		3 JMC 320 GS-S.LC	6,342	3,891
JF SECCO S.A.	Secco 1-15	08/04	ARG		15 JGS 420 GS.S.L	21,240	13,350
Belorusneft	Belorusneft 1-7	03/05	BLR	Gomel	7 JGS 620 GS-S.LC	21,000	25,200
Roc Oil	Cliff Head	08/05	AUS		3 JGS 612 GS-S.L	4,905	5,271
Water Tech Ltd	BG Central Block	03/06	TTO	Tobago	1 JGC 316 GS-S.L	760	0
Goloil	Goloil 3 1+2	05/06	RUS		2 JGC 320 GS-S.L	1,818	0
Surgutneftegas	Talakanskoe 1-11	01/06	RUS		11 JGC 320 GS-S.L	11,297	0
Nobel Oil	Nobel Oil 1-5	08/06	RUS		5 JGC 320 GS-S.L	3,800	0
Petrom	Off Shore	06/06	ROM		2 JGS 620 GS-S.L	4,408	0
Ecopetrol	SOH Ecopetrol	11/06	COL		5 JGS 620 GS-S.L	15,000	0
EWPL	EWPL CP 1-10	11/07	IND		21 JGS 420 GS-N.L	22,764	0
CAIRN Energy	Northern Stream	2008	IND		35 x JGC 420 GS-S.L	38,500	0
MONOLIT	Shapinshkoe	04/09	RUS		12 x JGC 420 GS-S.L	14,280	0
ENI	ENI Pakistan	04/09	PAK		10 x JGS 312 GS-N.L	3,500	0
					321 Engines	**453 MW**	

Jenbacher engines sold in APG-applications



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1. Jenbacher Flare gas installation in Brasil

Rio Ventura/Brasil

1 x JGS 612 GS-S.LC

Electrical Output: 1,164 kW

- Ventilation/air conditioning system for the Interface and Control Panel
- special alternator design for air temperatures > 40°C (heating device to avoid condensation problems)
- Ignition Coil ventilation system
- special turbocharger tuning

Commissioning 1996

1. Jenbacher flare gas installation Russia

Climate: arctic winter down to -50°C, heavy snowstorms

5 x JMC 320 GS-S.L

Electrical Output: 3.8 MW_{el}

Thermal Output: 2.1 MW_{th}

Gas composition:

CH_4 … 81.8 %

C_2H_6 … 6.8 %

C_3H_8 … 7.5%

C_4H_{10} … 1.0%

N_2 … 1.9%

CO_2 … 1.0%

LHV = 11.7 kWh/Nm³

MN = 63.9

Provides heat & power using associated gas from the oil production site near the Arctic Circle … avoids the need for **8M liters of diesel** annually

Flare gas installation Russia
Sibneft-Noyabrskneftegas

Sibneft

10 x JGC 320 GS-S.L

Electrical Output:
10,400 kW

Commissioning:

September 2003

Flare gas installation Argentina

This installation runs together with more than 20 engines an other site in island mode, providing the power for oil production equipment.

J.F. Secco

15 x JGS 420 GS-S.L

Electr. Output: 21,225kW

Gas composition:

CH_4 ... 48.5 %

C_2H_6 ... 2.4 %

C_3H_8 ... 1.0%

C_4H_{10} ... 1.1%

N_2 ... 1.5%

CO_2 ... 46.0%

Commissioned: 2004

Flare gas installation Colombia, Oxy - Caricare

Climate: tropical 35°C with 90% rel. humidity

OXY - Caricare

9 x JGC 320 GS-N/S.L

Electrical Output: 9,567 kW

Gas composition:

CH_4 ... 41.5 %

C_2H_6 ... 7.0 %

C_3H_8 ... 9.0%

C_4H_{10} ... 6.0%

N_2 ... 6.5%

CO_2 ... 27.5%

Commissioning: 2007

Flare gas installation off shore, Black Sea, Petrom

Romania, Black Sea

2 x JGC 620 GS-S.L

Electrical Output:
2 x 2,204 kW

Commissioning:

June 2007

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Pipeline heating by Skin heat effect

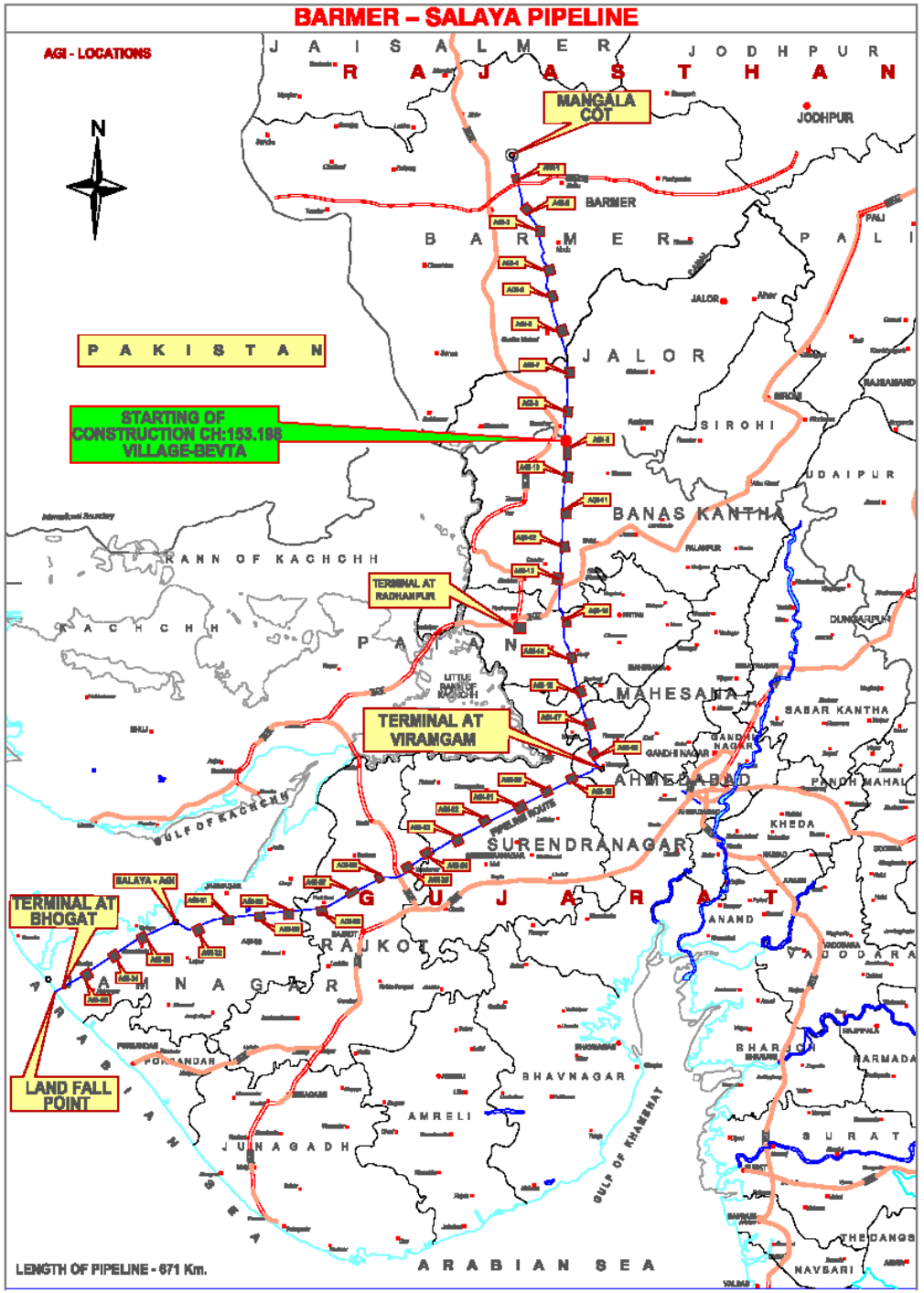
CAIRN Energy/IND

35xJGS 420 GS-N.L

Electrical Output: 39,095 kW

Commissioning:

Sept starting 2009



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Pipeline heating CAIRN Energy/IND

CAIRN Energy/IND

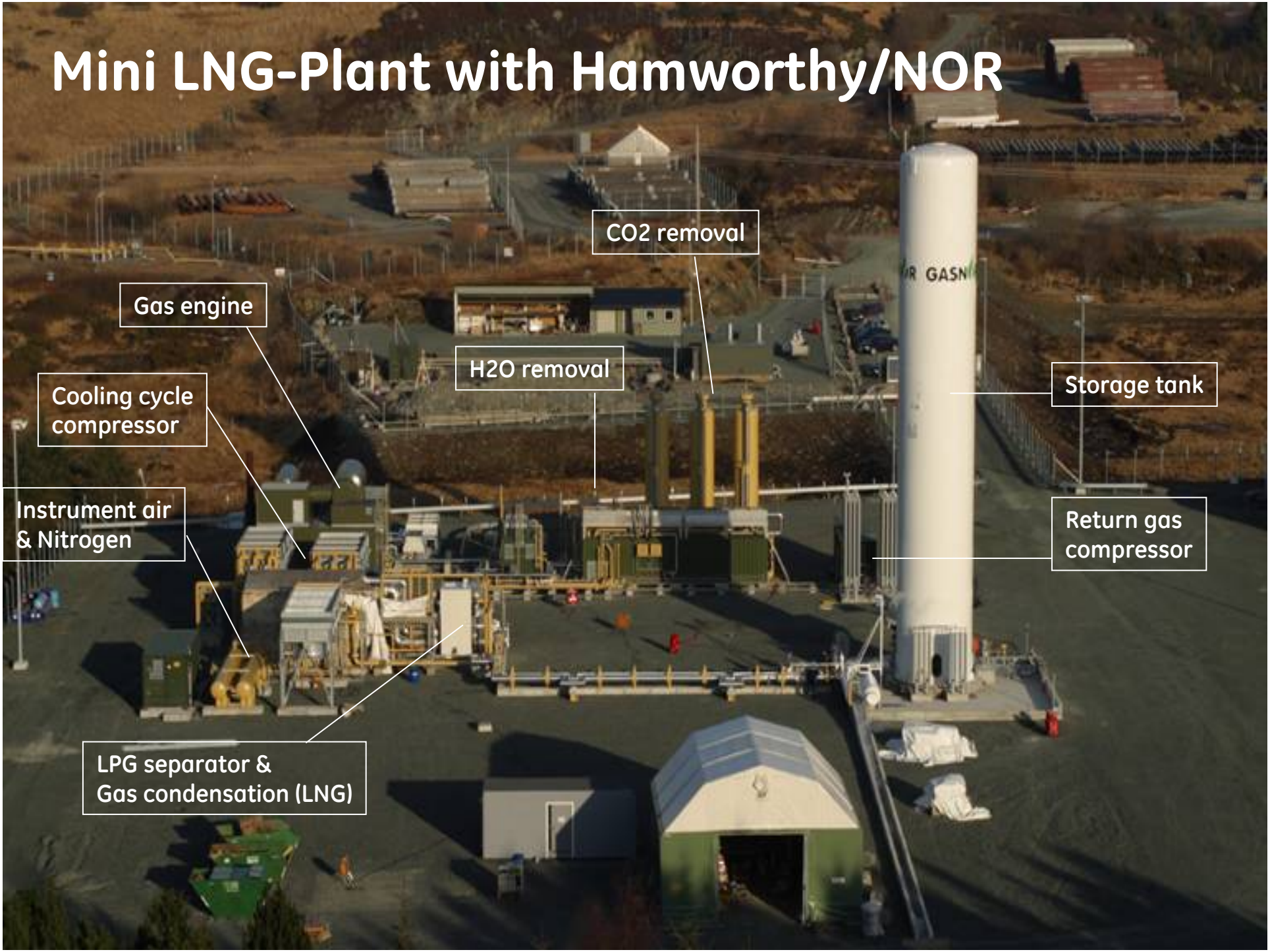
35xJGS 420 GS-N.L

Electrical Output:
39,095 kW

Commissioning:

Sept starting 2009

Mini LNG-Plant with Hamworthy/NOR



Questions