Waste heat recovery: Alfa Laval Micro

Uday Mahajani
Pratik Lele

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Waste heat source

- Waste Heat:
- The heat generated due to combustion or Chemical reaction and dumped into atmosphere, which can be used for useful purposes to generate energy

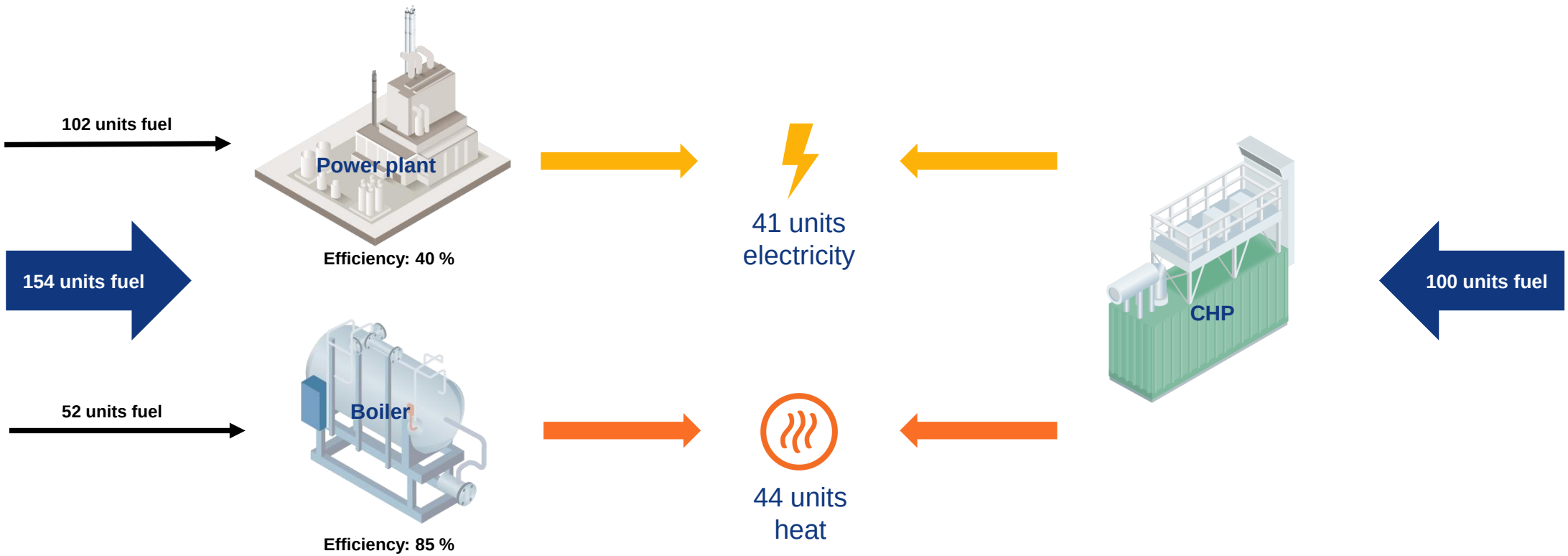
- Sources:
  - Flue Gases
  - Vapour streams
  - Liquid effluents

CHP vs conventional generation

– Overall efficiency

Conventional generation

Combined Heat and Power



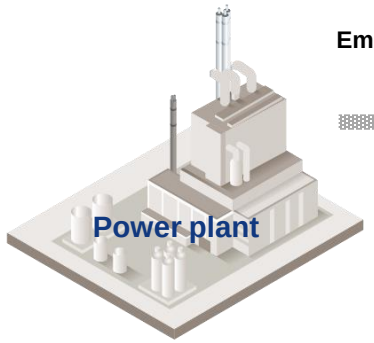
55 %	Overall efficiency	85 %

CHP vs conventional generation

– CO_2 emissions, example 5 MW natural gas

Conventional generation

Natural gas

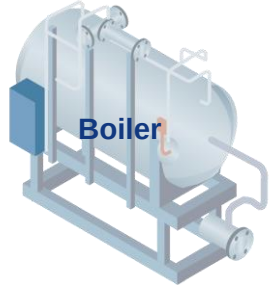


Emissions: 32 000 ton CO_2

Efficiency: 40 %

35 000 MWh

Natural gas



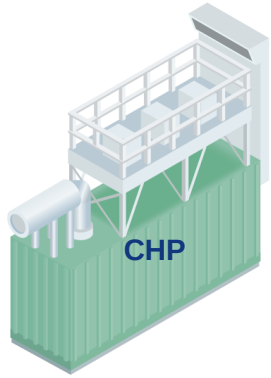
Emissions: 13 000 ton CO_2

Efficiency: 85 %

37 600 MWh

Combined Heat and Power (5 MW_e)

Emissions: 23 000 ton CO_2



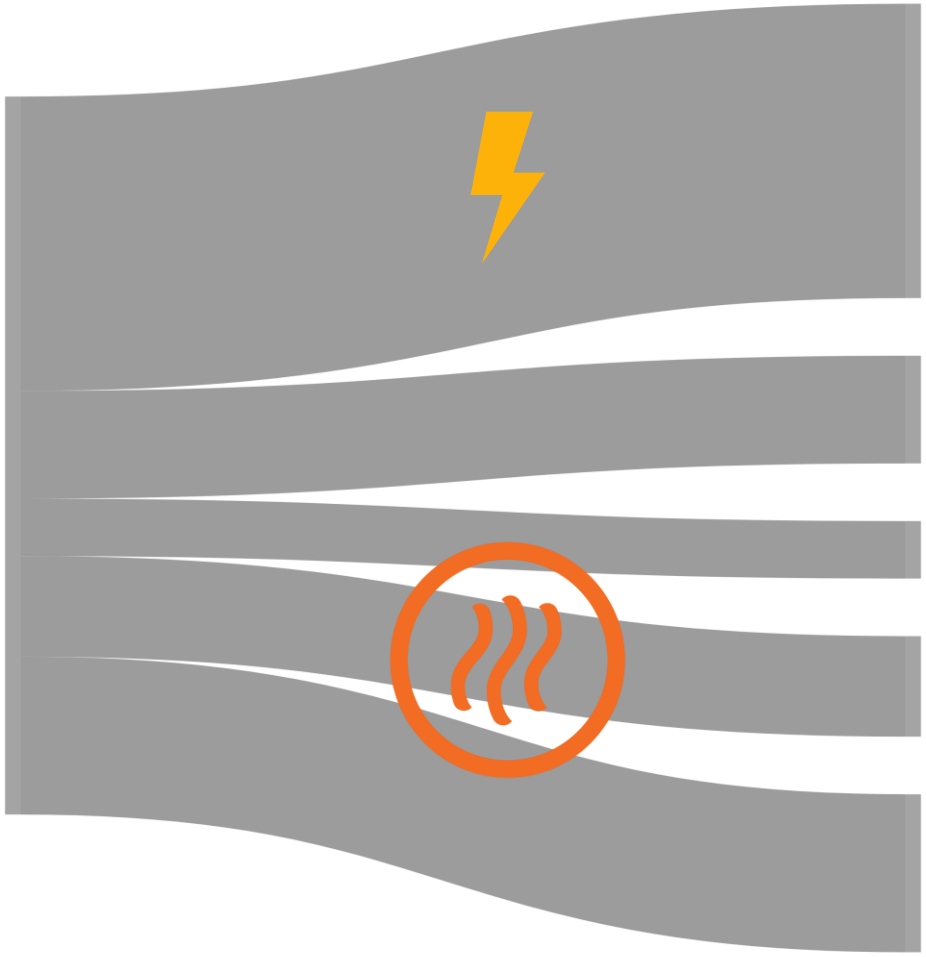
Natural gas

45 000 ton/year	Total CO_2 emissions	**23 000 ton/year**

Energy balance

– Engine CHP

Fuel 100%



41% Electricity

15% Heat loss (mainly from exhaust outlet)

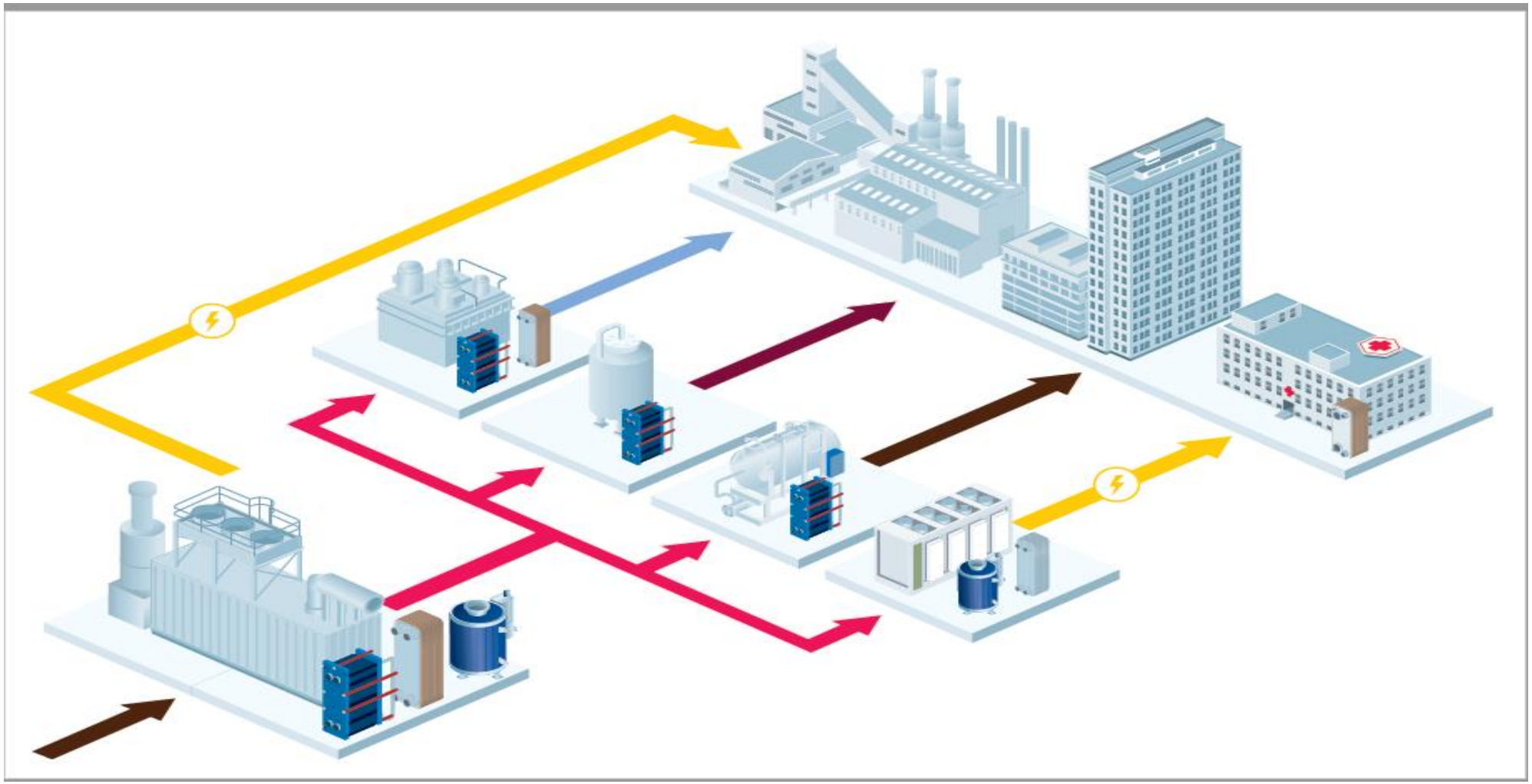
8% Lube oil (LT)

14% Jacket water (HT)

22% Exhaust gas

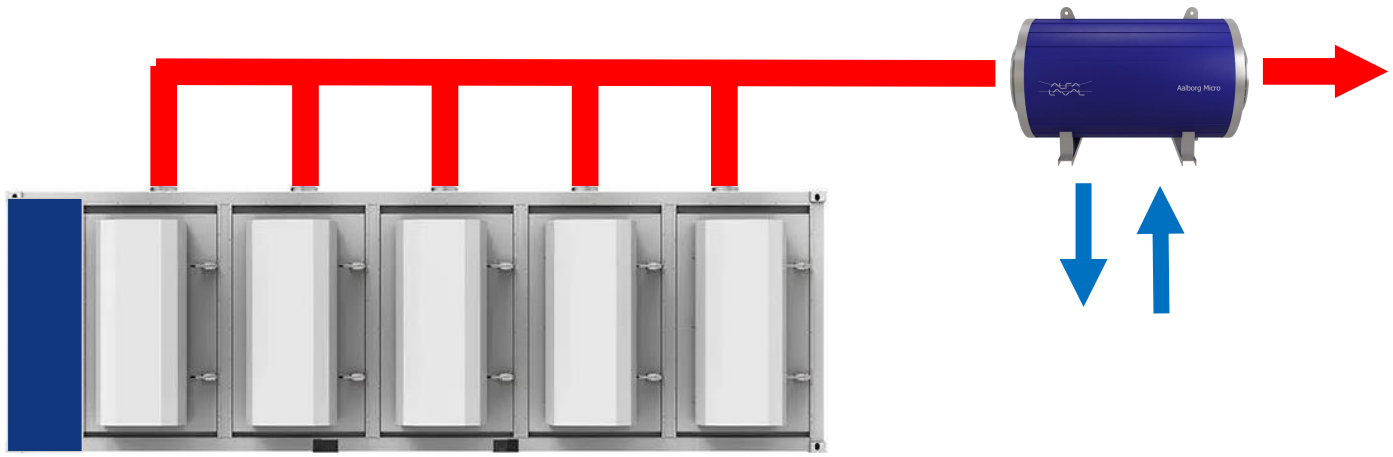
44% Recovered heat

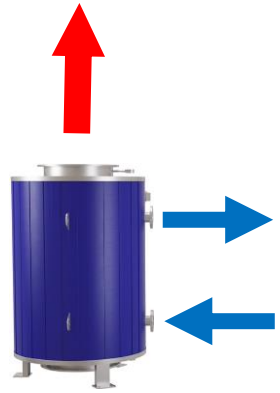
CHP applications

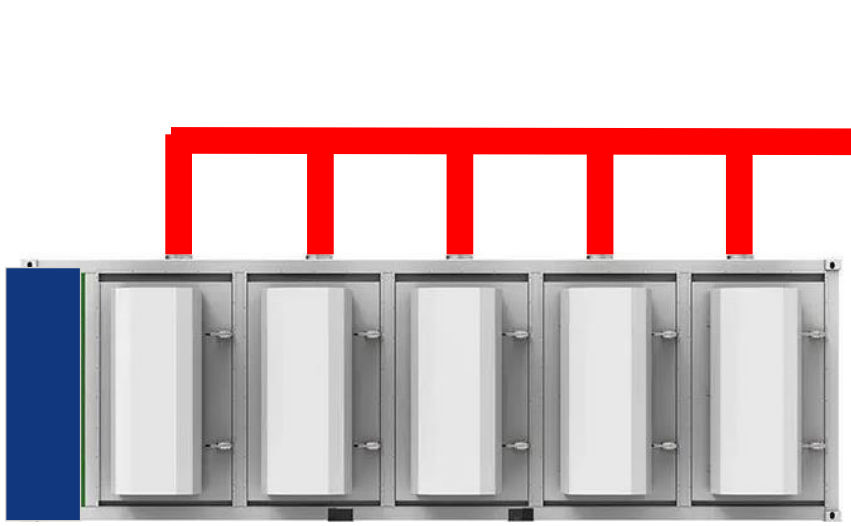


Heat Recovery for Hot Water Generation

– Horizontal & Vertical installation (Gas Turbine)

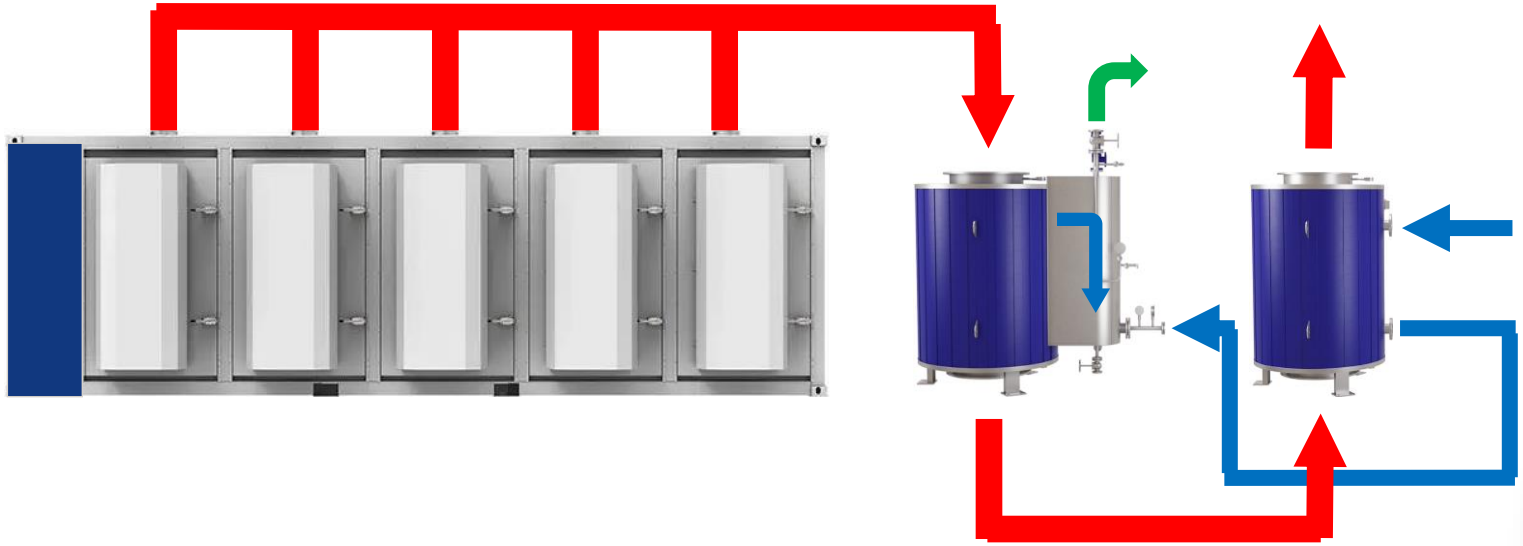




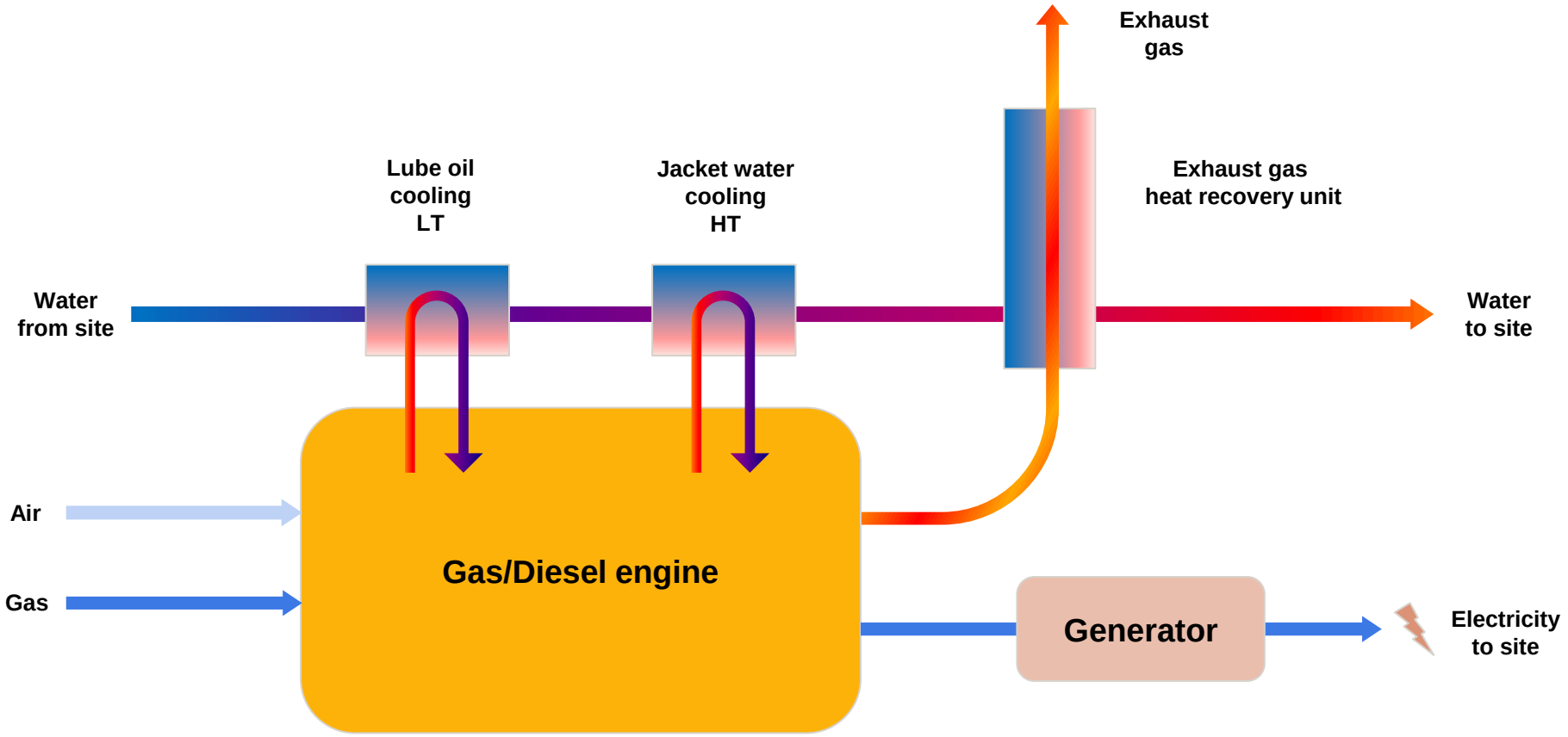


Heat Recovery for Steam Generation

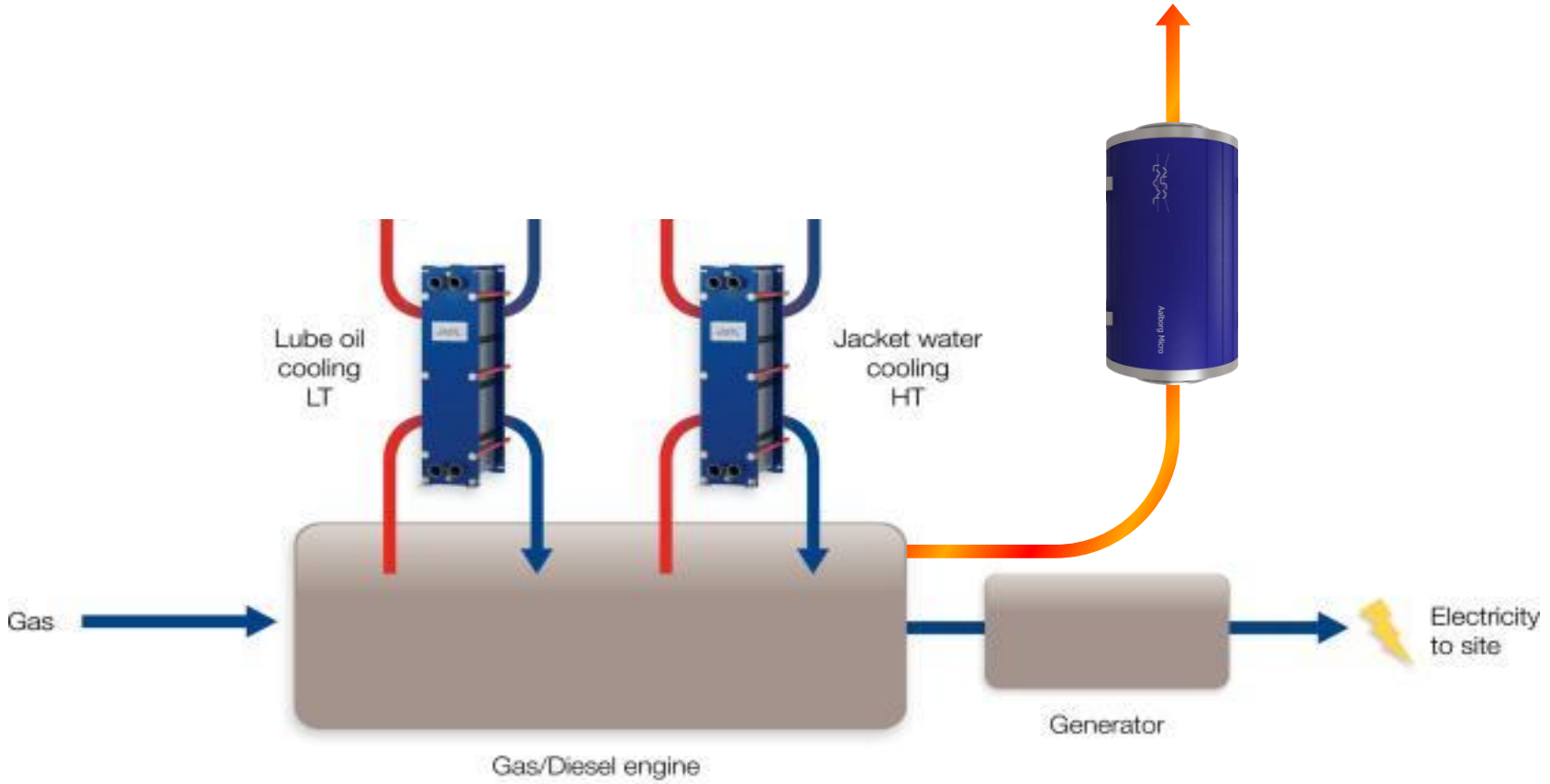
– Evaporator with Cyclone + Economizer (Gas Turbine)

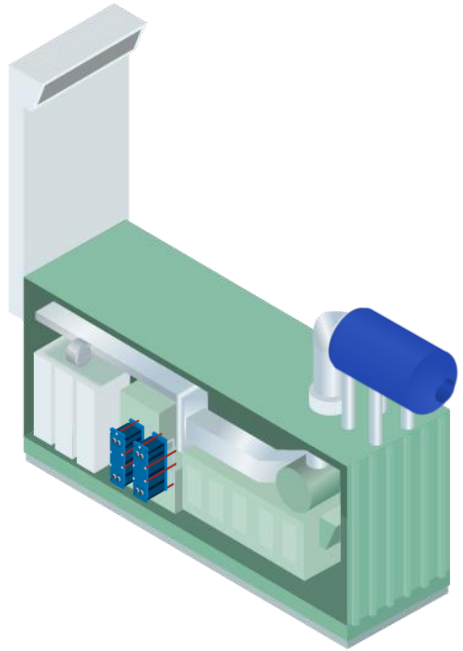


Heat recovery positions



Heat recovery positions

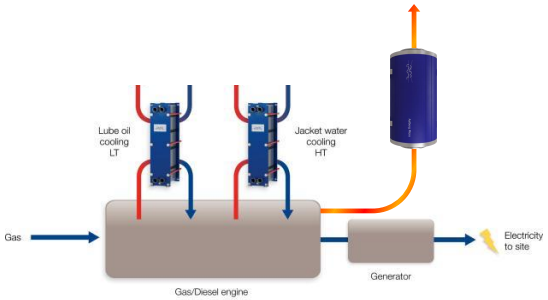




Our heat recovery portfolio for engine CHP

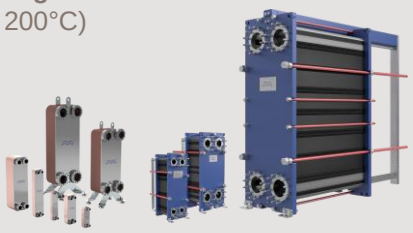
– And typical design data

Heat recovery position	Product	Media (prim / sec)	Typical primary inlet	Typical primary outlet	Typical primary pr. drop
LT Lube oil loop	GPHE or BHE	Glycol / Water	60-80 °C	50-70 °C	50-90 kPa
HT Jacket water loop	GPHE or BHE	Glycol / Water	90-105 °C	80-95 °C	
Exhaust gas	Micro or GTL	Exhaust gas / Water-Oil-Steam	300-550 °C	120-180 °C	1000-3000 Pa



Alfa Laval WHR portfolio

– Applications

Temperature classification	Waste heat source	Commercial technologies
High grade heat (> 450°C) 	Flue gas from furnaces and incinerators	• Waste heat boilers and steam turbines
Medium grade heat (200 – 450°C) 	Flue gas from engine, gas turbine and fuel fired boiler exhaust, heat treatment furnaces, ovens and processes.	• Waste heat boilers • ORC • District heating • Space heating • Preheating
Low grade heat (< 200°C) 	Hot air and gas from boilers, ovens and processes. Hot liquid from steam condensate, processes and cooling water.	• ORC • Preheating (economizers and recuperators) • Space heating • District heating

Micro and GTL are enablers for high temp WHR

Our traditional market for waste heat recovery

Alfa Laval Micro

The Micro is a compact exhaust gas heat exchanger designed for waste heat recovery from small engines as well as from small gas turbines and clean process flue gas. It can also be used as an economizer/condensing economizer for gas or diesel fired boilers.

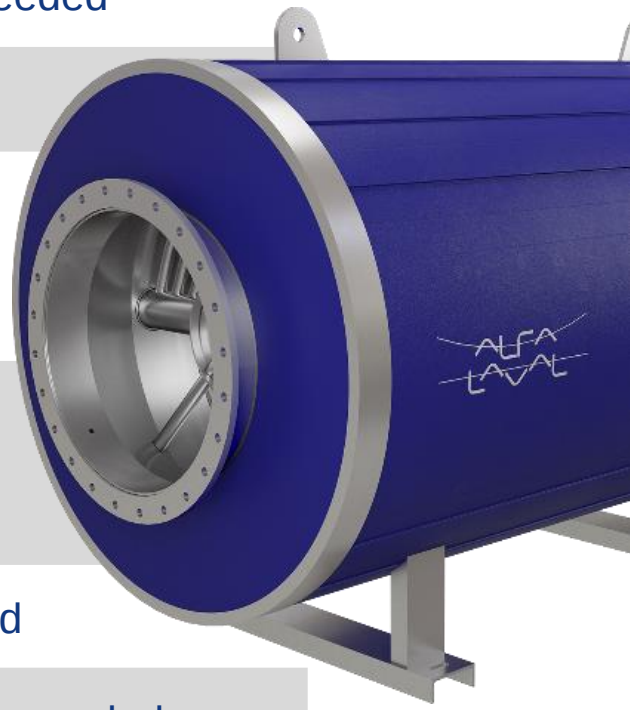
Alfa Laval Micro

– Technical video

Why Micro?

– Micro vs Conventional Technology

	Alfa Laval Micro	Shell & Tube (conventional S&T design)
By-pass	No external by-pass needed	100% external by-pass needed
Dry-run	Dry-run possible/can be used for pyrolysis cleaning of the heating surface	Not possible
Integrated cleaning device	Can be supplied with an integrated cleaning device making it possible to clean the heating surface either by air, steam or water during operation	Normally not an option
Integrated regulation damper	Includes an integrated regulation damper by which a part of the exhaust gas can be led outside the heating surface e.g. for regulation purposes	Normally not an option
Insulation	Integrated 150 mm insulation	External insulation needed
Noise reduction	-10 dB (Lwp) average, reduction over entire sound spectrum	Additional silencer usually needed



Micro

- Exhaust gas heat exchanger/ steam generator

Technical Data

Heat exchanger

Exhaust gas side:

Maximum inlet temperature	600 °C (dry run 530 °C)
Minimum outlet temperature	Depending on engine fuel and exhaust gas composition

Media side:

Through the tubes	Water, TEG or TFO
Quantity	Max. 160,000 kg/h
Maximum operating pressure/design pressure	39 bar(g)/42 bar(g)
Maximum outlet temperature, water	247 °C
Maximum outlet temperature, TEG	247 °C
Maximum outlet temperature, TFO	340 °C

General:

Standard norm (Industrial)	PED (type approved) or GB
Class (Marine)	DNV/GL/ABS/LLOYDS etc.
Test pressure carbon steel	110 bar(g)
Test pressure stainless steel	102 bar(g)

Technical Data

Steam generator

Exhaust gas side:

Maximum inlet temperature	600 °C (dry run 530 °C)
Minimum outlet temperature	Depending on engine fuel and exhaust gas composition

Media side:

Through the tubes	Water/Steam
Quantity	200 to 3,000 kg/h
Maximum pressure	42 bar(g)

General:

Standard norm (Industrial)	PED (type approved) or GB
Class (Marine)	DNV/GL/ABS/LLOYDS etc.
Test pressure carbon steel	110 bar(g)
Test pressure stainless steel	102 bar(g)

Technical Data

Geometry

Weight incl. insulation	400 – 3,900 kg
Diameter (incl. insulation)	950 to 1,870 mm
Height (incl. insulation)	1,700 to 2,800 mm
Media inlet/outlet header (flange)	DN100
Exhaust inlet/outlet header (flange - DIN86044)	DN450 to DN1000
Insulation	150 mm

Technical Data

- Highly efficient
- Compact and low footprint
- Utilizing waste heat from flue gases to improve thermal efficiency and to generate cost savings
- Highly applicable to be installed after small gas and diesel engines as well as gas turbines
- For engines/gas turbines using either gas, diesel oil or HFO as fuel (engines/turbines having a capacity of up to approx. 4,000 kWe) as well as for clean process flue gas applications & as economizer for gas fired industrial boilers

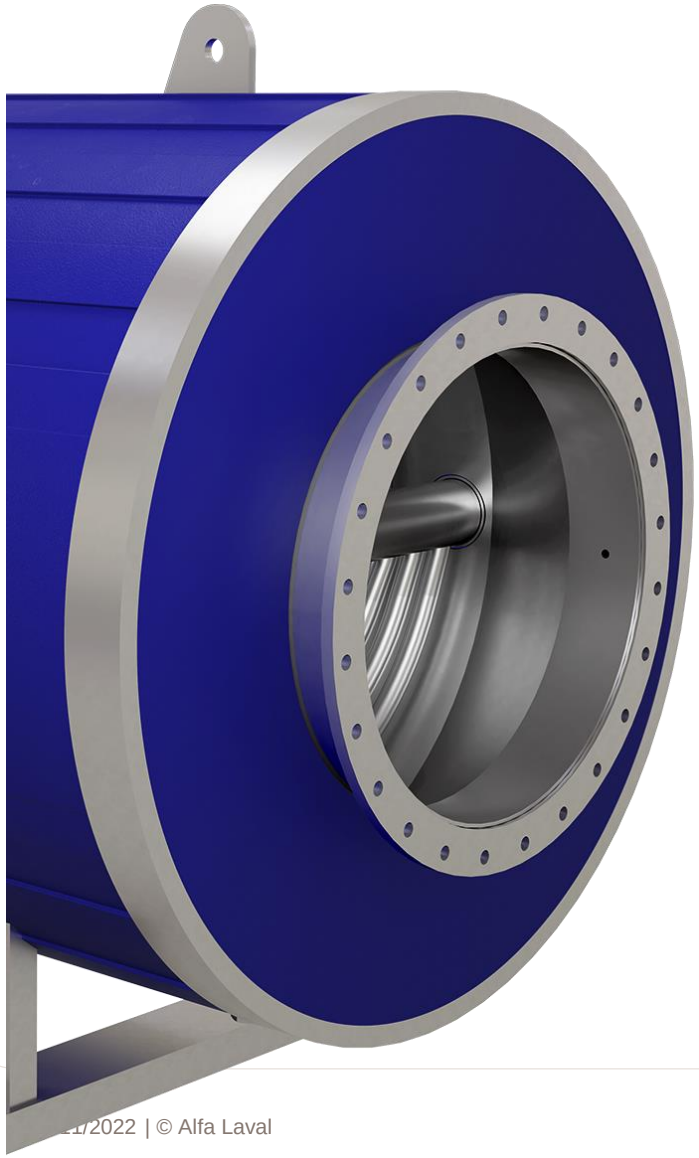
Technical Data

- Suitable for a number of various medias such as hot water, TEG and TFO as well as for generation of steam.
- Characterized by having a very low inertia
- Reaches operational temperature within minutes and reacts extremely fast if adjusted or at load changes.
- Designed with an integrated regulation damper ensuring that a certain amount of the flue gas, can be led outside the heating surface, providing unique possibilities for adjustments depending on required output.

Technical Data

- Includes internal regulation damper as well as electrical actuator
- Natural circulation (steam circulation pump can be avoided)
- Both outdoor & indoor installation possible
- Integrated cleaning device for compressed air, water or steam as optional
- No need for external by-pass - dry-run operation possible (used for pyrolysis cleaning)

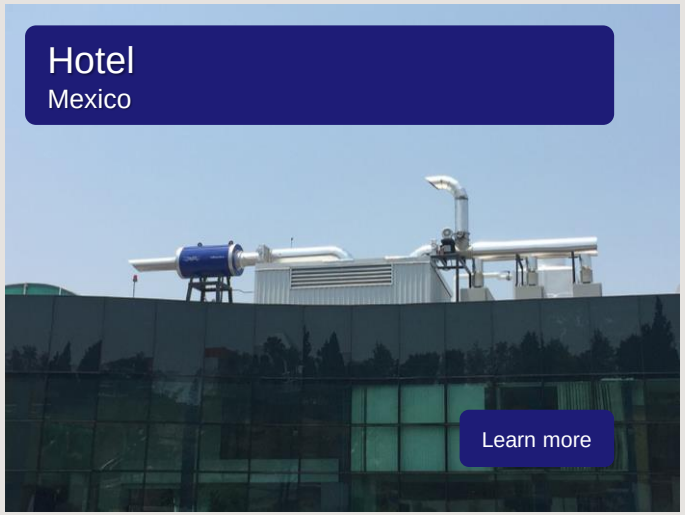
Technical Data

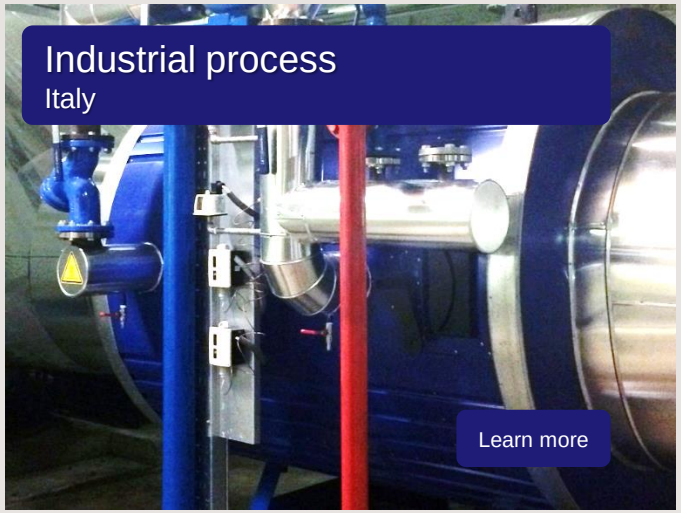


Arrangement

- Comes with a heating surface consisting of a number of co-axial tubes, placed in a vertical or horizontal cylindrical shell plate

Selected references Alfa Laval Micro





Hotel Industry – DTC Ecoenergia, Mexico

Aalborg Micro 210

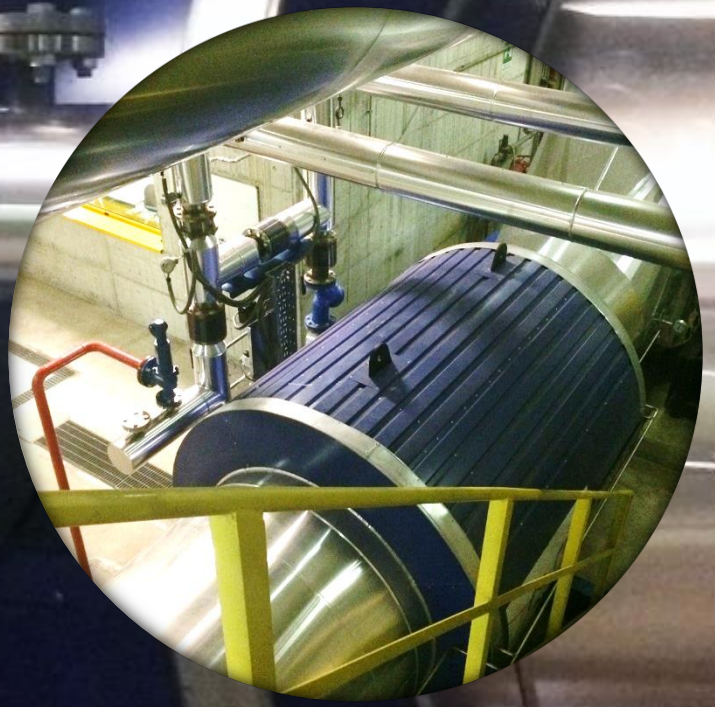
Hot water application after gas engine

Aalborg Micro reference menu

Industrial process – Innowatio, Italy

Aalborg Micro 814

Hot water application after gas engine



Aalborg Micro reference menu

District heating – MAN Diesel & Turbo, Denmark

MAN Diesel & Turbo

Aalborg Micro 714

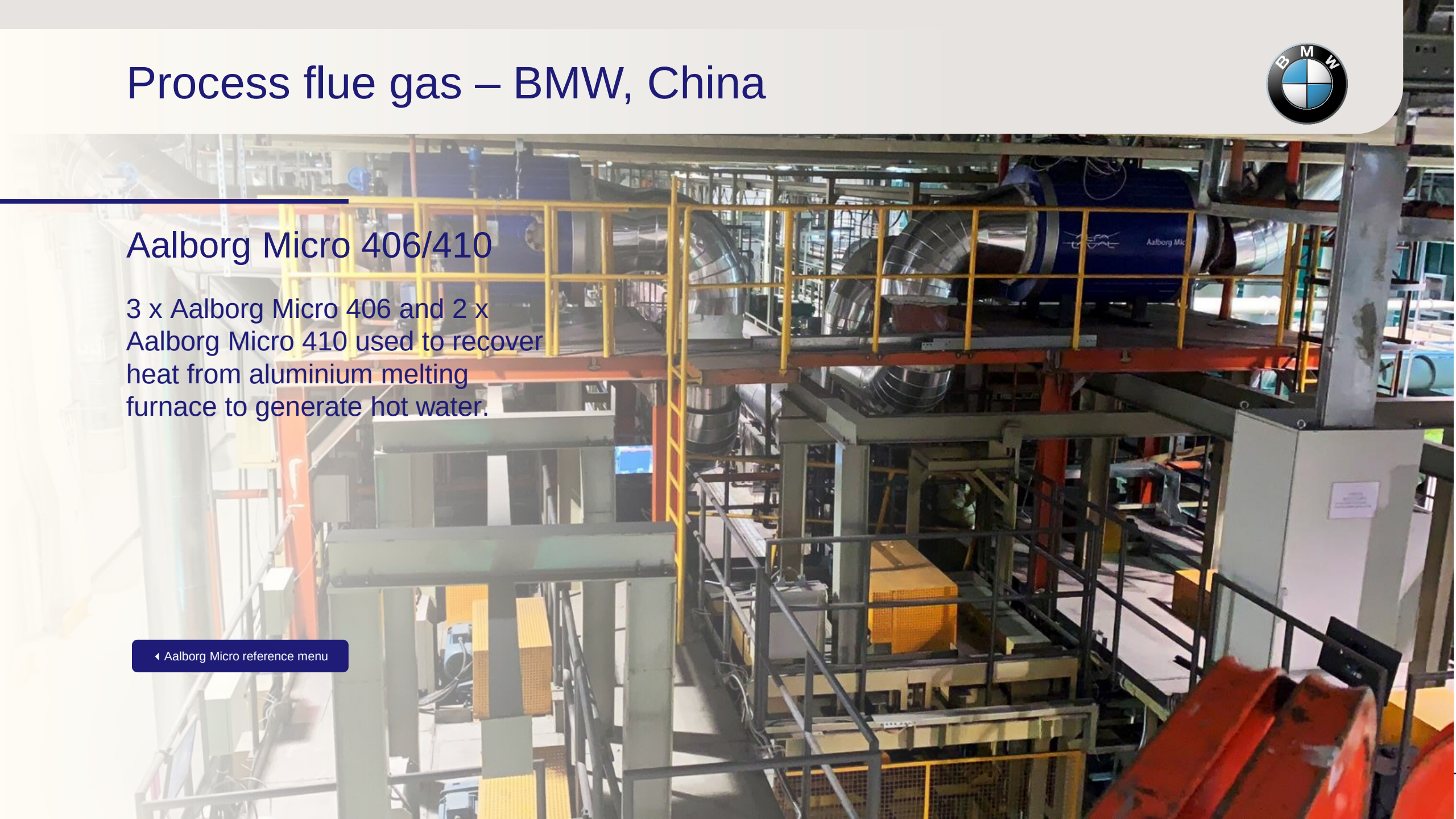
Hot water application after multi fuel engines

Aalborg Micro reference menu

Process flue gas – BMW, China

Aalborg Micro 406/410

3 x Aalborg Micro 406 and 2 x Aalborg Micro 410 used to recover heat from aluminium melting furnace to generate hot water.



Aalborg Micro reference menu

Power Generation – China

Aalborg Micro 422

11 x Micro 422 with cyclone
for steam production

Aalborg Micro reference menu

Boosting electricity production with a smaller CO_2 footprint

– Southeast Asia

Alfa Laval Micro recovers waste heat from the engines' exhaust gas streams, enabling production of clean electricity from the ORC (Organic Rankine Cycle) modules via hot water. This offers a sustainable solution in situations/climates where the waste heat is not required for other heating purposes.

9 Mio m³
of gas saved each year

5 MWel
produced fuel-free electricity

100 000 people
supplied with sustainable electricity

READ MORE >

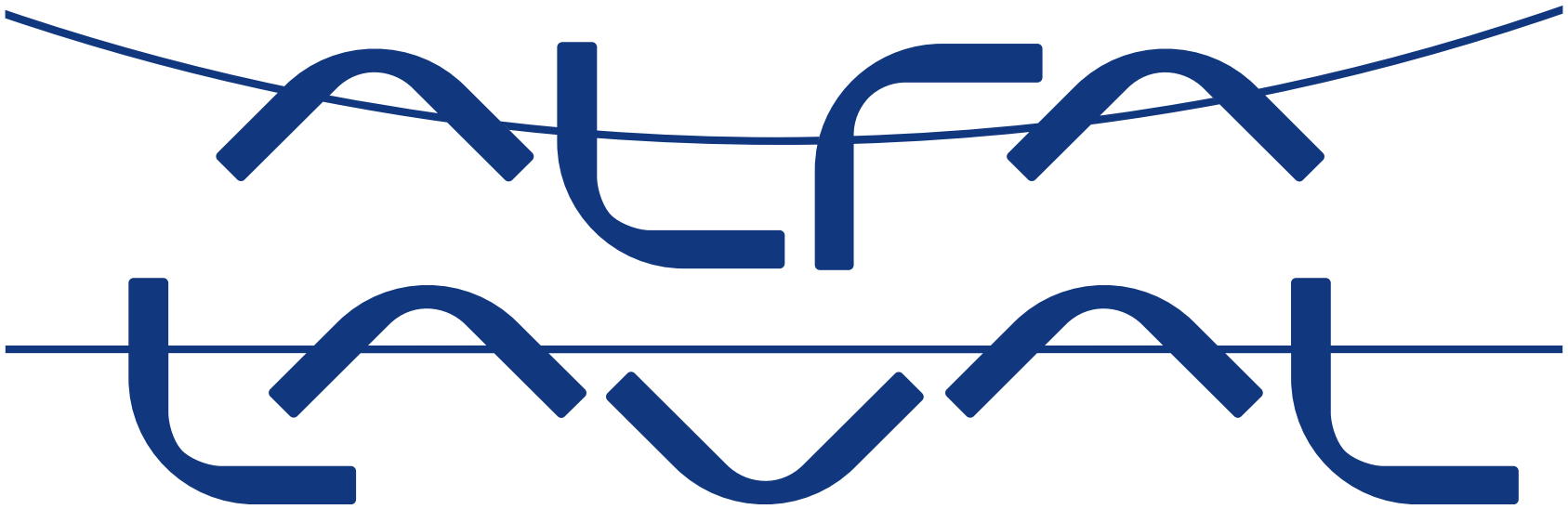
“..said by customers about the Micro…”

“…significantly cheaper than our usual supplier for this type of system”
TLV Euro Engineering, UK

“…there are not many products out there that do what the Micro does”
Aggreko, UK

“…it’s the single most interesting thing I’ve ever seen in the area of steam boilers”
Capstone, US

“…we could basically remove the silencer from the system after installing the Micro”
Secco, Argentina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