



HEATLEAP PROJECT

THE PIONEER FOR HIGH TEMPERATURE
DECARBONISATION

Grosswaermepumpe Congress
Linz, 16th September 2021.

MORE HEAT OUT OF HEAT.

SINCE 1980

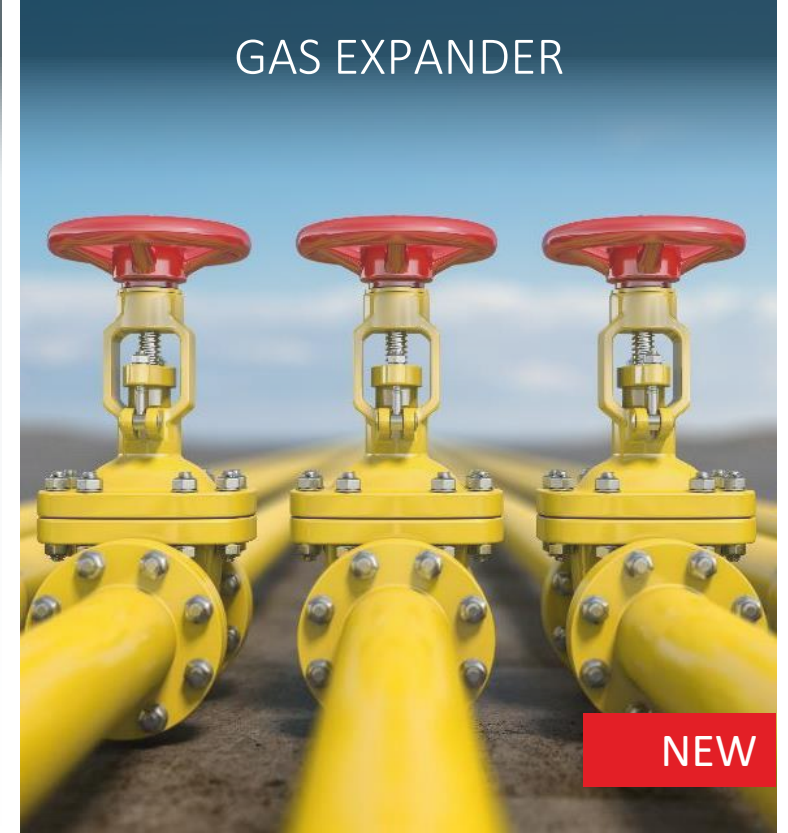
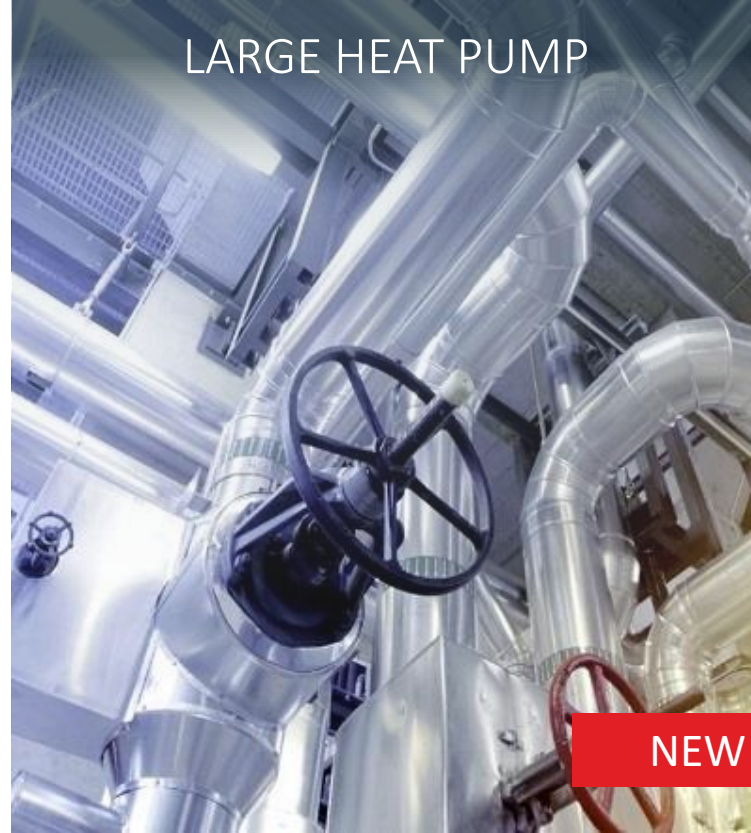
Turboden is an Italian firm and a global leader in the design, manufacture, and maintenance of **Organic Rankine Cycle (ORC) systems**, highly suitable for distributed generation, which produce electric and thermal power exploiting multiple sources.

Thanks to its long experience in the energy efficiency sector, today Turboden expands its solutions offering with **gas expanders and large heat pumps**.

MOVE THE WORLD FORW▶RD



OUR PRODUCTS

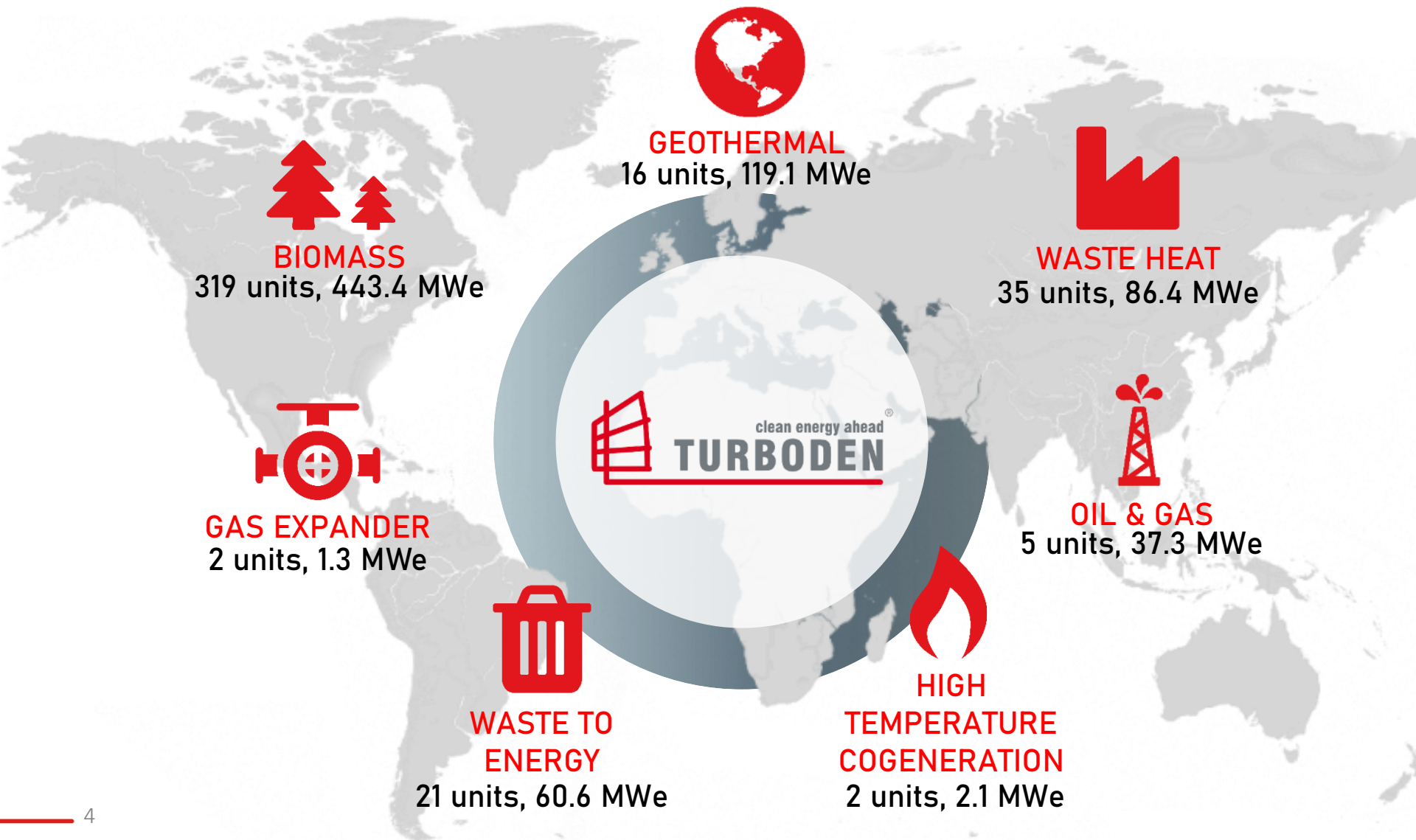


NEW

NEW

Designed for decarbonisation.

GLOBAL AND PROVEN EXPERIENCE



Experience in over
50
countries

With
400+
installations

Installed power
750+ MWe

Electric power generated
25 thousand
GWh

Cumulative operation time
19 million
hours

Average availability
98.4%

Last update: September 2021

TURBODEN EXPERTISE APPLIED TO LARGE HEAT PUMPS

DIRECT EXCHANGE

Expertise in design of custom equipment with **different heat streams**.

HIGH TEMPERATURE

40+ years experience with operative temperatures up to 400°C

WORKING FLUIDS

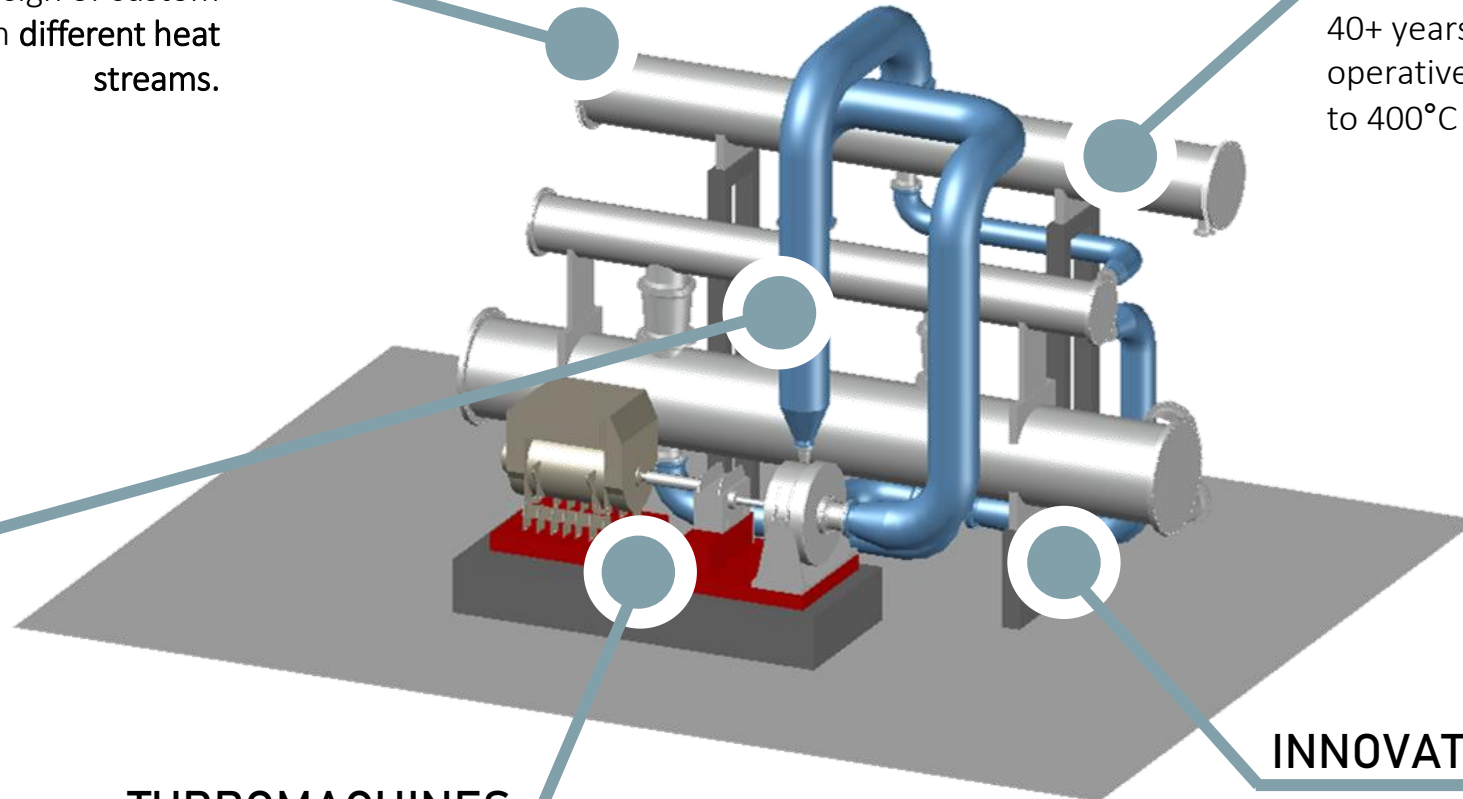
Selection of most suitable fluid case by case. Use of **low GWP**, **low ODP** and not harmful fluids.

TURBOMACHINES

Own design for more than 60 different turbines. Compressor shares **common technical features** and solutions with Turboden turbine.

INNOVATIVE DESIGN

Custom-made design with multiple possibilities of optimization.



TURBODEN LARGE HEAT PUMPS

Large Heat Pumps (LHP) are utility-scale heating plants that allow to transfer large quantities of heat from a colder source to a higher temperature heat user, like a district heating network or an industrial process.



Highly efficient

Electrically driven based on turbo compressor technology



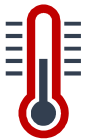
Large-scale

Output from 3 MWth to 30 MWth per single unit



High lift

Up to more than 100°C, possible thanks to custom design



High temperature

Output up to 200°C with the possibility to generate steam



Environment-friendly

Experience with 10+ different working fluids with low GWP and low ODP



LARGE HEAT PUMP SOLUTION

Typical LHP performance for 10 MWh thermal energy delivered to the final user at 90°C.

COP (Coefficient Of Performance) is a key driver for feasibility of heat pump based projects:

$$COP = \frac{\text{Useful heat}}{\text{Power consumption}}$$

The higher the COP, the lower the electrical consumption for a fixed thermal power output.

INDUSTRY

Typical heat source temperature ranges between 50 and 70°C.

- Waste heat from cooling water
- Exhaust gases
- Others

Achievable COP between 5 and 10.

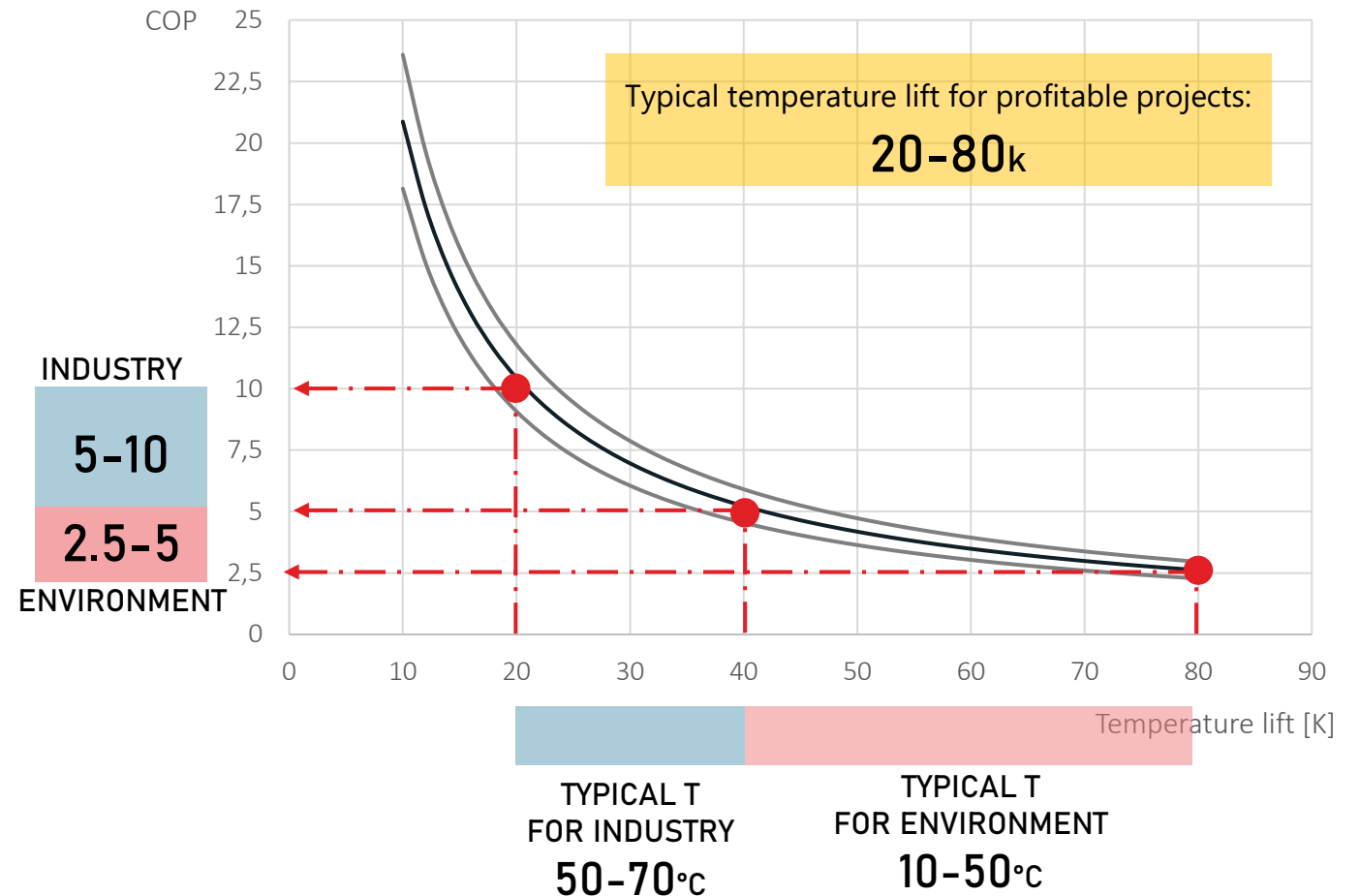
ENVIRONMENT

Typical heat source temperature ranges between 10 and 50°C.

- Ground water
- Sea water
- River water

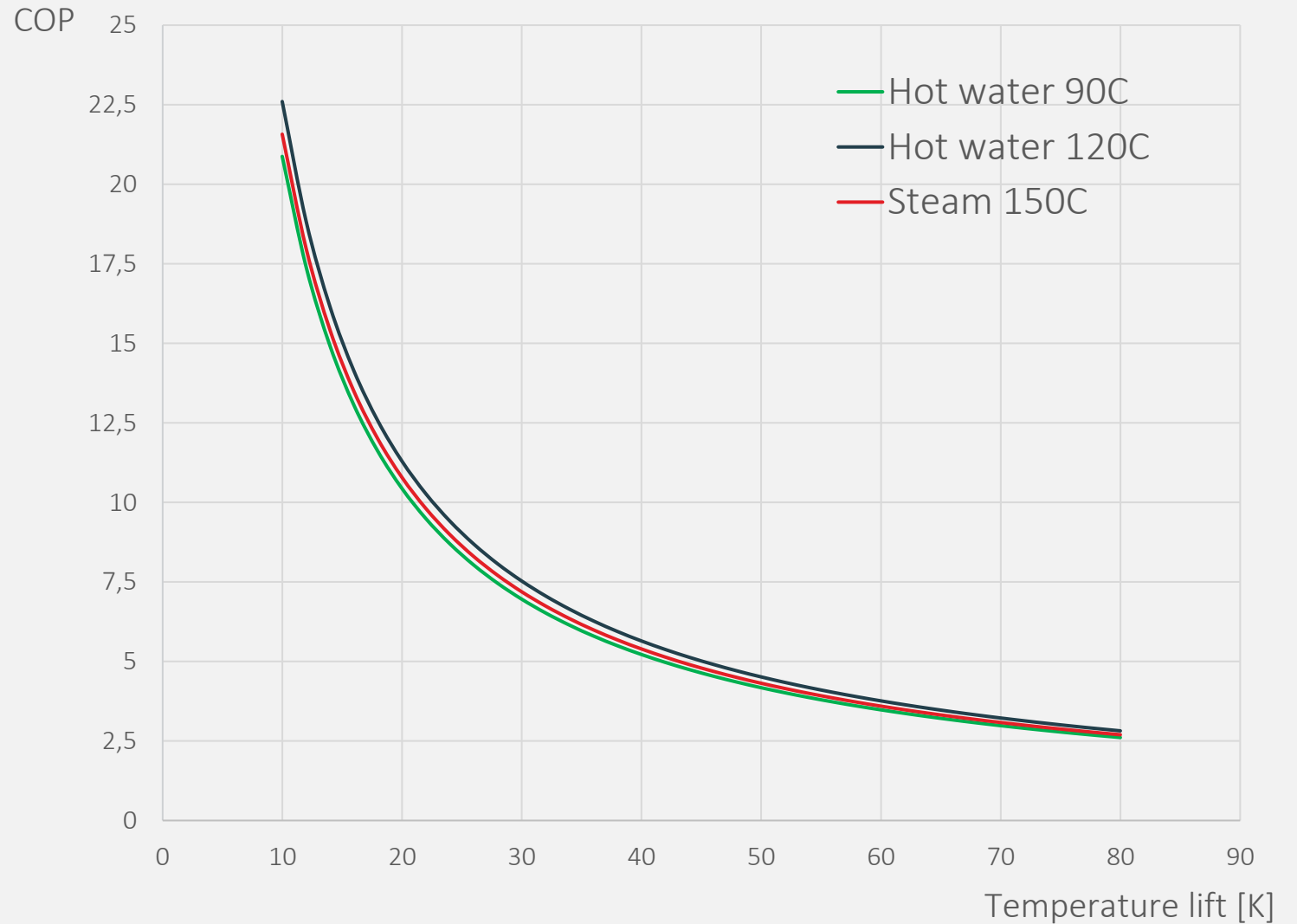
Achievable COP between 2.5 and 5.

COP VS LIFT AT SUPPLY TEMPERATURE OF 90°C



SPOTLIGHT: INFLUENCE OF HEAT SUPPLY TEMPERATURE

- The **most important factor** influencing the COP of a heat pump is the **temperature lift** by far.
- The **heat delivery temperature** and the **heat transfer medium** (heating water, steam, thermal oil, hot air, etc.) have a **relatively small influence**.

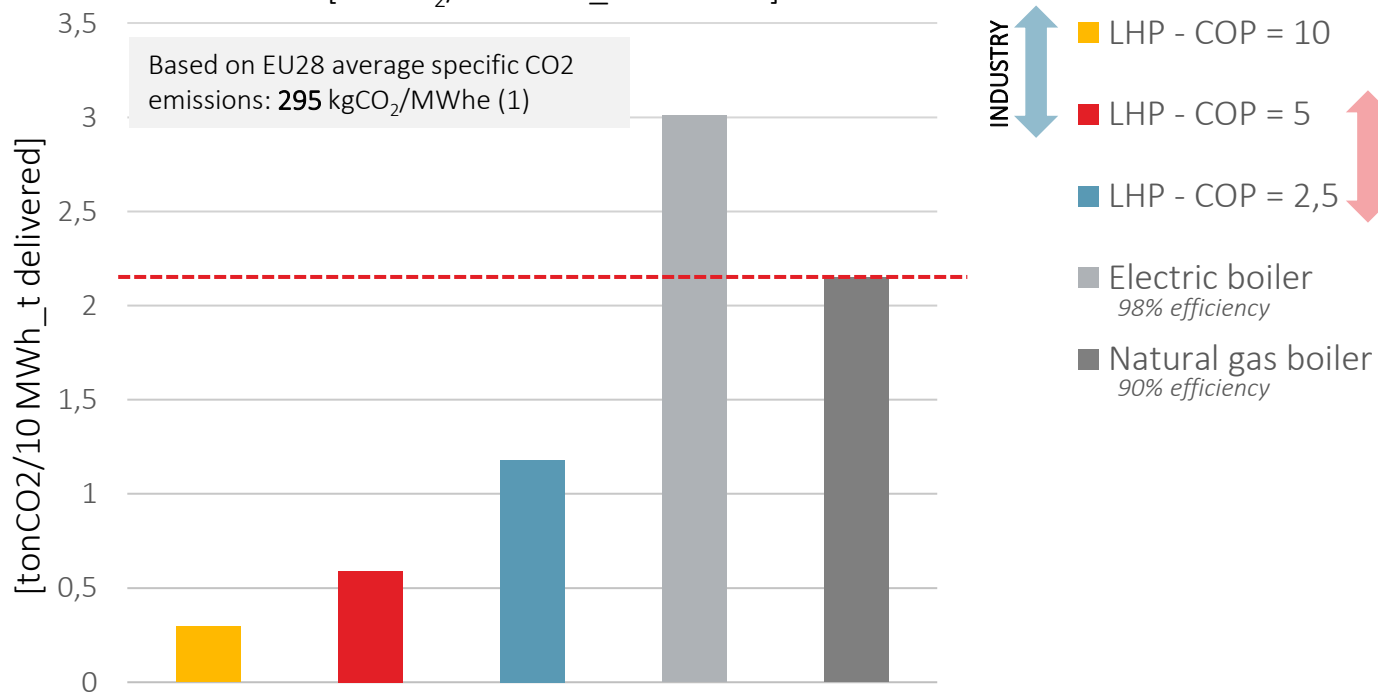


CARBON FOOTPRINT COMPARISON (FFB, EB AND HP)

Calculation of CO₂ emissions and operative costs for traditional natural gas boiler, electric boiler and heat pump technology with different COPs, based on 10 MWh_t thermal energy delivered.

Carbon footprint comparison

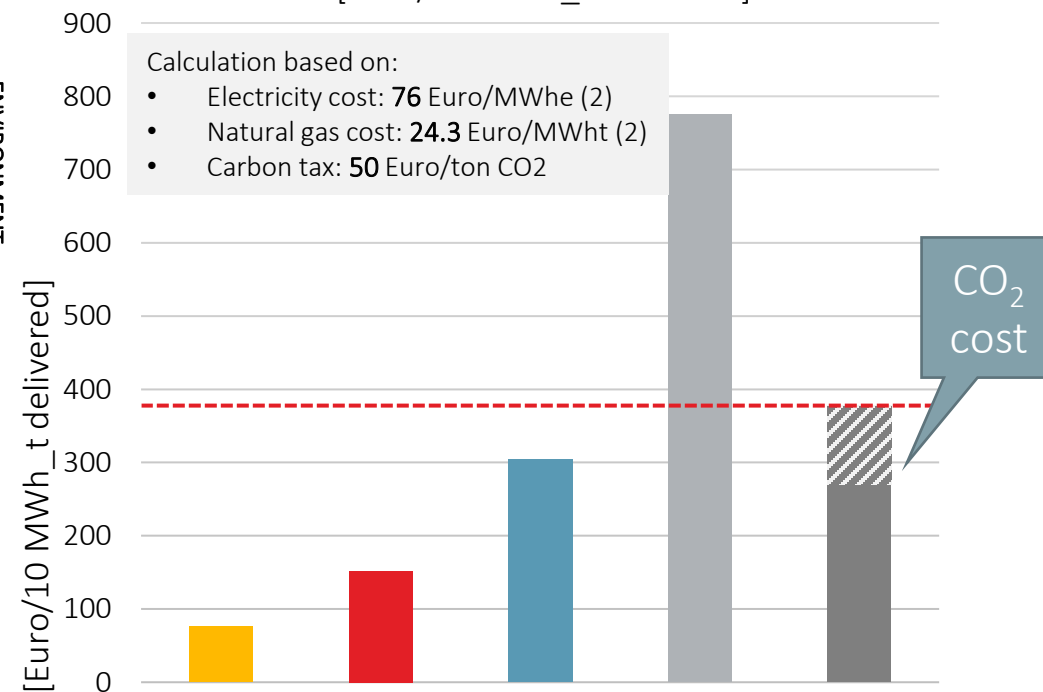
[tonCO₂/10 MWh_t delivered]



(1) Source: EEA - CO₂ Intensity of Electricity Generation.

Operative cost comparison

[Euro/10 MWh_t delivered]

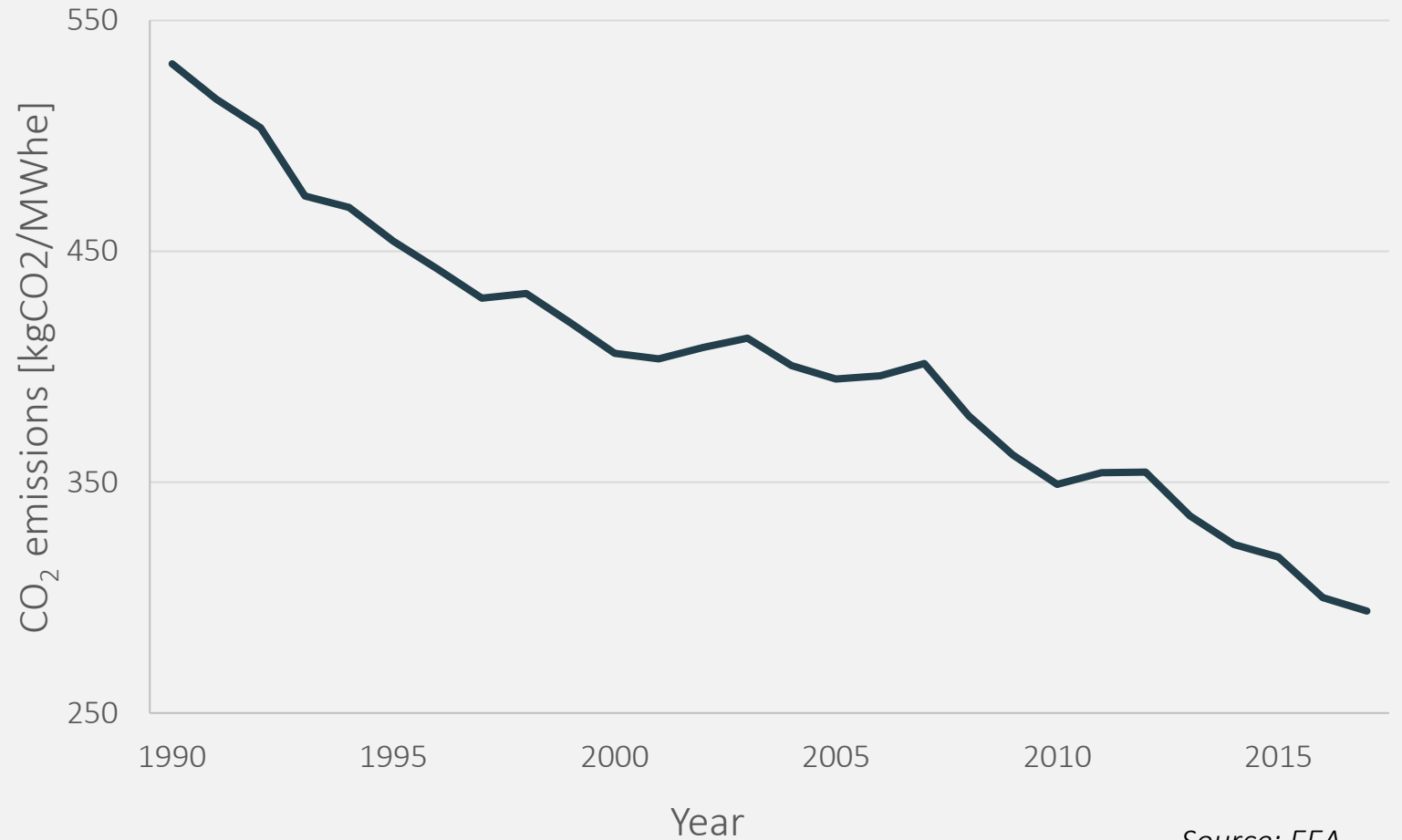


(2) Source: Eurostat data –Industrial electricity and gas data. Euro/KWh 2019 H2. Prices are based on Band IF for electricity and Band I4 for gas

SPOTLIGHT: CO₂ INTENSITY IN EU28 ELECTRICAL MIX

-32% CO₂ intensity
based on 20 years
comparison for EU28
countries.

CO₂ emissions trend in electricity generation mix - EU28



Source: EEA

HEAT PRODUCTION: ECONOMIC CONSIDERATIONS

- Sinergy between industry and DHN/industry leads to medium – high COPs (typically in the range of 5 to 10).
- Compared with tradional boilers, HP technology operational costs are lower when **COP/Eta boiler > Spark ratio**
- HPs higher CapEx is little influencing the LCOH over 20 years.
- Global trends will help to make **Heat Pump technology even more profitable.**

EU HEATLEAP PROJECT



The HEATLEAP project aims to demonstrate the environmental and economic benefits of **waste heat recovery systems** such as large heat pumps and gas expanders in energy intensive industries by testing these technologies at real scale. The project is funded under the **LIFE programme** (EU's funding instrument for the environment and climate action).

The ultimate goals of this project are the valorization of waste heat streams converting into useful heat for district heating (through an innovative Large Heat Pump) and the recovery of waste heat from decompression of natural gas from the grid to generate electricity (through Gas Expander).



Benefits

- Energy efficiency goes up
- Emissions go down
- Energy bills go down
- Industry more competitive
- Surrounding districts enjoy sustainable heat

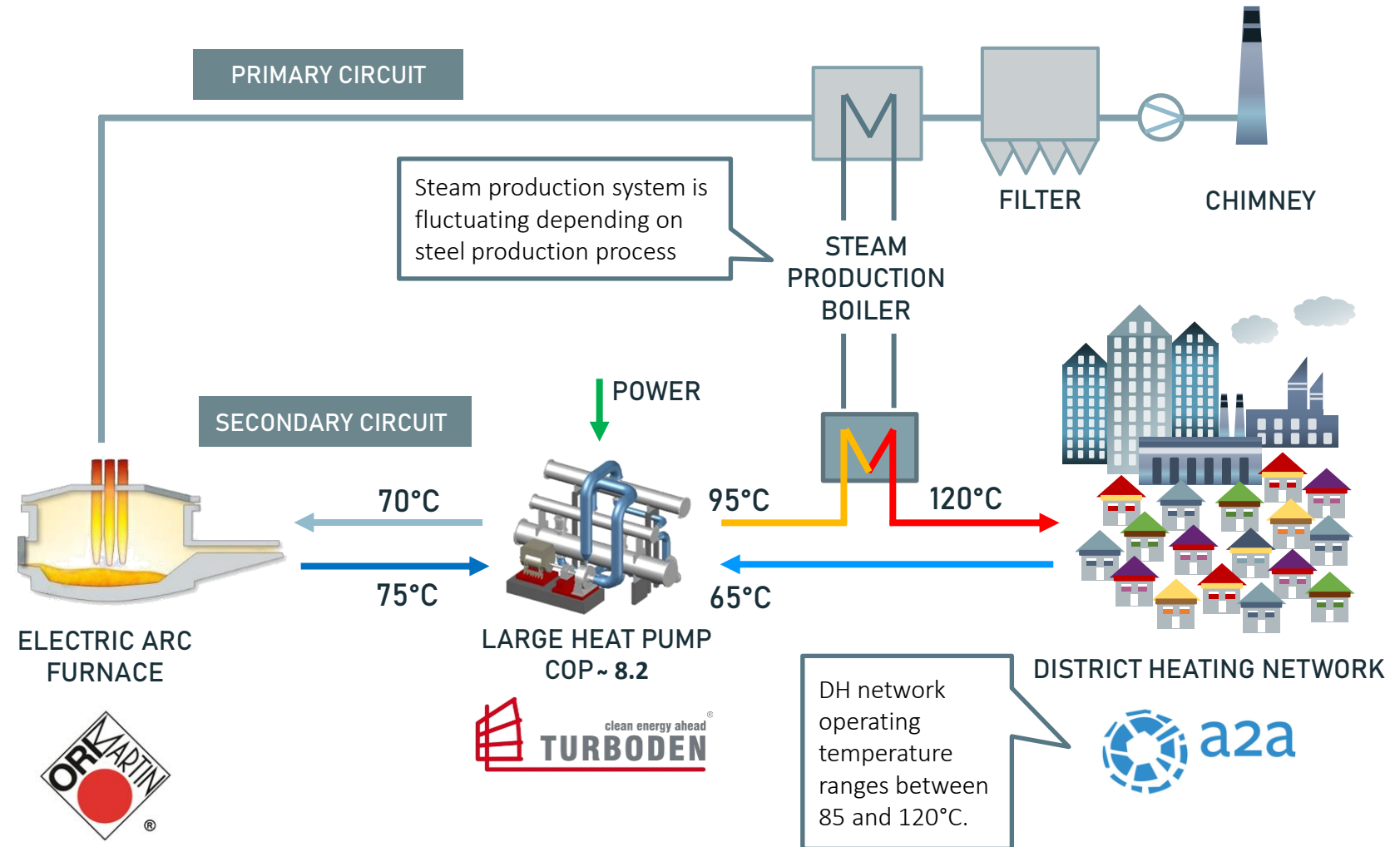
www.heatleap-project.eu

REFERENCE CASE: ORI MARTIN STEELWORKS



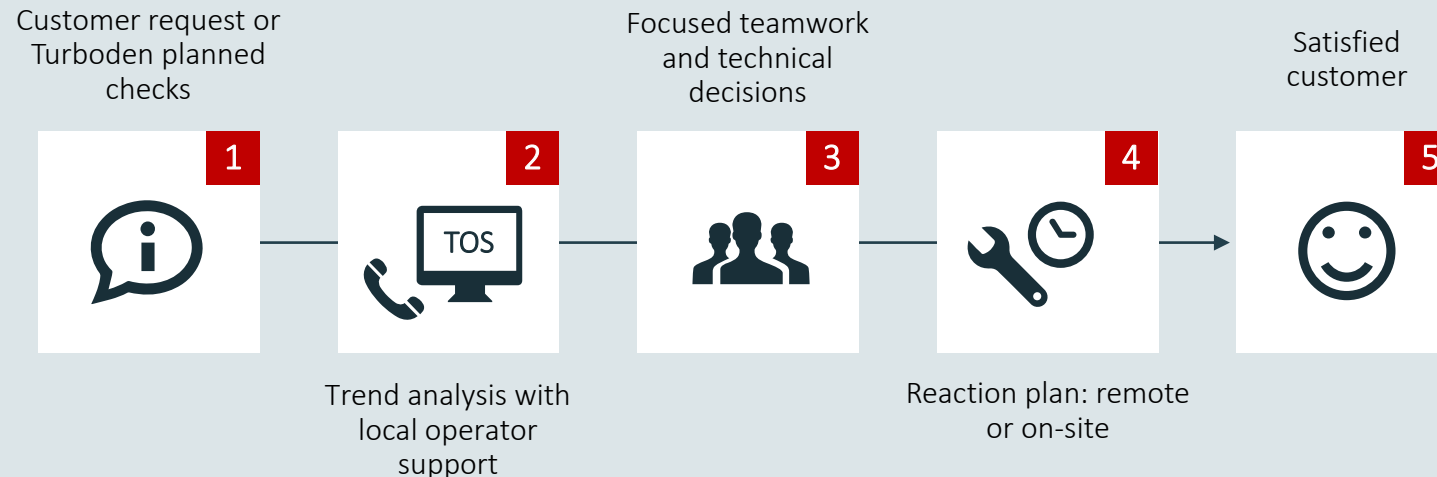
Heat from the cooling of the steelmaking process can be upgraded through a LHP and used for district heating instead of being wasted, i.e. dissipated through cooling towers.

- ### LHP TECHNICAL FEATURES
- Main technical features of LHP:
- **6 MWth** design heat delivered with output temperature up to **120°C**
 - Full **integration** with DH network. Control system designed to be highly flexible depending on:
 - DH network operating temperature
 - Steam production boiler heat production
 - **High flexibility** with 2 compression stages and variable frequency driver (due to a very variable process)
 - Working fluid: Low GWP HFO, R1233ZD



DEDICATED AFTER-SALES SERVICE

Qualified staff is exclusively dedicated to the customer assistance, both from remote and on-site, with the aim of optimizing the management of the plants. The customer can choose the most suitable service package thanks to the wide range of services offered.



COVERAGE

2 service subsidiaries and 5 international service partner companies.

ASSISTANCE

Turboden 24/7, the call center service h24, 7 days per week.

CUSTOMISED SERVICES

- single contact for requests for support
- staff dedicated to on-site and remote technical support
- assistance of an international network of companies able to provide technical support
- wide range of services provided
- prompt assistance and customized after-sales services
- remote technical support using innovative tools (TOS – Turboden Online Service)
- dedicated spare parts warehouse

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FIND OUR MORE



OUR EXPERIENCE. YOUR POWER.