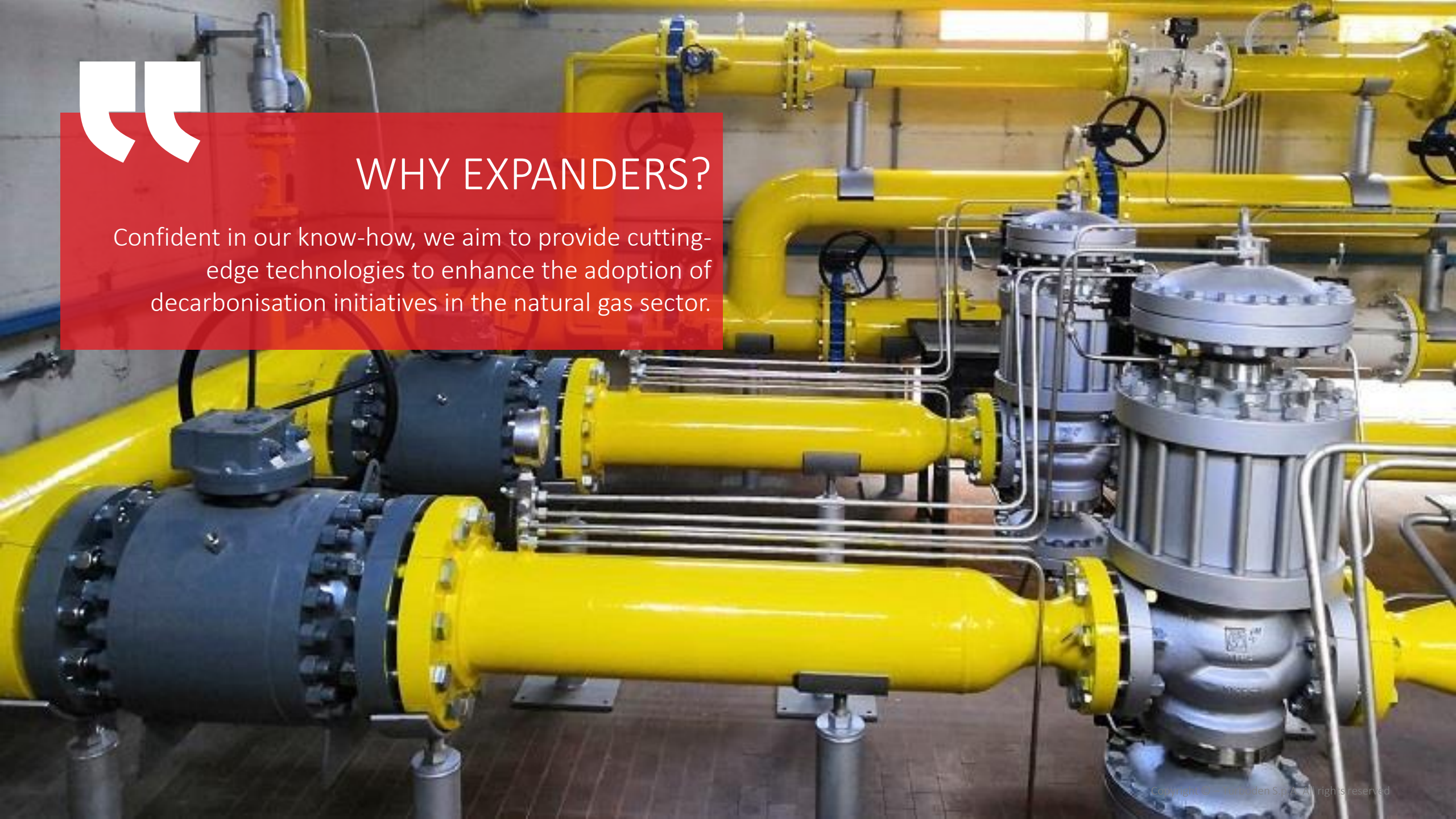
clean energy ahead
TURBODEN

MOVE THE WORLD FORWARD MITSUBISHI HEAVY INDUSTRIES GROUP

# TURBODEN
# GAS EXPANDER

Cod. 19-COM.P-5-rev.17

DON’T WASTE THE POWER OF GAS PRESSURE REDUCTION



# WHY EXPANDERS?

Confident in our know-how, we aim to provide cutting-edge technologies to enhance the adoption of decarbonisation initiatives in the natural gas sector.

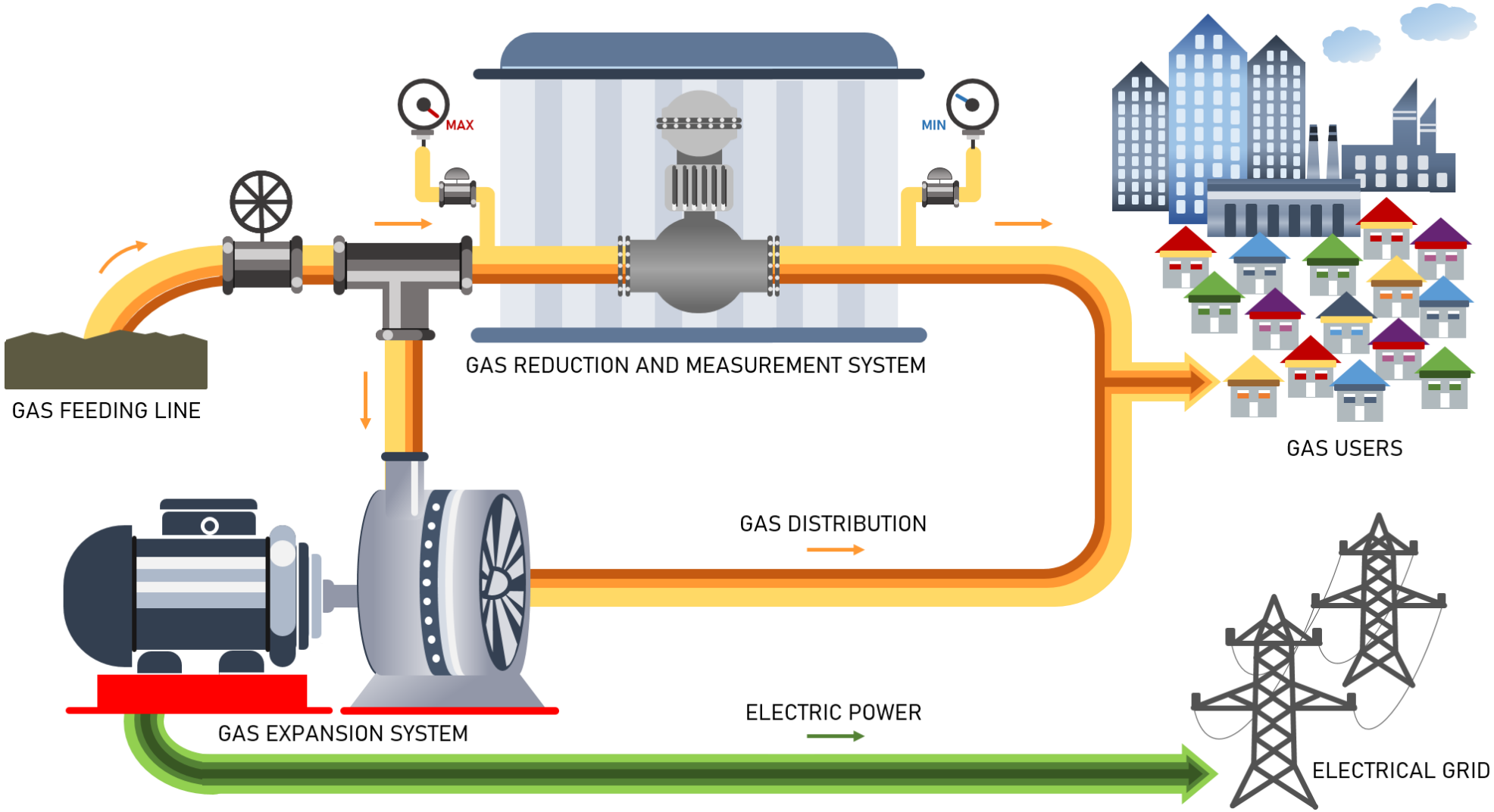
# INTRODUCTION

Turboden gas expander is a solution to enhance the energy efficiency of a natural gas network infrastructure, producing electricity by taking advantage of the reduction of gas pressure from the delivery level to the one required by users, be they residential or industrial.

## KEY POINTS

- Design based on 40+ years of experience, leveraging Mitsubishi Heavy Industries support
- Long experience in the energy efficiency sector
- Profit generation while reducing the gas pressure
- Solution for natural gas network decarbonisation
- Unmanned installations, thanks to specific technology features
- Turn-key equipment capabilities
- Over 60 Turboden turbine models within the 400 power plants fleet

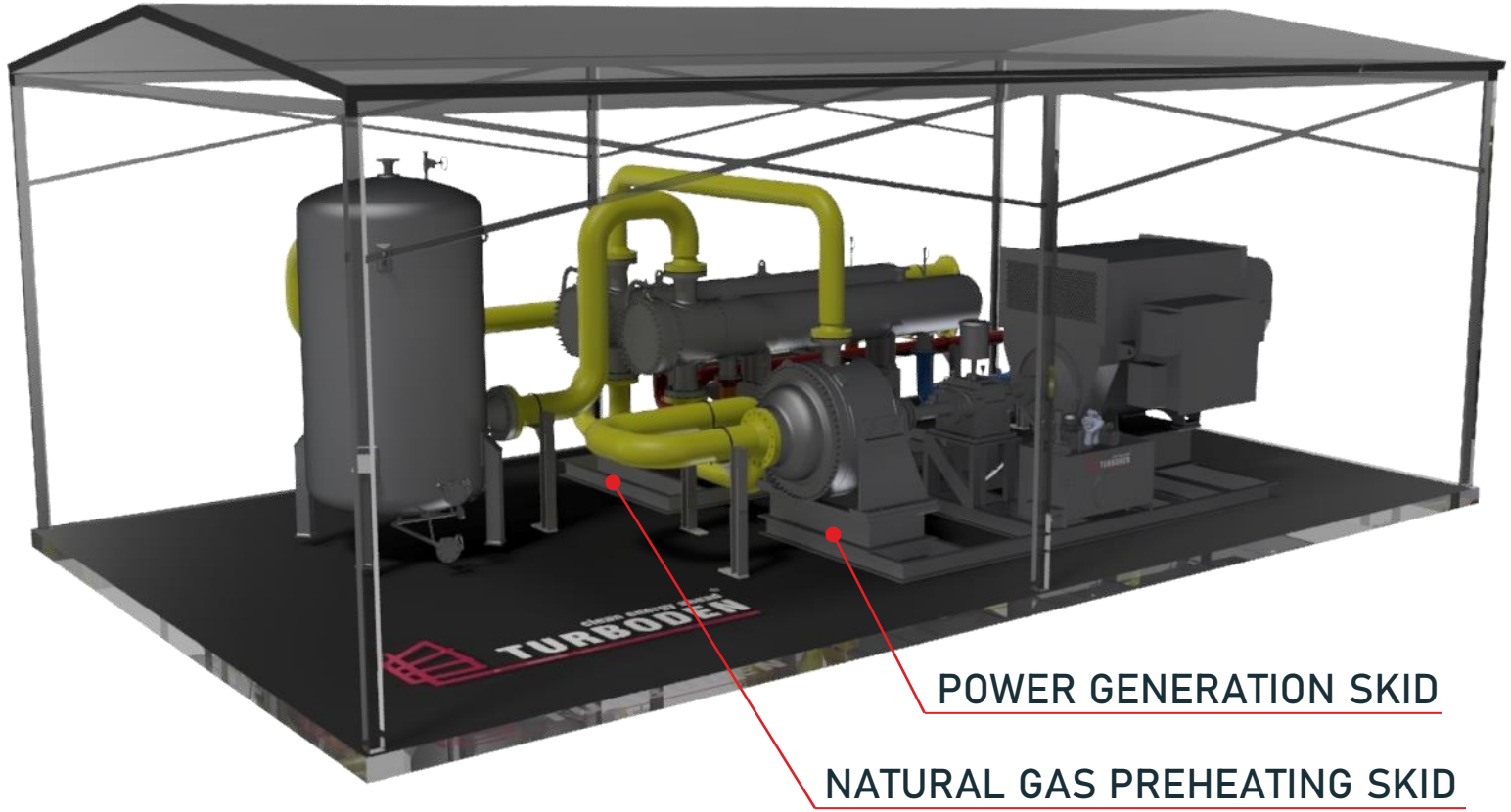
# THE CONFIGURATION



# THE SOLUTION

Natural gas turboexpanders **reduce gas pressure** from the delivery level to the one required by users, be they residential or industrial.

Unlike common pressure regulators (still present in by-pass to the turboexpander, for safety reasons, as a redundant system), the turboexpanders exploit the pressure drop to **produce electricity**, **improving the energy efficiency** of the entire gas distribution system.



# FEATURES

## Simplicity

- ✓ Skidded solution of the complete expansion system
- ✓ Simple and robust power set with proven track record
- ✓ No major overhaul

## Flexibility

- ✓ Wide range of solutions, starting from 100 kWe
- ✓ Ease of integration into existing gas network facilities
- ✓ Simple and automatic handling of partial loads

## Experience

- ✓ Over 60 Turboden turbine models within the 400 power plants fleet
- ✓ 40+ years in the design and production of turbomachinery
- ✓ Long experience in the energy efficiency sector

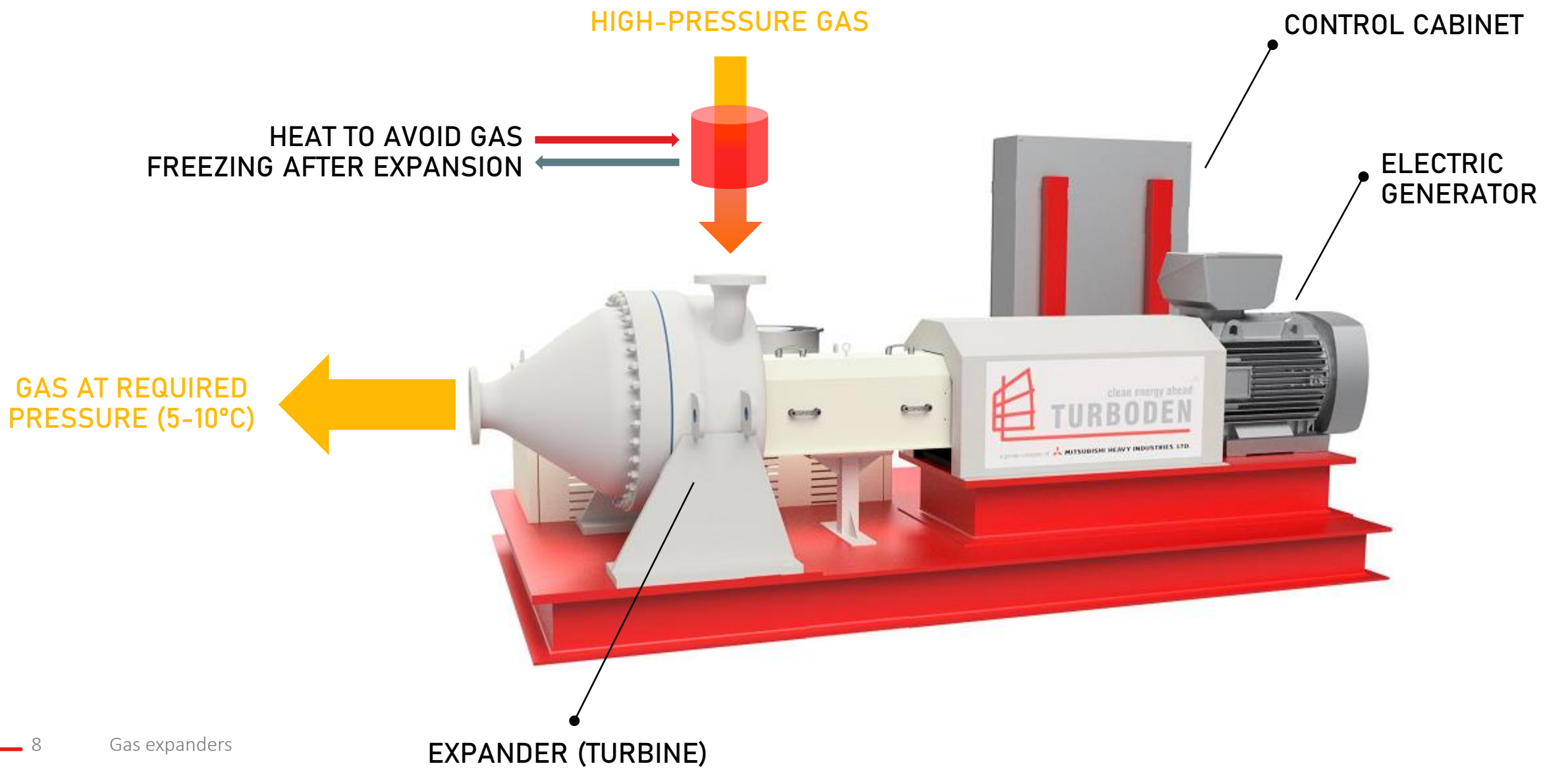
## Operation & Service

- ✓ High availability
- ✓ Designed to last over time (> 20 years)
- ✓ Structured after sales team, prompt assistance, personalized services

# TURBODEN RATING

| EXPANDERS SIZES | EXP 300 | EXP 600 | EXP 900 | EXP > 1 MW |
|---|---|---|---|---|
| ✓ Turbine stages/admission | Single stage radial turbine | Multi stages axial turbine | | |
| ✓ Flow rate | >5000 Sm3/h | 20,000 – 100,000+ Sm3/h | | |
| ✓ In - out gas pressure range | 50 - 1 bar(g) | | | |
| ✓ Bearings | Self-lubricated rolling bearings | Rolling bearings | | |
| ✓ Seals | Single tight casing for impeller and generator | Double mechanical | | |
| ✓ Generator | Permanent Magnet Generator | A/Synchronous LV - Eff. 97% | | |
| ✓ Containerization | Sandwich panel REI 120 if 10m gate distance possible; or concrete if 2m gate distance possible. Necessary to segregate electrical panel and hot water boiler. | | | |
| ✓ Gas pre-heating | Custom based on project specific features (e.g. gas fired boilers, waste heat, heat pump...) | | | |

# CORE COMPONENTS



# REFERENCES

2022

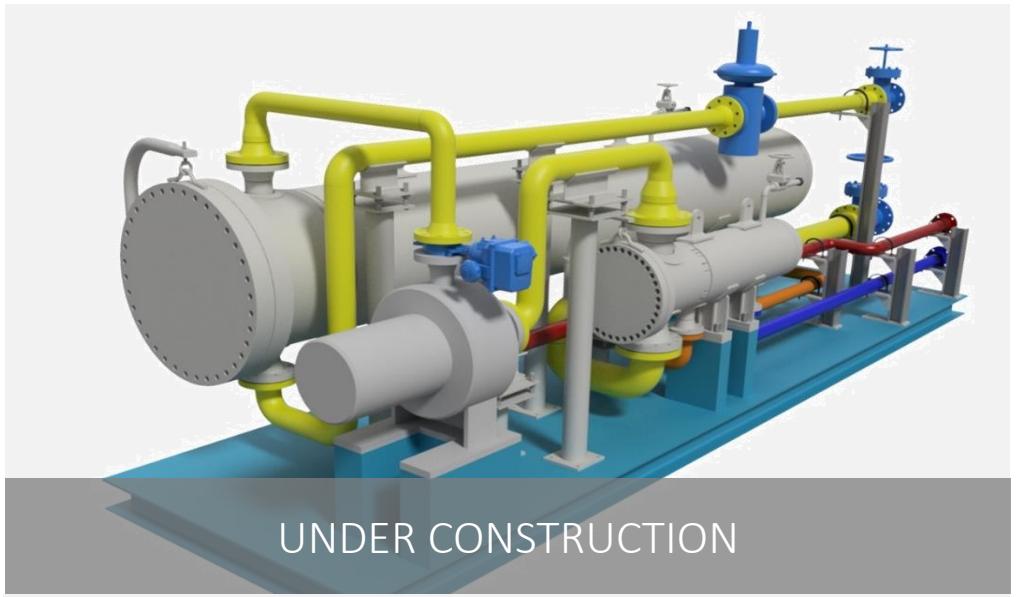
**CUSTOMER**: Italgas, Italy

**CONFIGURATION**: power generation from gas pressure reduction in the natural gas network infrastructure of Rome

**EXP POWER**: 1.3 MWe (2 gas expanders, 650 kWe each)

**KEY FEATURE:** 2 x 80,000 Sm3/h @ 50 - 24 barg

**HIGHLIGHTS**: high efficiency project, electrified by two turboexpanders and two cogenerative gas engines



UNDER CONSTRUCTION

**CUSTOMER**: A2A, Italy

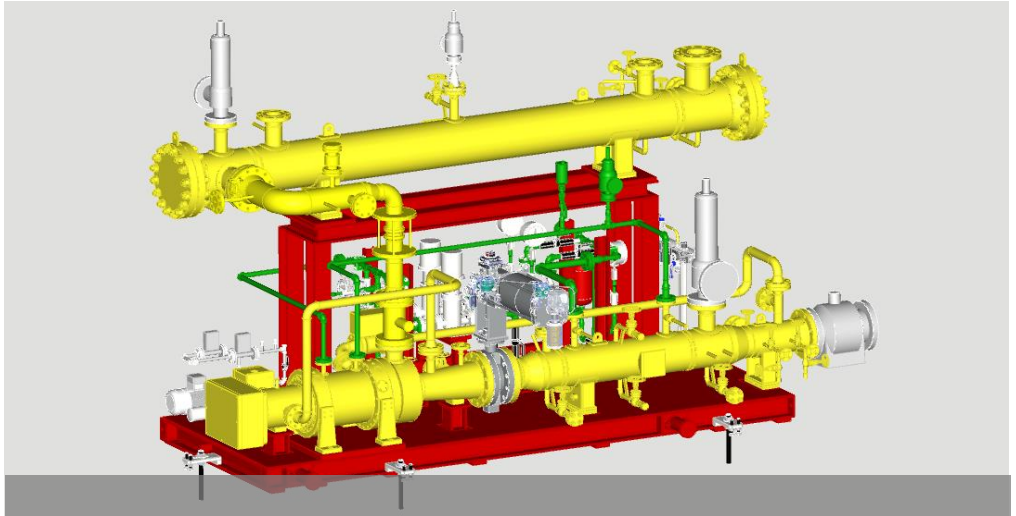
**CONFIGURATION**: power generation from gas pressure reduction within Brescia's natural gas network infrastructure

**EXP POWER**: 0.3 MWe

**KEY FEATURE:** 25,000 Sm3/h @ 12 - 6 barg

**HIGHLIGHTS** : smart city project – expansion of the natural gas entering the Brescia's gas distribution network, exploiting the district heating for the natural gas pre-heating

# REFERENCES



UNDER CONSTRUCTION

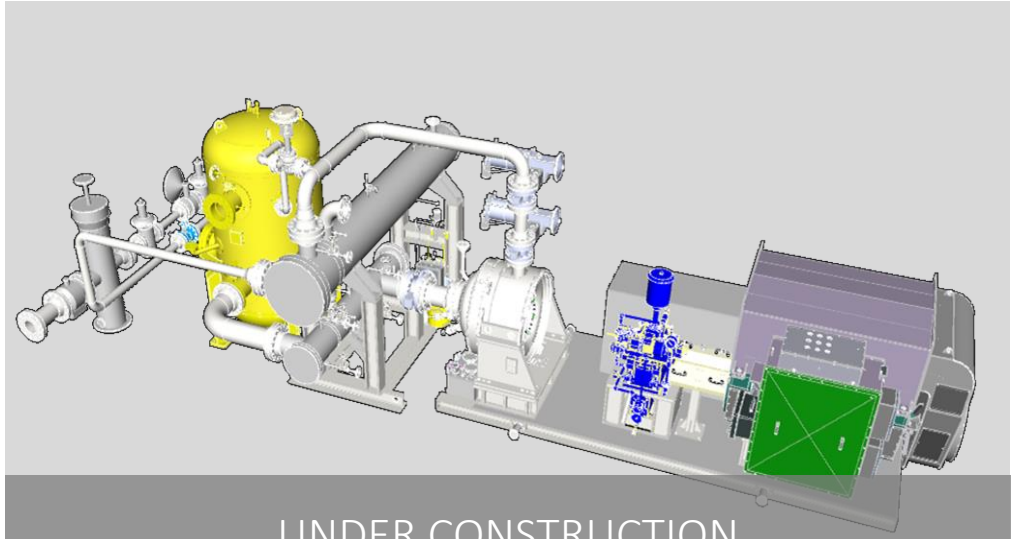
**CUSTOMER**: Pietro Fiorentini/Italgas, Italy

**CONFIGURATION**: power generation from gas pressure reduction in the natural gas network infrastructure of Turin

**ORC POWER**: 0.3 MWe

**KEY FEATURE:** 9,000 Sm3/h @ 24 - 6 barg

**HIGHLIGHTS**: power generation from gas pressure reduction implemented in one of the reduction and measurement station of Turin natural gas distribution network



UNDER CONSTRUCTION

**CUSTOMER**: HERAtech, Italy

**CONFIGURATION**: power generation from gas pressure reduction in the Ravenna natural gas network infrastructure

**ORC POWER**: 0.7 MWe

**KEY FEATURE:** 25,000 Sm3/h @ 45 - 5 barg

**HIGHLIGHTS**: high efficiency expansion system to exploit the natural gas expansion at one of the main gate of Ravenna natural gas distribution network

# TURBODEN MILESTONES

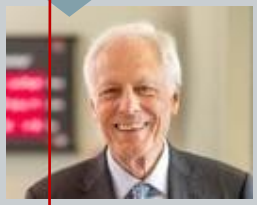
**‘60-’70**

Prof. Mario Gaia makes experience in the field of ORC within his research group at Politecnico di Milano.

**1976**

1st ORC prototype.

**1980**



Prof. Mario Gaia founds Turboden.

**1998**

1st ORC biomass plant.

**‘90-2000**

Turboden enters geothermal, waste heat recovery and solar markets.

**2000-2009**

Turboden becomes leader in Europe with its biomass plants.

**2013**

MITSUBISHI HEAVY INDUSTRIES, LTD.

MHI acquires the majority of Turboden.

**2017**

Turboden develops natural gas expansion technology. In 2019 first turboexpander.

**2020**

40 YEARS

| | 1990 | 2000 | 2010 | 2020 |
|---|---|---|---|---|
| ORC SIZES AVAILABLE | 300 kW | 1 - 2 - 4 MW | 5 - 8 - 10 MW | 20 MW |
| ORC PLANTS INSTALLED | 1 | 100 | 220 | 400+ |

# WHY TURBODEN

## MITSUBISHI HEAVY INDUSTRIES GROUP

- Turboden fully embraces the values, philosophy and vision of its parent company MHI
- Turboden leverages the financial stability of its parent company and the technical support to satisfy customer needs

## CAPABILITIES & EXPERIENCE

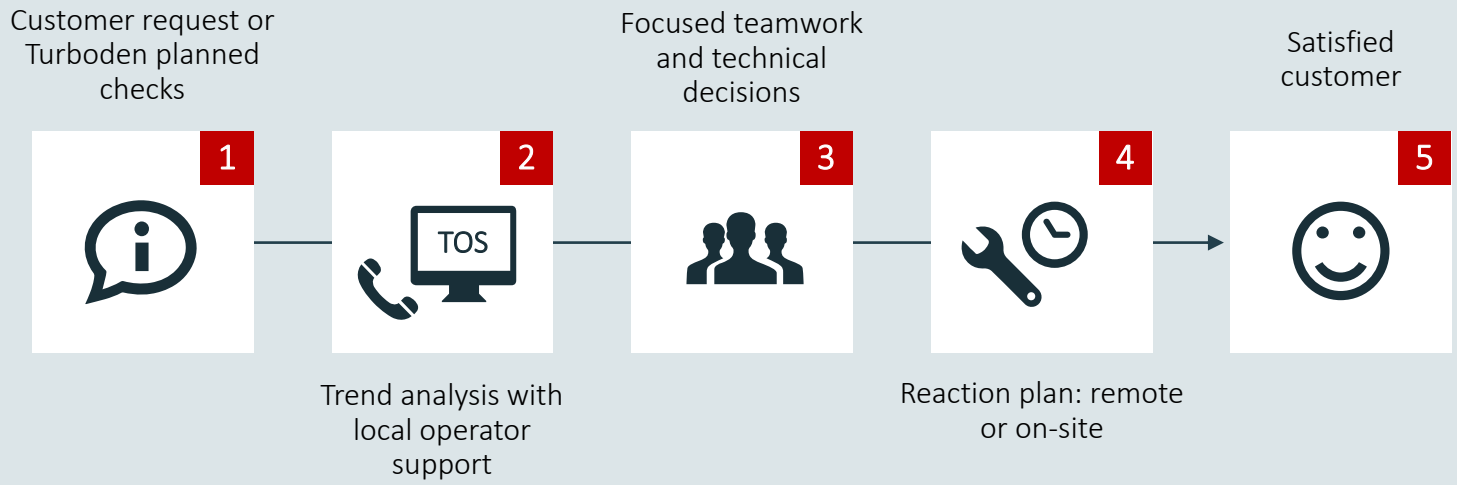
- With 40 years of experience, Turboden holds the know-how of the ORC technology
- Excellence in R&D and turbine design
- Total capacity of 750+ MWe, 400+ plants, 50 countries
- Global presence


## CUSTOMER ORIENTATION

- Always dedicated to the success projects of the customers
- Prompt assistance and customized after-sales service
- Ready to provide optimized solutions for the clients
- High availability
- High customer satisfaction

# 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 OUT MORE

OUR EXPERIENCE. YOUR POWER.