DON’T WASTE THE POWER OF GAS PRESSURE REDUCTION. EXPLOIT IT.
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 390 power plants fleet
THE CONFIGURATION

Gas expanders
THE SOLUTION

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

Unlike the reduction stations (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

<table>
<thead>
<tr>
<th>Simplicity</th>
<th>Flexibility</th>
<th>Experience</th>
<th>Operation &amp; Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Low speed turbine</td>
<td>✓ Wide range of solutions, starting from 100 kWe*</td>
<td>✓ Over 330 turbines in operation in 45 countries</td>
<td>✓ High availability</td>
</tr>
<tr>
<td>✓ Simple and robust power set with proven track record</td>
<td>✓ Ease of integration into existing gas network facilities</td>
<td>✓ 40 years in the design and production of turbomachinery</td>
<td>✓ Long life (&gt; 25 years)</td>
</tr>
<tr>
<td>✓ No major overhaul</td>
<td>✓ Simple and reliable handling of partial loads</td>
<td>✓ Mitsubishi Heavy Industries constant support</td>
<td>✓ Structured after sales team, prompt assistance, personalized services</td>
</tr>
</tbody>
</table>

* Indicatively 5,000 Sm³/h with a pressure ratio of 9-10.

Gas expanders
## TURBODEN RATING

<table>
<thead>
<tr>
<th>EXPANDERS SIZES</th>
<th>EXP 400</th>
<th>EXP 600</th>
<th>EXP 900</th>
<th>EXP &gt; 1 MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔ Turbine stages/admission</td>
<td>Single stage radial turbine</td>
<td>Multi stages axial turbine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>✔ Flow rate</td>
<td>&gt;5000 Sm3/h</td>
<td>5,000 - 100,000 Sm3/h</td>
<td></td>
<td></td>
</tr>
<tr>
<td>✔ In - out gas pressure range</td>
<td></td>
<td></td>
<td>70 - 1 bar(g)</td>
<td></td>
</tr>
<tr>
<td>✔ Bearings</td>
<td>Magnetic or rolling bearing</td>
<td>Rolling bearing oil lubricated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>✔ Seals</td>
<td>Single tight casing for impeller and generator</td>
<td></td>
<td>Mechanical</td>
<td></td>
</tr>
<tr>
<td>✔ Generator</td>
<td>Permanent Magnet generator</td>
<td></td>
<td></td>
<td>A/Synchronous LV - Eff. 97%</td>
</tr>
<tr>
<td>✔ Containerization</td>
<td></td>
<td></td>
<td></td>
<td>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.</td>
</tr>
<tr>
<td>✔ Gas pre-heating</td>
<td>Hot water boiler fed by natural gas and shell&amp;tube heat exchangers + possible combination with electrical heaters and heat pumps – custom based on project specific.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SYSTEM LAYOUT

HEAT TO AVOID GAS FREEZING AFTER EXPANSION

HIGH-PRESSURE GAS

GAS AT REQUIRED PRESSURE (5-10°C)

AXIAL TURBINE EXPANDER

CONTROL CABINET

ELECTRIC GENERATOR
GENERAL ARRANGEMENT

COMPACT PRE-ASSEMBLED SINGLE SKID

POWER GENERATION SKID

NATURAL GAS PREHEATING SKID
**Turboden Milestones**

- **1976**: 1st prototype.
- **1980**: 1st ORC biomass plant Switzerland (300 kW).
- **1990**: ORC size developed 300 kW, ORC plants number 1.
- **1998**: Turboden installs ORC biomass plants, especially in Austria, Germany and Italy.
- **‘90-2000**: Turboden develops research projects in solar, geothermal and heat recovery applications.
- **2000-09**: United Technologies Corporation acquires the majority of Turboden and supports the company in new markets beyond Europe.
- **2009**: Turboden installs ORC biomass plants, especially in Austria, Germany and Italy.
- **2013**: Mitsubishi Heavy Industries acquires the majority of Turboden.
- **2017**: Turboden develops natural gas expansion technology, thanks to its knowledge in the expansion of organic fluids. In 2019 the company launches its turboexpander.
- **2020**: ORC plants number 220, ORC size developed 5-8-10 MW, ORC plants number 390.

---

**Gas expanders**
## 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 660 MWe, 390 plants, 45 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.

---

**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

---

**COVERAGE**

2 service subsidiaries and 5 international service partner companies.

**ASSISTANCE**

Turboden 24/7, the call center service h24, 7 days per week.
TWO GAS EXPANDERS FOR ITALGAS GENERATORS

650 kWe EACH
CUSTOMER: Italgas
COUNTRY: Italy
STATUS: under construction
GAS EXPANDER SIZE: 1.3 MWe (2 gas expanders, 650 kWe each)
DESCRIPTION: power generation from gas pressure reduction in a natural gas network infrastructure
OVERALL SOLUTION: comprehensive project of a greenfield high efficient natural gas pressure reduction station, electrified by means of two turboexpanders and two cogenerative gas engines
## PROJECT DETAILS

### GAS REDUCTION STATION

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Station size</td>
<td>280,000 Sm3/h</td>
</tr>
<tr>
<td>In - out gas pressure</td>
<td>~ 50 (max design 75) - 24 bar(g)</td>
</tr>
<tr>
<td>In - out gas temperature</td>
<td>5+15 - 5 °C</td>
</tr>
</tbody>
</table>

### SINGLE EXPANDER

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow rate</td>
<td>80,000 Sm3/h</td>
</tr>
<tr>
<td>In - out gas pressure</td>
<td>50 - 24 bar(g)</td>
</tr>
<tr>
<td>Expander power output</td>
<td>650 kWe</td>
</tr>
<tr>
<td>In - out gas temperature</td>
<td>40 - 5 °C heated up with a hot water/natural gas heat exchanger</td>
</tr>
</tbody>
</table>
FIND OUR MORE

OUR EXPERIENCE. YOUR POWER.