



WE TRANSFORM ENERGY

PRODUCT SHEET

TURBOEXPANDER TECHNOLOGY

35 - 250 kWe

ENERGY
PRODUCTION
MODULES

ZE-50-G
ZE-75-G
ZE-100-G
ZE-150-G
ZE-200-G
ZE-250-G

let the gas give you more

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TURBOEXPANDER CONCEPT

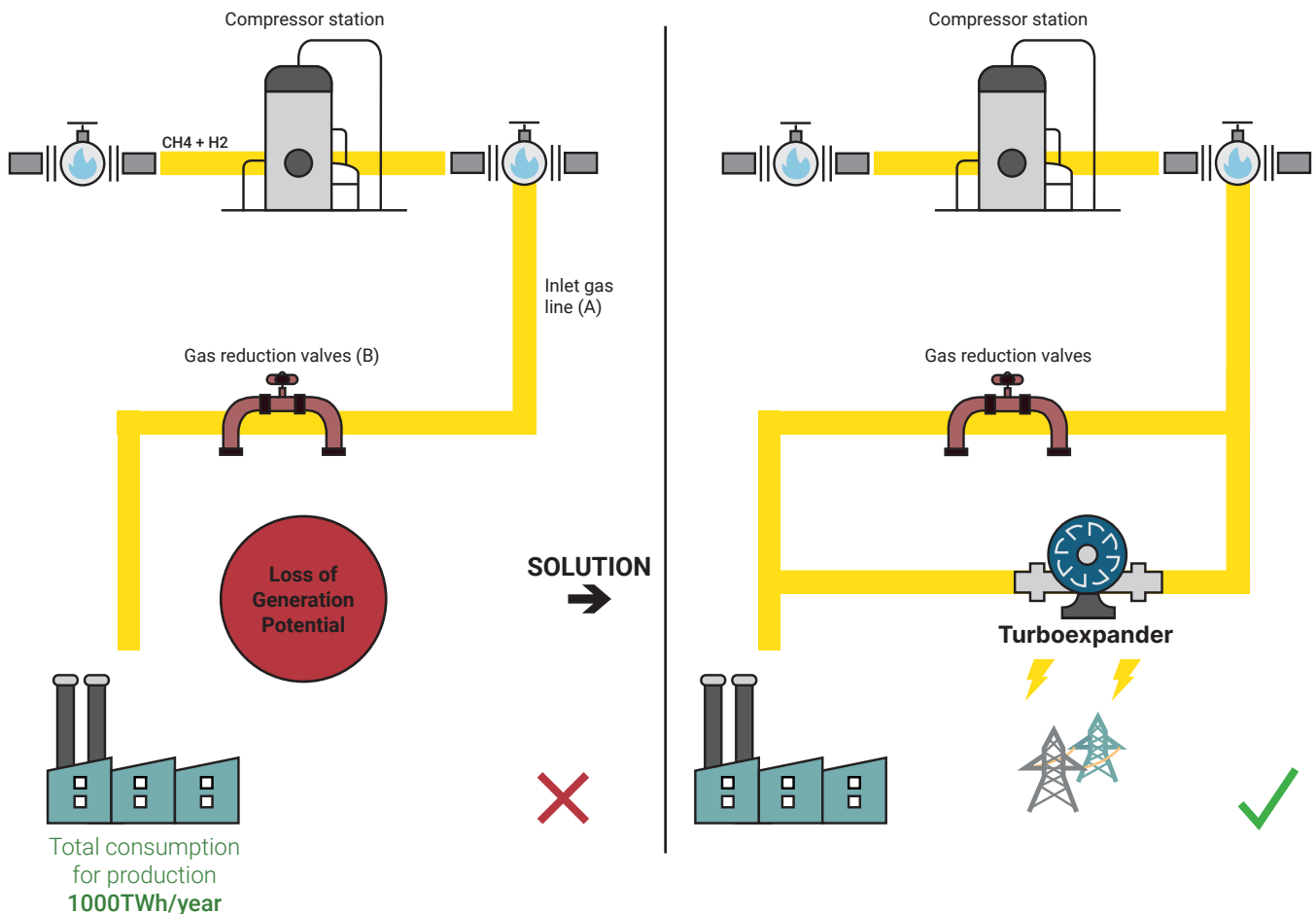
European industries obtain about **1000TWh** of energy annually by burning natural gas. This gas is transmitted via pressurized pipelines and while the pressure is reduced at the user's gas letdown station, **its potential energy is permanently lost**. These losses are quantified as **400 MW** of installable electric power.

Turboexpander operation

An inlet gas line **(A)** is entering the user's site with high gas pressure. Normally, this pressure is reduced through reduction valves **(B)** and no useful work is produced.

By installing a Turboexpander in parallel to the existing pressure reducing valves, it is possible to exploit this energy potential to produce zero-emission electricity.

Fig.1 Turboexpander operation



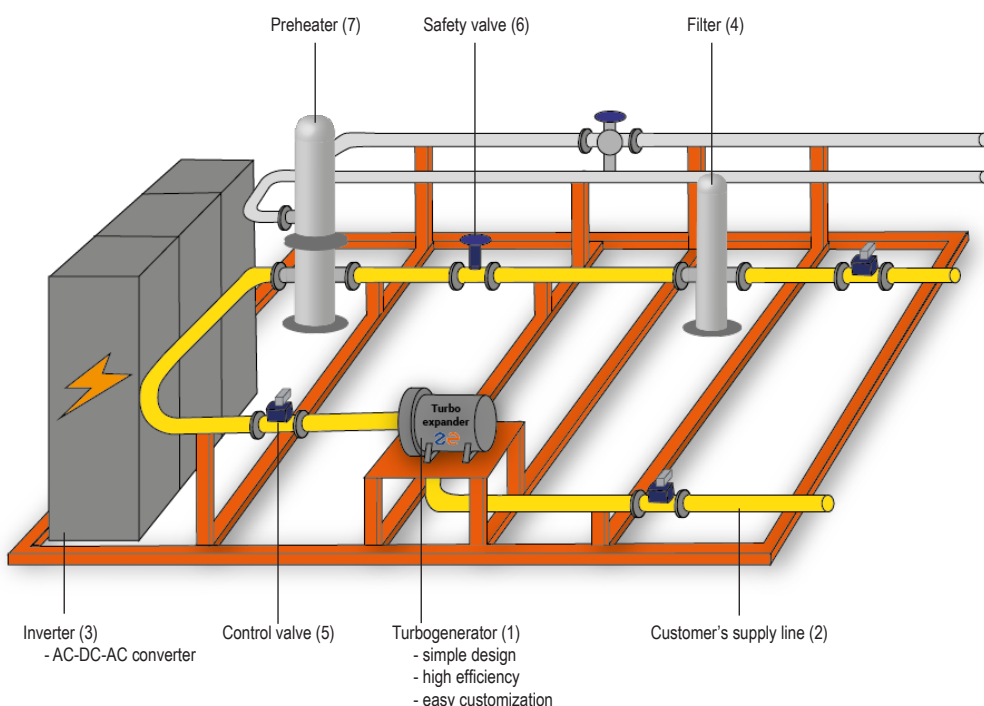
TURBOEXPANDER TECHNOLOGY

The core of the plant is a high-speed turbogenerator (1), which comprises a turbine and a generator placed on the same shaft into a hermetic enclosure. Natural gas exiting from the turbogenerator (1) is heading to the user's supply line (2).

Turbogenerator (1) produces high-frequency alternating current, which then is transformed by means of AC-DC-AC power converter (3) into alternating current with frequency and voltage requested by the national grid.

The natural gas before entering the plant is cleaned via a filter (4) to ensure long-lasting and safe operation of all the plant components. The control valve (5) and the safety valve (6) are aimed at keeping a certain value of the turbine outlet pressure and protect the plant components and customer's supply line from overpressure.

The gas expansion in the turbogenerator (1) is linked to a significant reduction of its temperature. In order to avoid the formation of condensates and freezing of the pipelines the gas is preheated prior to the expansion at the gas preheater (7) – a water to gas heat exchanger.



SAFETY FIRST

- Our systems are equipped with a safety valve (6) that mechanically limits the pressure on the user's side to a certain value even in case the plant's control system is blacked out. In case of shut down of the plant, the gas supply will be provided normally thanks to the closure of the safety valves upstream of the Turboexpander and diverting the gas to its original path.
- The control of the system start and stop procedures is made by the control valve (5) in order to redirect the flow from the valves towards the turbogenerator (1) smoothly and not to cause any pressure increase which may affect the user's process.
- All components of the Turboexpander system included in **Zone 2** of the ATEX directives are certified by the respective manufacturers. The ATEX certificate of the Turboexpander is issued by the Authorized competent body therefore the highest level of safety is guaranteed.



TURBOEXPANDER PLANT OVERVIEW



Entire Plant



High speed turbogenerator



TURBOEXPANDER RANGE

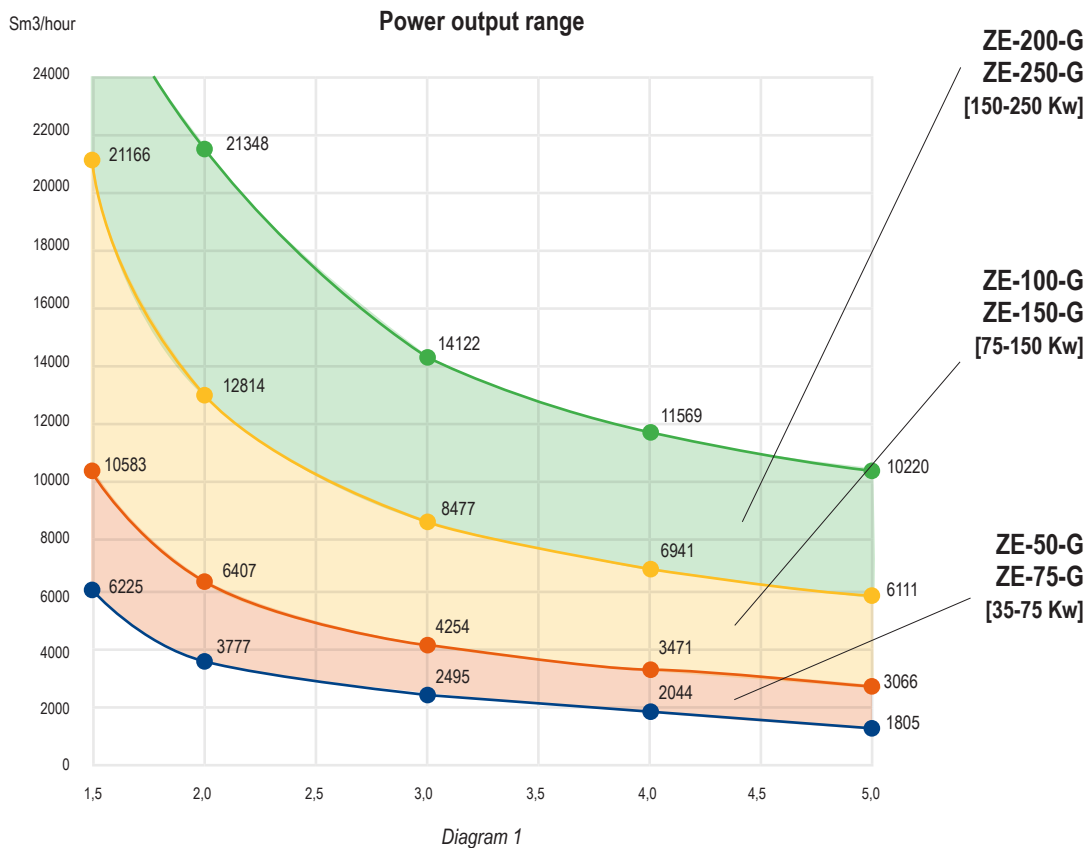
Turboexpander system of Zuccato Energia is suitable for industries with mass flow of natural gas from **1800 to 21000 Sm³/h** and inlet pressure up to 50 bar. The target power range is **from 35 to 250 kW**. The power range of Turboexpander is depend on the mass flow of natural gas and pressure ratio between inlet and outlet. The detailed information is presented in the table 2 and diagram 1:

Table 2. TURBOEXPANDER RANGE

ZE-50-G [35-50 kW]	ZE-75-G [35-75 kW]	ZE-100-G [75-100 kW]	ZE-150-G [75-150 kW]	ZE-200-G [150-200 kW]	ZE-250-G [200-250 kW]
Q ≥ 2044 Sm ³ /h Pressure ratio ≥ 5	Q ≥ 3066 Sm ³ /h Pressure ratio ≥ 5	Q ≥ 4100 Sm ³ /h Pressure ratio ≥ 5	Q ≥ 6100 Sm ³ /h Pressure ratio ≥ 5	Q ≥ 8200 Sm ³ /h Pressure ratio ≥ 5	Q ≥ 10200 Sm ³ /h Pressure ratio ≥ 5
Q ≥ 2314 Sm ³ /h Pressure ratio ≥ 4	Q ≥ 3470 Sm ³ /h Pressure ratio ≥ 4	Q ≥ 4670 Sm ³ /h Pressure ratio ≥ 4	Q ≥ 6950 Sm ³ /h Pressure ratio ≥ 4	Q ≥ 9300 Sm ³ /h Pressure ratio ≥ 4	Q ≥ 11570 Sm ³ /h Pressure ratio ≥ 4
Q ≥ 2800 Sm ³ /h Pressure ratio ≥ 3	Q ≥ 4250 Sm ³ /h Pressure ratio ≥ 3	Q ≥ 5650 Sm ³ /h Pressure ratio ≥ 3	Q ≥ 8470 Sm ³ /h Pressure ratio ≥ 3	Q ≥ 11300 Sm ³ /h Pressure ratio ≥ 3	Q ≥ 14100 Sm ³ /h Pressure ratio ≥ 3
Q ≥ 4300 Sm ³ /h Pressure ratio ≥ 2	Q ≥ 6400 Sm ³ /h Pressure ratio ≥ 2	Q ≥ 8560 Sm ³ /h Pressure ratio ≥ 2	Q ≥ 12800 Sm ³ /h Pressure ratio ≥ 2	Q ≥ 17100 Sm ³ /h Pressure ratio ≥ 2	Q ≥ 21350 Sm ³ /h Pressure ratio ≥ 2

*Pressure ratio = $\frac{\text{Pressure inlet}}{\text{Pressure outlet}}$

*Q - Flow rate, Sm³/h



6100 Sm³/h ≤ Q ≤ 10200 Sm³/h
Pressure ratio ≥ 5

8470 Sm³/h ≤ Q ≤ 14120 Sm³/h
Pressure ratio ≥ 3

12810 Sm³/h ≤ Q ≤ 21350 Sm³/h
Pressure ratio ≥ 2

3066 Sm³/h ≤ Q ≤ 6100 Sm³/h
Pressure ratio ≥ 5

4250 Sm³/h ≤ Q ≤ 8470 Sm³/h
Pressure ratio ≥ 3

6400 Sm³/h ≤ Q ≤ 12810 Sm³/h
Pressure ratio ≥ 2

1800 Sm³/h ≤ Q ≤ 3066 Sm³/h
Pressure ratio ≥ 5

2495 Sm³/h ≤ Q ≤ 4250 Sm³/h
Pressure ratio ≥ 3

3777 Sm³/h ≤ Q ≤ 6400 Sm³/h
Pressure ratio ≥ 2



TURBOEXPANDER

TECHNICAL SPECIFICATION

Table 3. UNIT SPECIFICATIONS

	ZE-50-G	ZE-75-G	ZE-100-G	ZE-150-G	ZE-200-G	ZE-250-G
Power output	35-50 kWel	35-75 kWel	75-100 kWel	75-150 kWel	150-200 kWel	150-250 kWel
Inlet pressure	≤ 50 bar					
Pressure rating	35 / 75 bar					
Preheating: Energy source	Hot water 80°C					
Required thermal power	≤80 kWth	≤100 kWth	≤155 kWth	≤215 kWth	≤280 kWth	≤350 kWth
Mass flow of natural gas	1800 ÷ 4300 Sm ³ /h	1800 ÷ 6400 Sm ³ /h	3066 ÷ 9000 Sm ³ /h	3066 ÷ 12810 Sm ³ /h	6100 ÷ 17120 Sm ³ /h	6100 ÷ 21350 Sm ³ /h
Rotational speed	up to 45.000 rev/min	up to 45.000 rev/min	up to 32.000 rev/min	up to 32.000 rev/min	up to 25.000 rev/min	up to 25.000 rev/min

Table 4. TURBINE SPECIFICATIONS

TURBINE	
Arrangement	Turbine and generator directly connected placed in hermetic enclosure
Turbine type	Curtis turbine (Velocity compounded 2-stage turbine)
Overspeeding control	Direct speed control via varying the generator output voltage by power converter
Seals and gaskets	Flow path: labyrinth seals Casing and piping: spiral metal gaskets
Generator type	Synchronous permanent magnet generator
Generator cooling	By natural gas downstream the turbine
Bearings	Ceramic ball bearings

Table 5. INVERTER SPECIFICATIONS

INVERTER	
Type	AC-DC-AC IGBT converter
Output current	380-480V, 59/60 Hz, 3 Phase
Cooling	Induced air cooling

