ZUCCATO ENERGIA

WE TRANSFORM ENERGY

PRODUCT SHEET

TURBOEXPANDER TECHNOLOGY

35 - 250 kWe

ENERGY PRODUCTION MODULES

ZE-50-G
ZE-100-G
ZE-150-G

let the gas give you more

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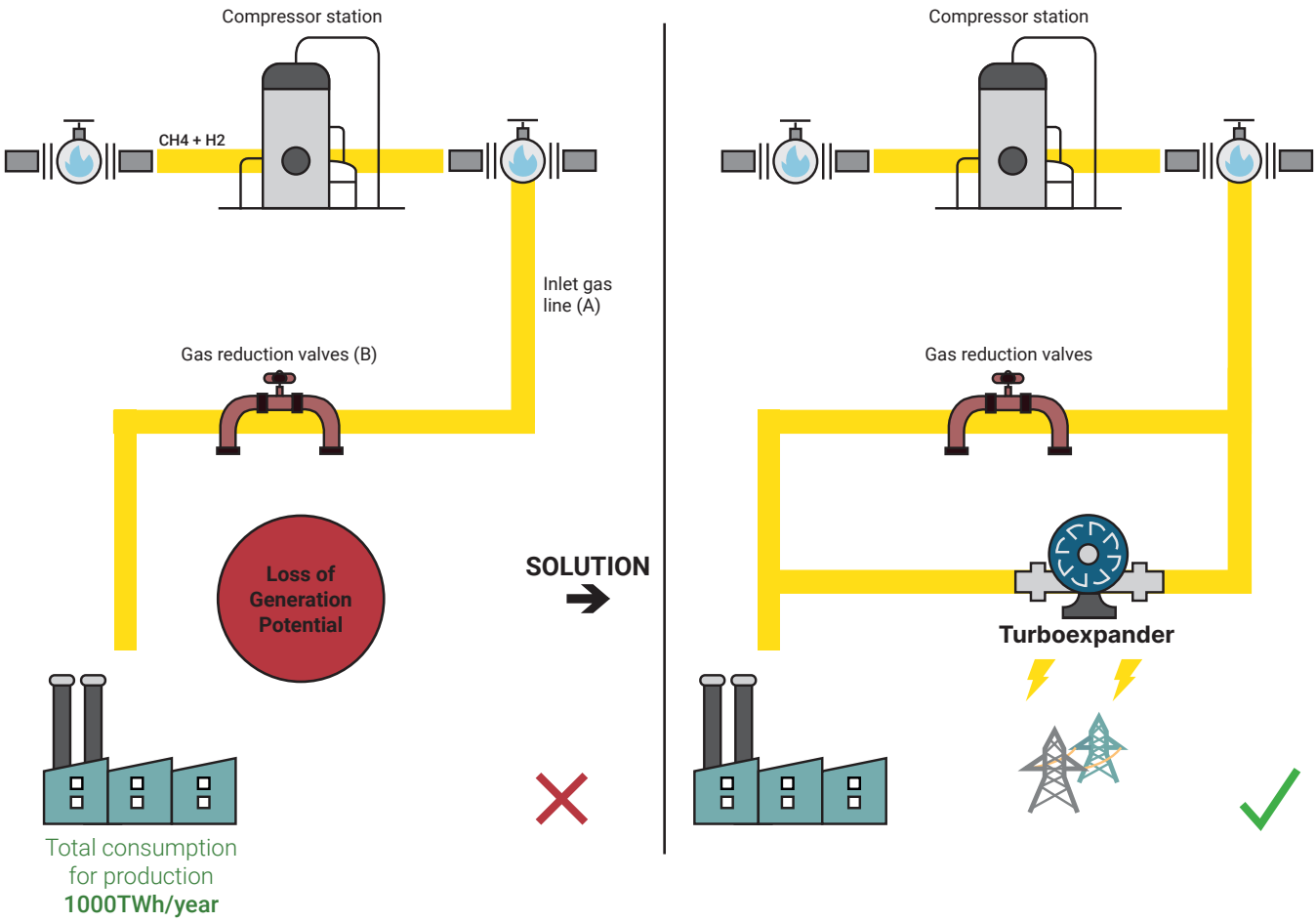
TURBOEXPANDER
CONCEPT

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

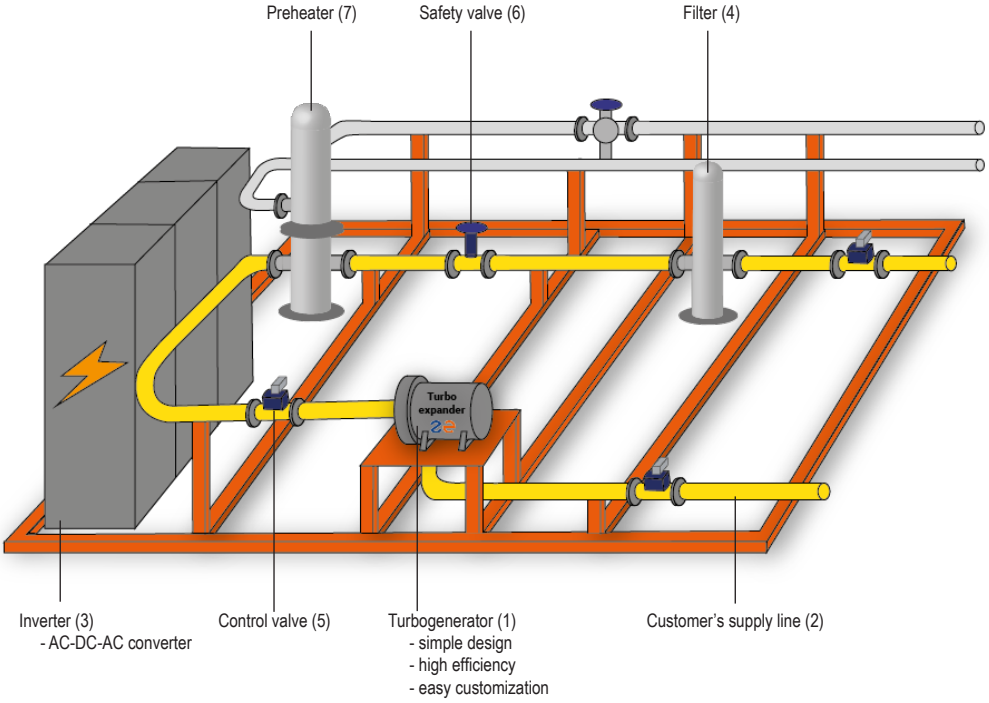
An inlet gas line **(A)** is entering the user's site with high gas pressure. Normally, this pressure is reduced throughh reduction valves **(B)** and no useful work is produced.
By installing a Turboexpander in parallel to the existing pressure reducing valves, it is possible to exploit this energy 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 [35-75 kW]	ZE-100-G [75-150 kW]	ZE-150-G [150-250 kW]
1800 Sm3/h ≤ Q ≤ 3066 Sm3/h Pressure ratio ≥ 5	3066 Sm3/h ≤ Q ≤ 6100 Sm3/h Pressure ratio ≥ 5	6100 Sm3/h ≤ Q ≤ 10200 Sm3/h Pressure ratio ≥ 5
2045 Sm3/h ≤ Q ≤ 3470 Sm3/h Pressure ratio ≥ 4	3470 Sm3/h ≤ Q ≤ 6940 Sm3/h Pressure ratio ≥ 4	6940 Sm3/h ≤ Q ≤ 11570 Sm3/h Pressure ratio ≥ 4
2495 Sm3/h ≤ Q ≤ 4250 Sm3/h Pressure ratio ≥ 3	4250 Sm3/h ≤ Q ≤ 8470 Sm3/h Pressure ratio ≥ 3	8470 Sm3/h ≤ Q ≤ 14120 Sm3/h Pressure ratio ≥ 3
3777 Sm3/h ≤ Q ≤ 6400 Sm3/h Pressure ratio ≥ 2	6400 Sm3/h ≤ Q ≤ 12810 Sm3/h Pressure ratio ≥ 2	12810 Sm3/h ≤ Q ≤ 21350 Sm3/h Pressure ratio ≥ 2

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

*Q - Flow rate, Sm3/h

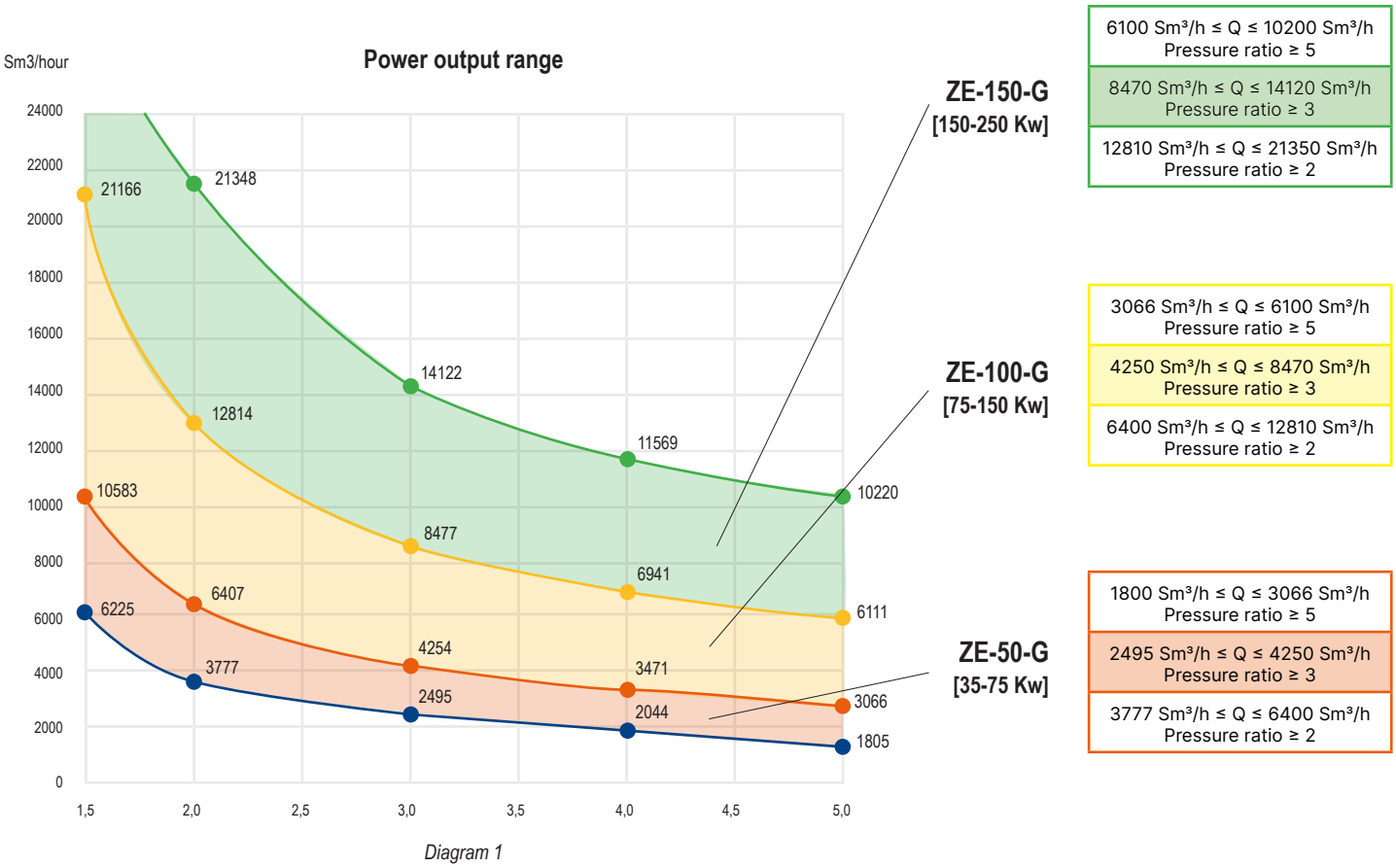


Diagram 1

TURBOEXPANDER
TECHNICAL SPECIFICATION

Table 3. UNIT SPECIFICATIONS			
	ZE-50-G	**ZE-100-G**	**ZE-150-G**
Power output	35-75 kWel	75-150 kWel	150-250 kWel
Inlet pressure	≤ 50 bar		
Pressure rating	35 / 75 bar		
Preheating: Energy source	Hot water 80°C		
Required thermal power	≤125 kWth	≤225 kWth	≤350 kWth
Mass flow of natural gas	1800 ÷ 6400 Sm3/h	3066 ÷ 12810 Sm3/h	6100 ÷ 21350 Sm3/h
Rotational speed	up to 45.000 rev/min	up to 32.000 rev/min	up to 25.000 rev/min

Table 4. TURBINE SPECIFICATIONS	
TURBINE	
Arrangemet	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: labyrint seals Casing and piping: spiral metal gaskets
Generator type	Sinchronous 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