



TECHNICAL COMMERCIAL OFFER
TURBOGENERATOR UNITS «TURBOSPHERE»

TGU 28.11.23-001-29475178-2017



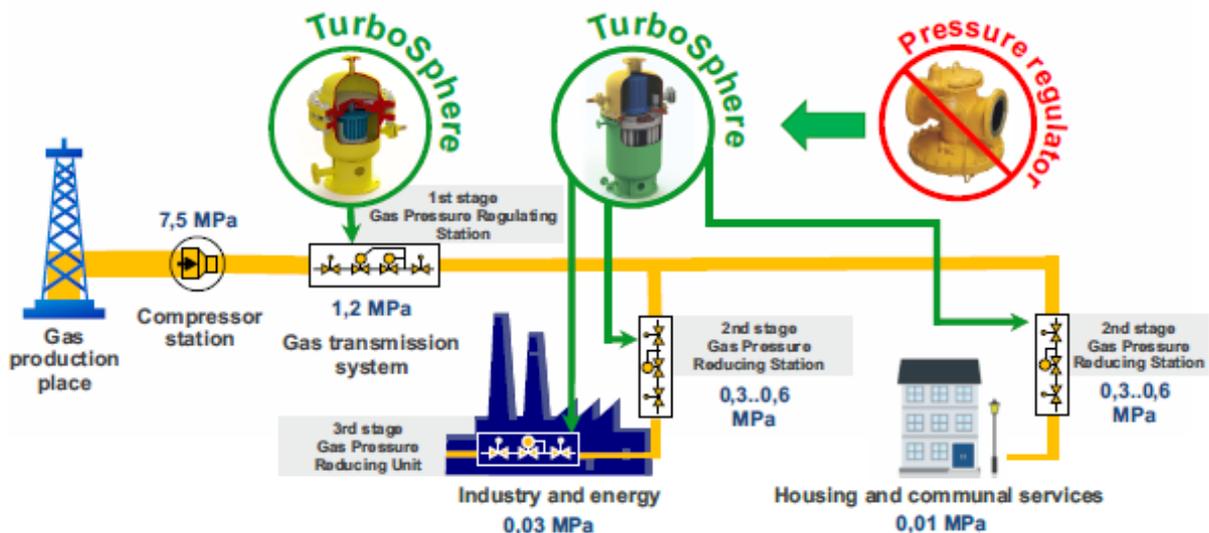
Dear sirs!

We suggest you to consider the possibility of electric energy generation **WITHOUT ADDITIONAL FUEL COMBUSTION** but at the expense of **PRESSURE DIFFERENCE of NATURAL GAS** on your object!

The turbogenerator units Turbosphere (TGU "Turbosphere") is the innovative development created by TurboSfera group of companies: LLC "Scientific and Engineering Center "EnergTech" the resident of Science and Technology Park of BNTU "Polytechnic" and Skolkovo project participant LLC "TurboEnergy".

This product is intended for a generation of additional electric energy at the expense of pressure difference of natural gas that allows *to increase fuel efficiency*, to receive an *environmentally friendly electric power source* and also *additional income* for the enterprise, equivalent to annual cut on electric energy purchase from external network, or by its sale to a third-party consumer!

TGU "Turbosphere" represents the innovative solution applied at Gas Pressure Regulating Station, Gas Pressure Reducing Station and Gas Pressure Reducing Units in gas transmission systems, the industry, the municipal sector and energetics to productively use energy of natural gas overpressure energy.



It is possible to decide whether TGU "Turbosphere" will be favorable specifically to you in only 3 steps:

1. To define an expense and pressure difference of natural gas on your object (to provide the completed questionnaire for the analysis – in the application).
2. To pick up a unit from the model range given below (or to contact our experts for selection).
3. To estimate revenue of implementing unit and its payback period.

Preliminary economic indicators can be estimated on the following example:

On an object with an average consumption of natural gas in 2000 m³/h and standard pressure difference for similar objects 3 (absolute input in respect to the output) the average generated power will be 20 kW that corresponds to annual power production at the level of 160 thousand kW·h. At an average tariff for electric energy of 0,2 Euro for kW·h and the conditions described above annual cut will make up to 32K Euro or about 45 t of conditional fuel.

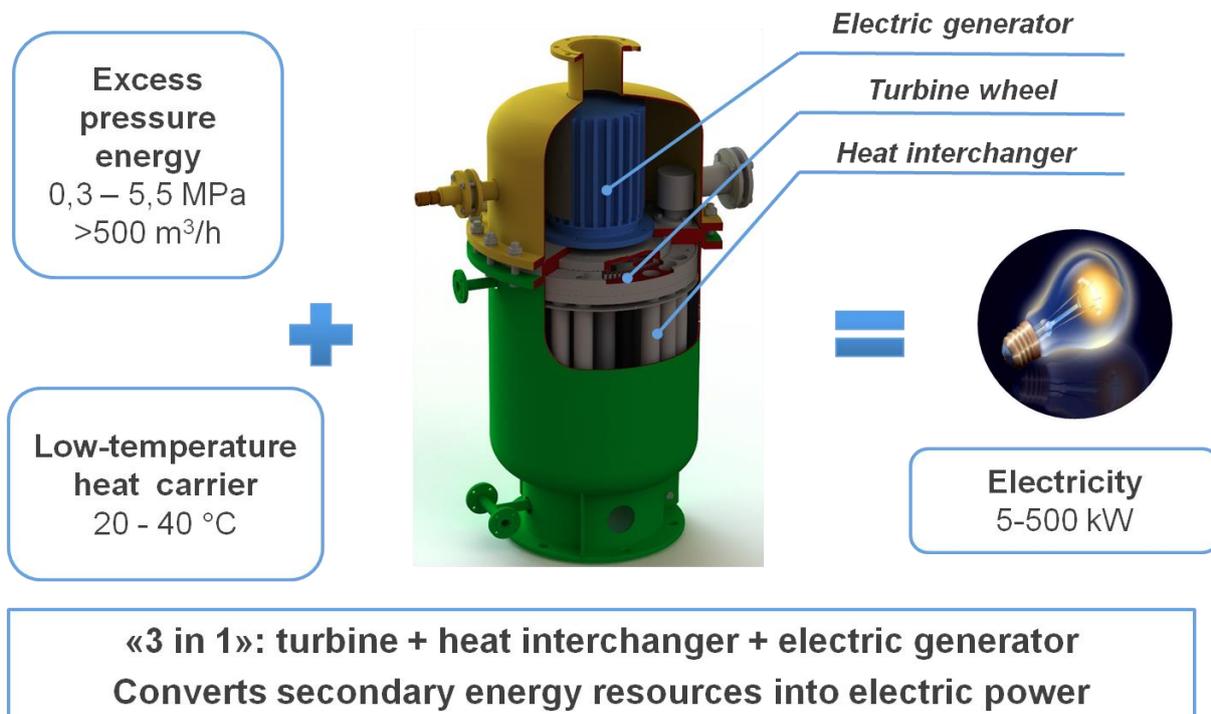
The offered model range of installations works in the range of expense from 500 and up to 40000 m³/h and also with natural gas pressure to 6,3 MPa that allows to achieve universality and the opportunity almost everywhere to use gas differential pressure energy.

Main technical characteristics of TGU

Payment order No.	Name of the Parameter	Parameter value
1	Maximum working pressure, MPa	0,6/1,2/5,4/6,3
2	Rated gas working pressure, MPa	0,2 - 6,3
3	Jutput gas pressure, MPa (absolute)	0,01 - 1,2
4	Gas flow in the nominal loading mode, m ³ /kW	70-120
5	Range of gas flow, m ³ /hour	500 - 40000
6	Temperature of working environment for TG, not below °C	0
7	Working pressure of the heat carrier, no more than a MPa	0,4
8	Heat carrier temperature on an input of TG, no less than a °C	30
9	Generated electric power, kW	5 - 400
10	Rated voltage, kV	0,4
11	Rated frequency, Hz	50
12	Nominal synchronous shaft speed of TG, rpm	3000
13	Automatic control system	On basis of PLC

Most part of the specified parameters can be changed upon the demand of the customer

The main difference of the Turbosphere units from turbodetanders and detander-generating units is that it is capable to work in the wide range of expenses and gas pressure, keeping at the same time both required parameters and quality of the generated electric power; it is reliable, rather inexpensive unit, the minimum requirements to technical services. Turbosphere is applicable for both autonomous power supply where the main goal is to ensure needs for the electric power of object's own needs and for parallel work with an external network when the purpose is to generate maximum power using all potential from gas stream while delivering electric power to an internal network of an enterprise and with sale (if needed) of overpressure energy to an external network.



The specified advantages are reached mainly by:

- 1) The original patented construction at which there is a high level of use of standard elements, details and nodes of local production that also excludes dependence on import.
- 2) Use of common industrial asynchronous generators and bearing blocks with consistent lubrication and also absence of dynamic multiplexing.
- 3) The relative simplicity of construction due to minimization of quantity of details and elements and also a turbogenerator low speed (the synchronous rotating speed - 3000 RPM).
- 4) Besides we managed to realize the diagram of multistage extension of gas on one driving wheel with a possibility of the intermediate heating of gas in the course of extension by means of the built-in heat exchanger heater, using low-potential heat and thermal waste of the enterprises.
- 5) Unit is intended for operation not only on natural gas, but also with others non-aggressive gases.

TGU "Turbosphere" are developed and made according to all to requirements of standards European and Custom unions (TR CU 04, TR CU 012, TR CU 020, TR CU 032, Gazpromsert, etc. Process of certification in the European Union is conducted.) Our company works and has undergone assessment procedure of compliance to the international quality management system of ISO 9001.

Model range of installations

TGU execution options and their symbols:

Rated generated power / Maximum working pressure	0,6 MPas	1,2 MPas	5,4 MPas	6,3 MPas
5 kW	TGU-5-6	TGU -5-12	TGU -5-54	TGU -5-63
8 kW	TGU -8-6	TGU -8-12	TGU -8-54	TGU -8-63
11 kW	TGU -11-6	TGU -11-12	TGU -11-54	TGU -11-63
15 kW	TGU -15-6	TGU -15-12	TGU -15-54	TGU -15-63
18,5 kW	TGU -18,5-6	TGU -18,5-12	TGU -18,5-54	TGU -18,5-63
22 kW	TGU -22-6	TGU -22-12	TGU -22-54	TGU -22-63
30 kW	TGU -30-6	TGU -30-12	TGU -30-54	TGU -30-63
37 kW	TGU -37-6	TGU -37-12	TGU -37-54	TGU -37-63
45 kW	TGU -45-6	TGU -45-12	TGU 45-54	TGU -45-63
55 kW	TGU -55-6	TGU -55-12	TGU -55-54	TGU -55-63
75 kW	TGU -75-6	TGU -75-12	TGU -75-54	TGU -75-63
90 kW	TGU -90-6	TGU -90-12	TGU -90-54	TGU -90-63
110 kW	TGU -110-6	TGU -110-12	TGU -110-54	TGU -110-63
132 kW	TGU -132-6	TGU -132-12	TGU -132-54	TGU -132-63
160 kW	TGU -160-6	TGU -160-12	TGU -160-54	TGU -160-63
200 kW	TGU -200-6	TGU -200-12	TGU 200-54	TGU -200-63
250 kW	TGU -250-6	TGU -250-12	TGU -250-54	TGU -250-63
315 kW	TGU -315-6	TGU -315-12	TGU -315-54	TGU -315-63
400 kW	TGU -400-6	TGU -400-12	TGU 400-54	TGU -400-63

Depending on purpose and the place of application, TGU execution can be with the heater (execution – H) and the magnetic clutch (execution - C).

Symbol TGU at the order:

Turbogenerator unit TGU -

1. Nominal generated electric power, kW

2. Maximum working pressure, bar

3. With the heater (falls without heater)

4. With magnetic clutch (falls without magnetic clutch)

Example of TGU identification number at the order: "Turbogenerator unit "Turbosphere" TGU-15-6-H-C of TU 28.11.23-001-29475178-2017" – Turbogenerator unit "Turbosphere" with the rated generated electric power of

15 kW calculated on the maximum working pressure of gas of 6 bars, execution – with the heater and the magnetic clutch.

TGU "Turbosphere" is delivered in a set:

- TGU turbogenerator (according to the selected model);
- Automatic control system of TGU intended for control, monitoring and dispatching of data on TGU operation to the operator station;
- Passport of a unit;
- Operation manual;
- Documents of certified compliance.

Terms of delivery:

We are ready to provide the full complex of works on application of TGU "Turbosphere" including the following main stages together with the partner organizations:

- 1) Carrying out energy survey;
- 2) Development of technical enquiry and techno-economic justification;
- 3) Development of design documentation;
- 4) Production and test of the unit at the testing stand;
- 5) Development of the implementation project on an object;
- 6) Carrying out the set and commissioning works;
- 7) Service implementation.

30% together with the order (advance payment);

70% payment after delivery (on receiving CMR, invoice).

This condition is standard, at the same time we offer *alternative options of delivery*:

- within the energetics service contract;
- turnkey basis together with the partner organizations;
- set implementation with the delayed payment (till 4000 hours of operating time on your object!).

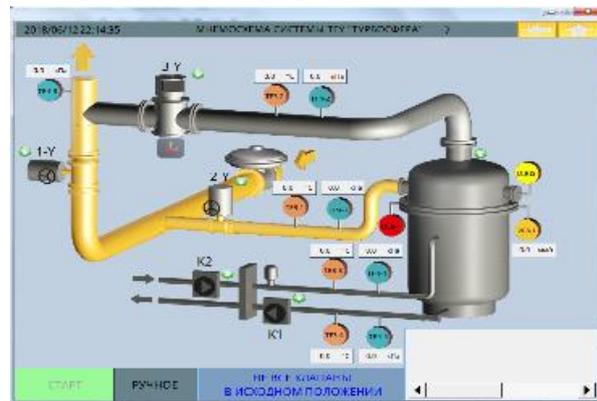
Warranty

The manufacturer provides a warranty of 24 months after set implementation to its maintenance.

Installation and mounting:

Installation and mounting of TGU will be executed based on results of project developments.

Being the experts in the field of energetics engineering and industry, we are ready to approach it fully and in a flexible way to solve your tasks in the field of energy efficiency.



CHP Plant MKTS, Minsk



CE Certificats

Sincerely,
Group of companies “TurboSphere”!

QUESTIONNAIRE

Turbogenerator unit "TurboSphere"*

* TurboSphere is the turbogenerator unit (TGU) intended for generate electrical energy by converting natural gas overpressure energy. TurboSphere are mounted in parallel with gas pressure regulator on the Gas Pressure Regulating Station and Gas Pressure Reducing Station. It is possible to install either single unit or several of them one by one or parallel to each other. TurboSphere can be used for pressure utilization of other gases. All the parameters are selected according to the object features. We ask you to completely fill out the provided questionnaire.

Ready to answer your questions: 375292589241, e-mail: kl@ts.energy

Name of an object where the TGU implementation is considered:

Place of accommodation (in a boiler room, Gas Pressure Reducing Stations, open area or other):

Type of gas

№	Name of the parameter	Value	Unit of measure
1	Gas consumption under normal conditions:		
	minimum		m ³ /hr
	maximum		m ³ /hr
	nominal		m ³ /hr
	Number of hours of a nominal expense (<i>the statistics and schedules of annual, monthly or daily consumption are welcomed</i>)		hr
2	Gas overpressure input (before pressure regulator):		
	minimum		MPa
	maximum		MPa
	nominal		MPa
3	Gas overpressure output (after pressure regulator):		
	nominal		kPa
	admissible deviation from nominal		%
4	Minimal gas temperature:		
	Before pressure regulator		°C
	after regulators (admissible)		°C
5	Recommended range of temperatures of gas at the output		°C
6	Parameters of the electric power output:		
	autonomous work / work for network		
	existence of external network		yes/no
	voltage (with admissible deviation)		κW
	Frequency (with admissible deviation)		hz
7	Electricity rate (for date of filling):		
	Bought from electric energy system		\$/(κW·h)
	Selling price (for on-site generation)		\$/(κW·h)
8	Total rated capacity of consumers of EE		κW
9	Annual consumption of EE for own needs of an object		κW·h/year
10	Parameters of low-temperature (from 30 °C) thermal streams (sources) for gas heating:		
	name (water, combustion gases, etc.)		
	temperature		°C
	pressure		MPas
	consumption		m ³ /hr
11	Notes		
12	Date of compilation		
13	Job position and full name of compiler		
14	Contact details:		