KUALA LUMPUR 2012 WORLD GAS CONFERENCE

25th world gas conference

"Gas: Sustaining Future Global Growth"

New approach to solving the problem of energy efficiency increase in the operation of major gas transportation system

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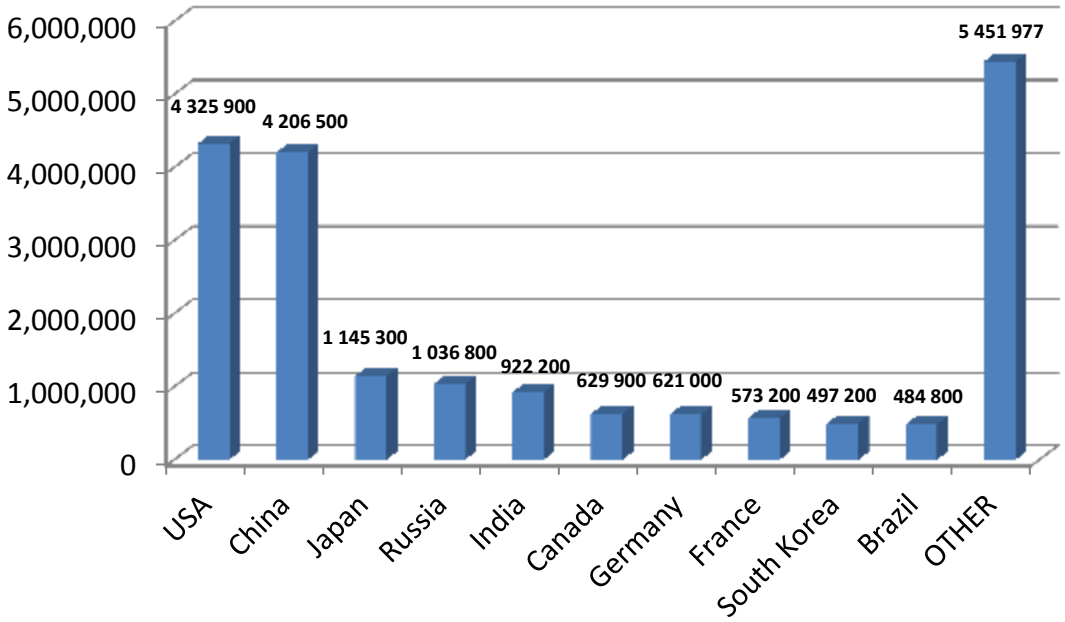
Annual production of electricity worldwide

mln. kW/hour



Structure of electric power production

THERMAL POWER PLANTS- 62,5%

HYDROELECTRIC POWER PLANTS - 19,5%

NUCLEAR POWER PLANTS - 16,5%

OTHER KINDS OF ENERGY - 1,5%

Energy consumption prospects

Global energy consumption from 2008 to 2035 will grow by 53%.

(as reported by Bloomberg agency with the reference to the report of the US Department of Energy)

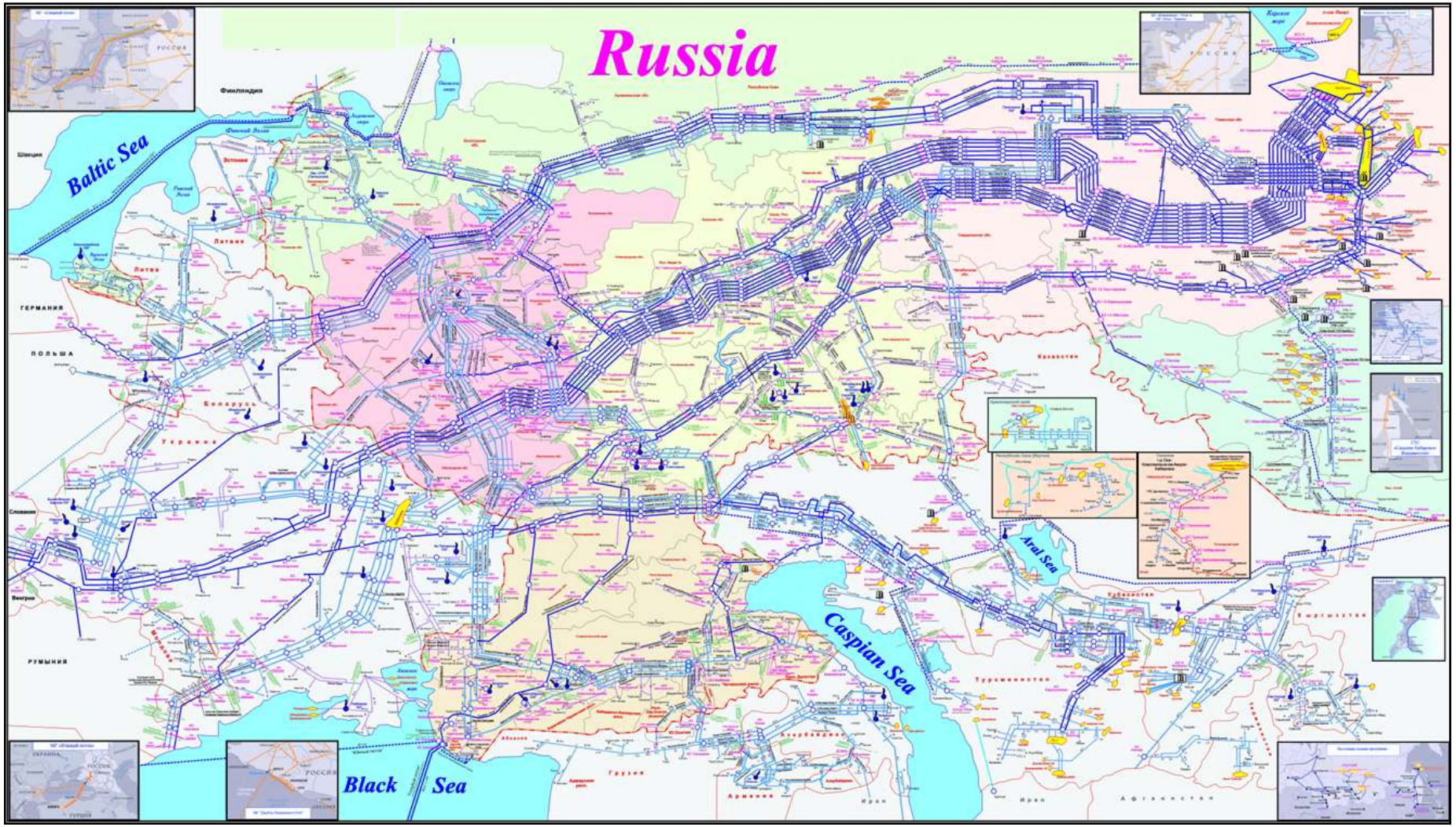
In order to meet the demand for fuel, global extraction of natural gas will increase by 52%

- up to 4,79 trn. cub. m.

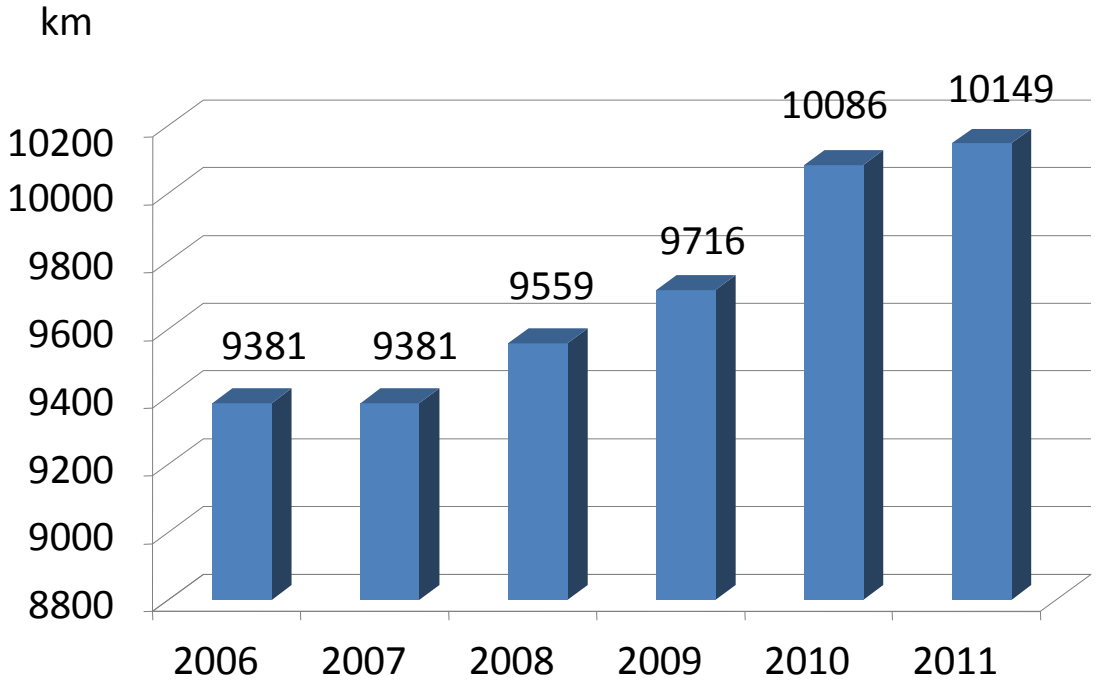
As the production of electrical energy rises and the demand for natural gas increases, the impact to the environment grows too.

In order to solve this contradiction – the demand for more and more energy production and desire not to pollute our environment - it is necessary to turn our undivided attention to increasing the efficiency of fuel energy utilization obtained by burning fossil fuels.

Unified gas supply system of Russia

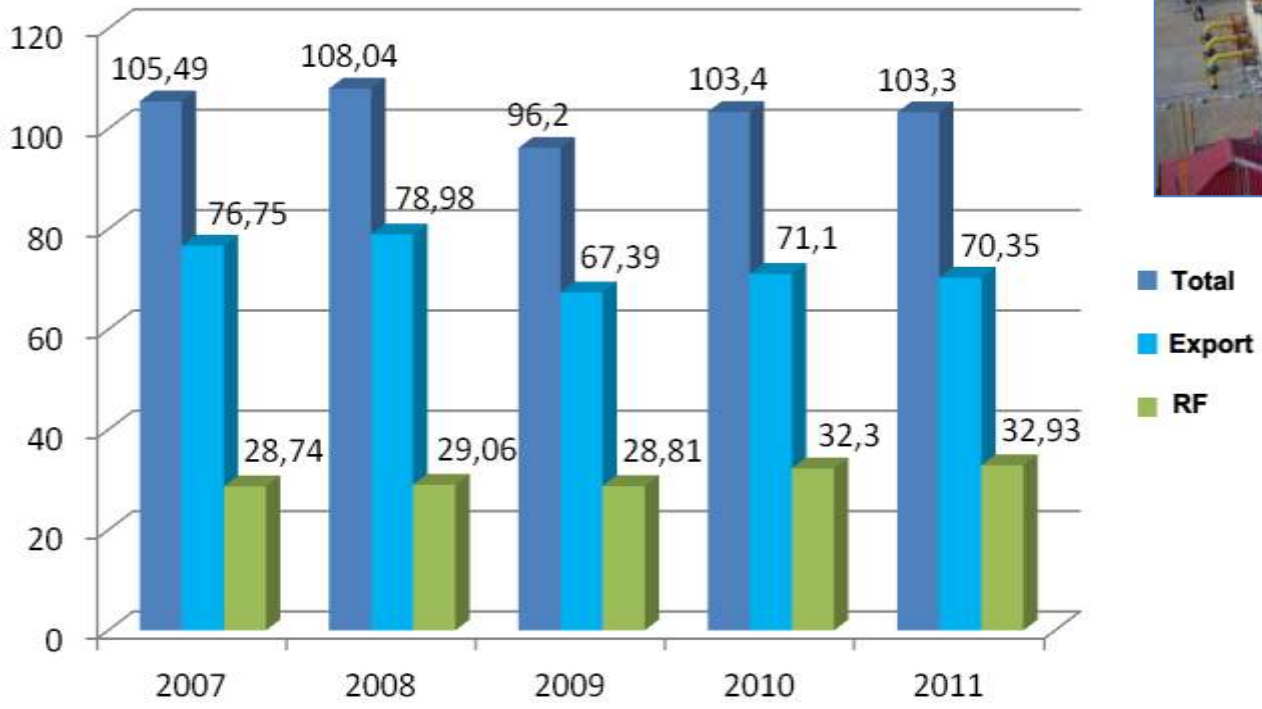


Length of gas pipelines of Gazprom transgaz St.-Petersburg



Volume of gas transported by Gazprom transgaz St.-Petersburg

bln.cub.m



Major hydroelectric power plants of Russia

Description	Installed capacity, MW
Sajano-Shushenskaja HPS	6400
Krasnojarskaja HPS	6000
Bratskaja HPS	4500
Ust-Ilimskaja HPS	3840
Volgogradskaja HPS	2541
VOGES HPS	2300
Cheboksarskaja HPS	1370
Saratovskaja HPS	1360
Zejskaja HPS	1330
Nizhnekamskaja HPS	1205
Zagorskaja HPS	1200
Votkinskaja HPS	1020
Chirkejskaja HPS	1000
Total capacity	34066

Yamal-Europe gas pipeline of Gazprom transgaz St.-Petersburg

Specific waste of the thermal energy per 1 GCU along Yamal-Europe gas pipeline is up to 36,8 mW

Potential of thermal energy consumption

Natural gas is generally used in the operation of gas compressor units intended for transportation of gas by gas pipelines.

The efficiency for the heat combustion of fuel gas is not more than 35%, and up to 2/3 of thermal energy is emitted into the atmosphere.

The thermal energy from exhaust gases within Gazprom OJSC as a whole, could be used to generate up to 5 000 MW of additional electric power

Development of steam-and-gas heat recovery unit

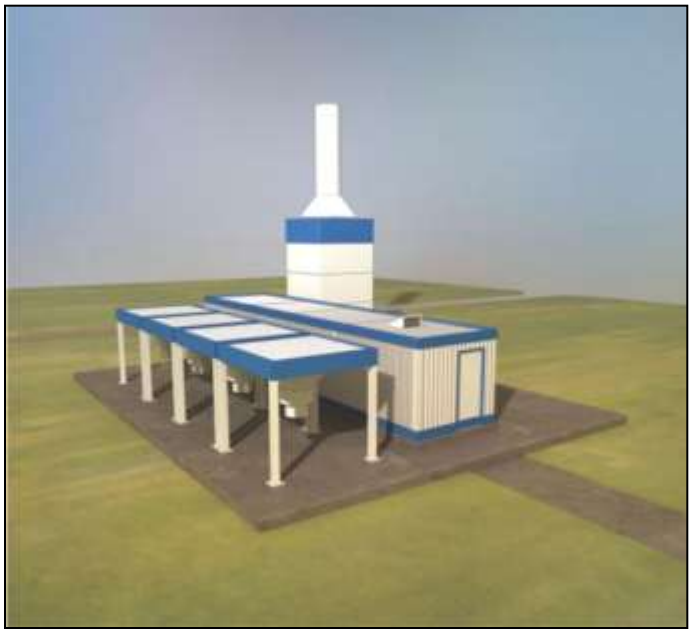
- The use of steam-and-gas heat recovery units

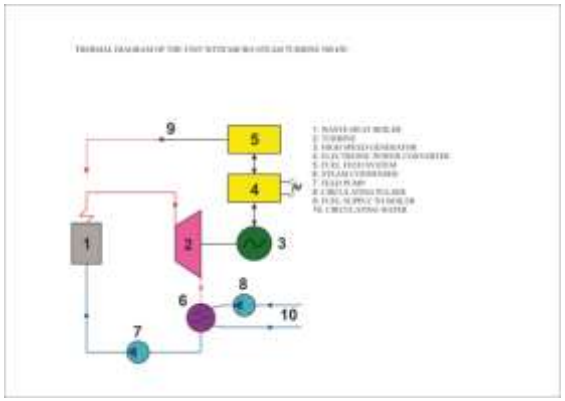
is an innovative solution of using the excess thermal energy formed at the compressor stations.

Since 2011, Gazprom transgaz Saint Petersburg LLC has been carrying out activities to design steam-and-gas heat recovery unit, consisting of:

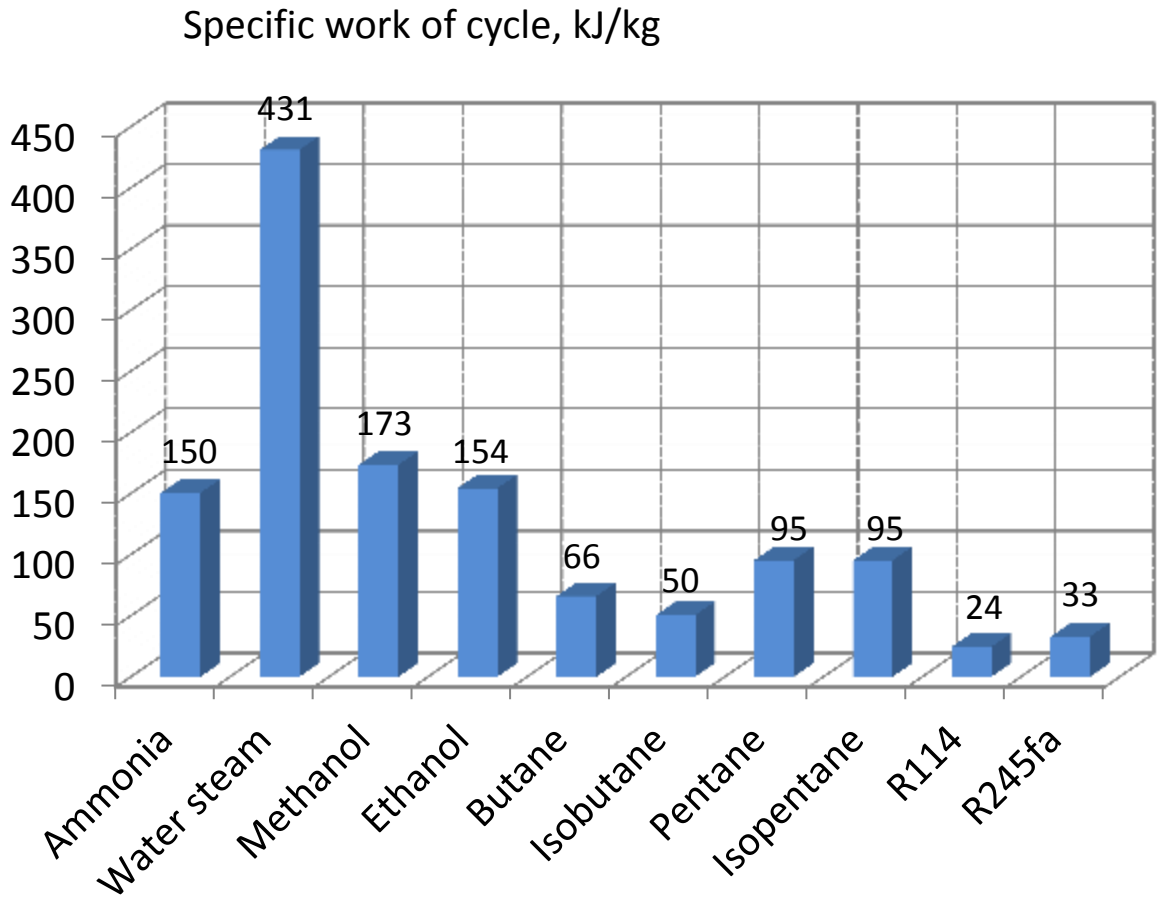
- currently operating gas turbine

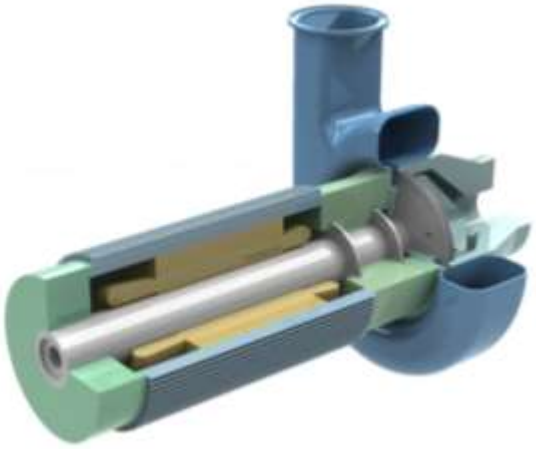
- heat-recovery steam-turbine unit with unique size and weight parameters that uses choked-flow, low flow-rate steam turbine and high-speed synchronous electric generator





The choice of working medium for heat recovery unit





Unit with micro-steam turbine

The use of gas reduction energy

In 2010-2011 Gazprom transgaz Saint-Petersburg developed and implemented at gas distribution station a development prototype of independent source of electrical power with capacity up to 20 kW, operating due to pressure drop during gas reduction.

Low flow-rate extension turbine

This equipment represents a new class of turbines characterized by the following main features :

- small volume flow rates of the working medium
- possibility of considerable enthalpy drops with comparatively high economical efficiency
- transonic and supersonic flows in nozzle apparatus and in working wheel
- increased erosion resistance of nozzle and working screens

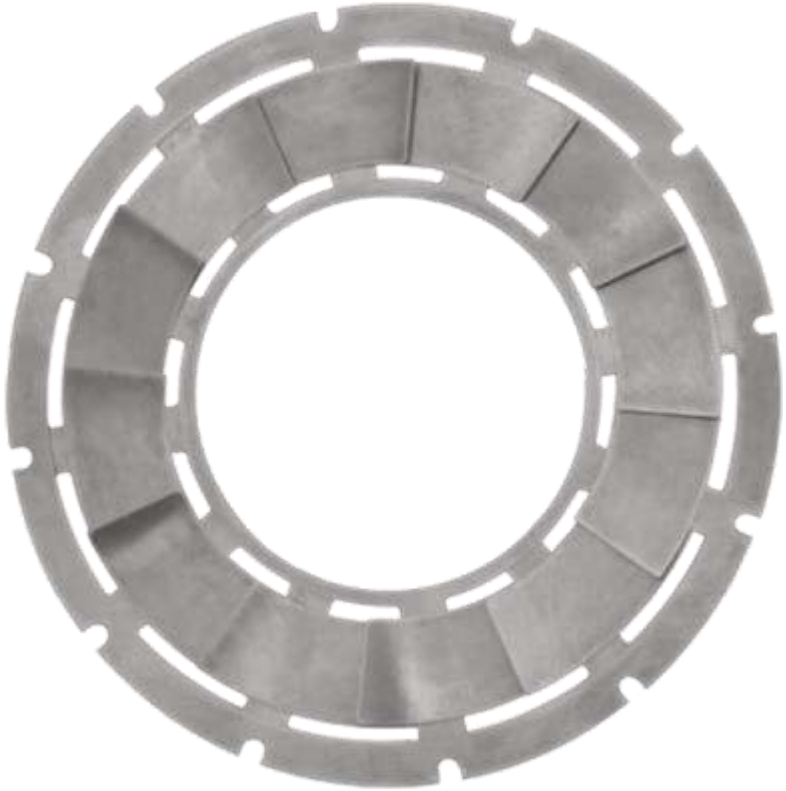
Synchronous Generator

High-speed synchronous generator :

- is made with permanent super strong magnet excitation
- has a higher performance factor
- has improved output, size, weight and noise characteristics

The synchronous generator is highly reliable. The simplicity of its design and maintenance is an important factor for the facilities of independent and small-scale power generation

Gas spade dynamic bearings (GSDB)



GSDB have several advantages:

- They ensure operational integrity over a wide range of temperatures
- They provide high rotational speed of supported shaft
- They are ecologically clean because they use ambient air or other working gases, such as natural gas, as a lubricant
- They eliminate the need for the delivery of special lubricants, which is particularly important when working in distant regions

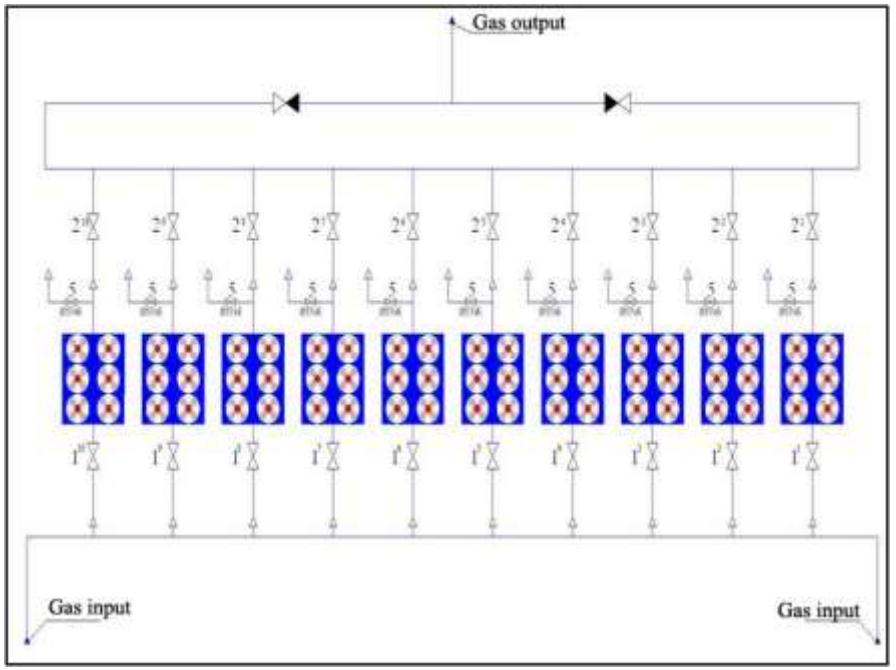
Special features of developed turbo-generator

- High performance factor - not less than 70%
- Extremely low size and weight parameters: *weight of rotor of turbo-generator is 8 kg; diameter of rotor of turbine is 126 mm*
- Absence of lubrication system:
  thrust spade gas dynamic bearings are used
- High explosive and fire safety
- Highly ecological:
  no need to burn additional fuel to produce electricity, so there will be no air emissions
- No maintenance staff is required: *the working process if fully automated*

Apart from gas industry the above-mentioned independent power plants of low power can also be used in the other fields that have low-grade thermal energy sources.

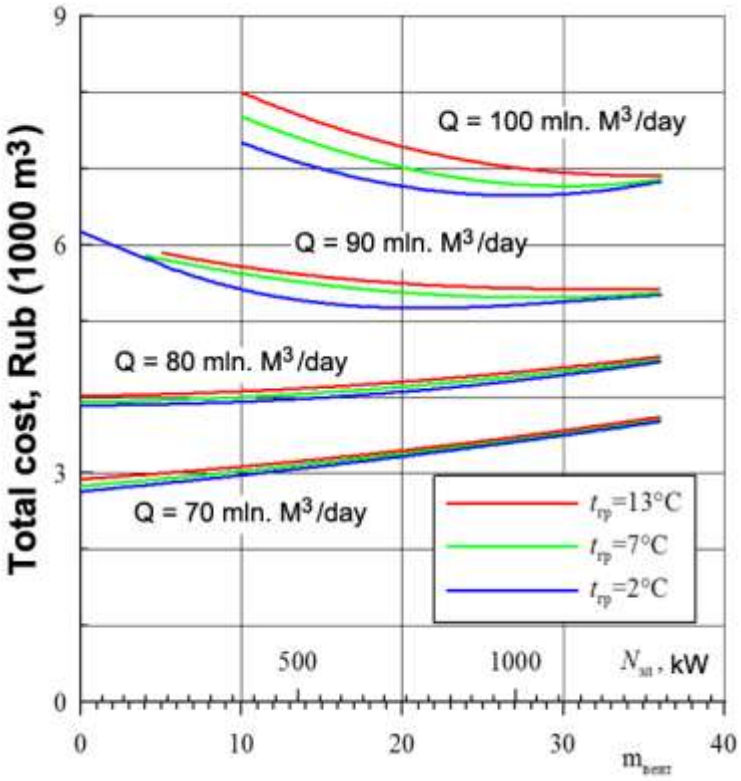
Gas air cooling units

Gas ACU connection diagram



Gas transportation costs

Relation of cost for pumping 1000 cub.m. of gas depending on the number of ACU fans operating at Torzhok Compressor station on Torzhok – Rzhev sector of Gazprom transgaz Saint-Petersburg pipeline at outer air temperature 10°C and CS output pressure of 80 kg/cm²



q – gas flow rate
$t_{гр}$ – soil temperature
$N_{эл}$ – total power of electric engines
$m_{вент}$ – number of fans

Main conclusions

1. The principles of design and application of heat-recovery steam turbines to generate additional electricity based on fuel gas used in GPUs are justified.

2. A method for identifying and reducing the cost of natural gas transportation that takes into account both the costs of electricity to drive ACU fan motors and the cost of fuel gas for GPU is developed.

3. A microturboexpander generator with electric power of 20 kW was designed, manufactured and commissioned

The results of our work are presented:

- At the II и III International forums «ENERGY FRESH 2010» and «ENERGY FRESH 2011»
  (Moscow, September 23-24, 2010 and September 28-29, 2011)

Diplomas and special prizes for best innovative design were received

- At the 22nd International Invention, Innovation and Technology Exhibition
  (May 20-22, 2011, Kuala- Lumpur, Malaysia)

The gold medal and special prize for the best ecological invention of the highest category were received

- At the 6-th Seoul International Invention Fair SIIF-2010
  (December 2– 5, 2010 , Seoul, South Korea)

Diplomas and medals including from Polish inventors' Association were received

Thank you for attention