

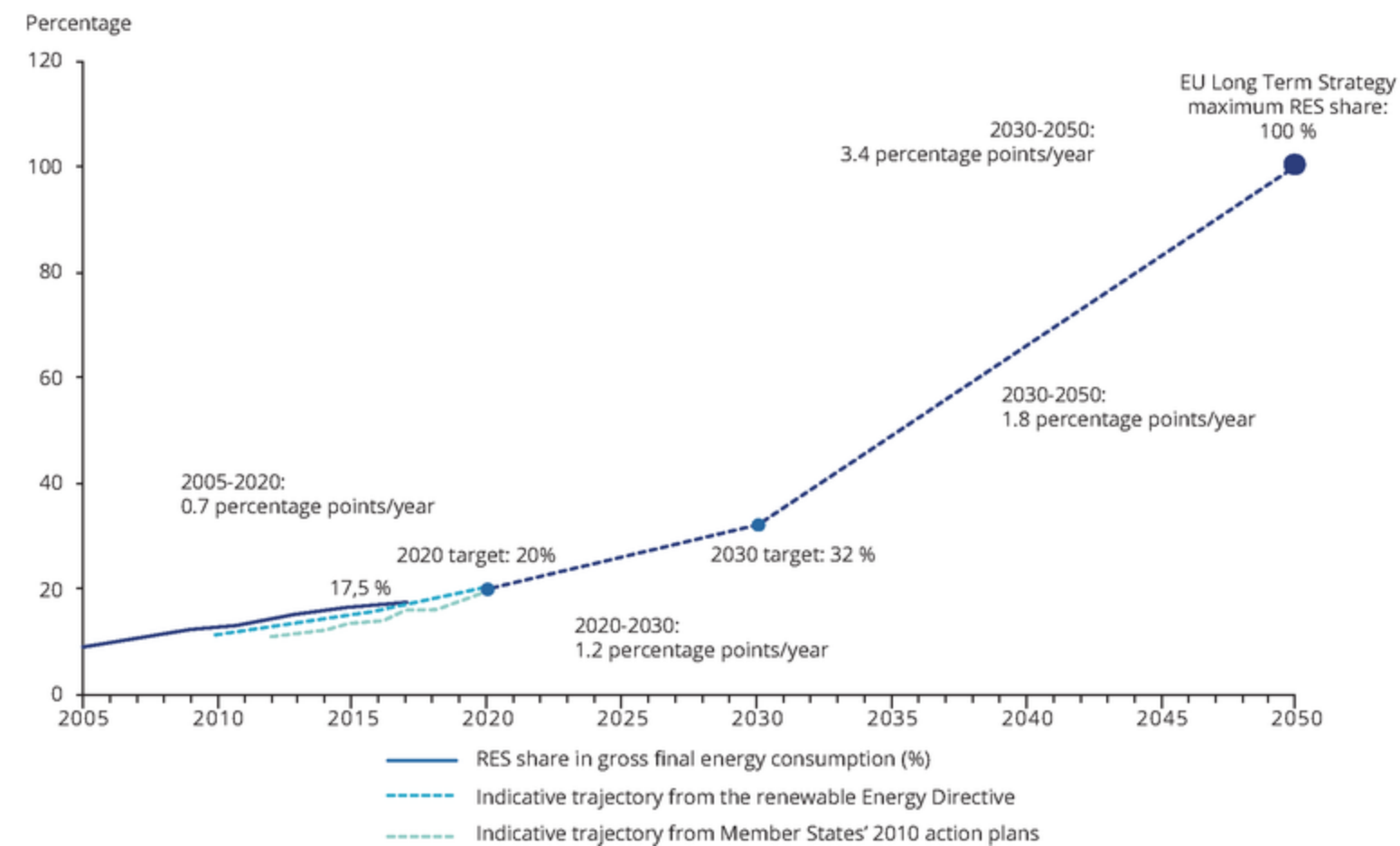


**“Substitution of fossil fuels through the gasification  
of carbon-containing raw materials.”**

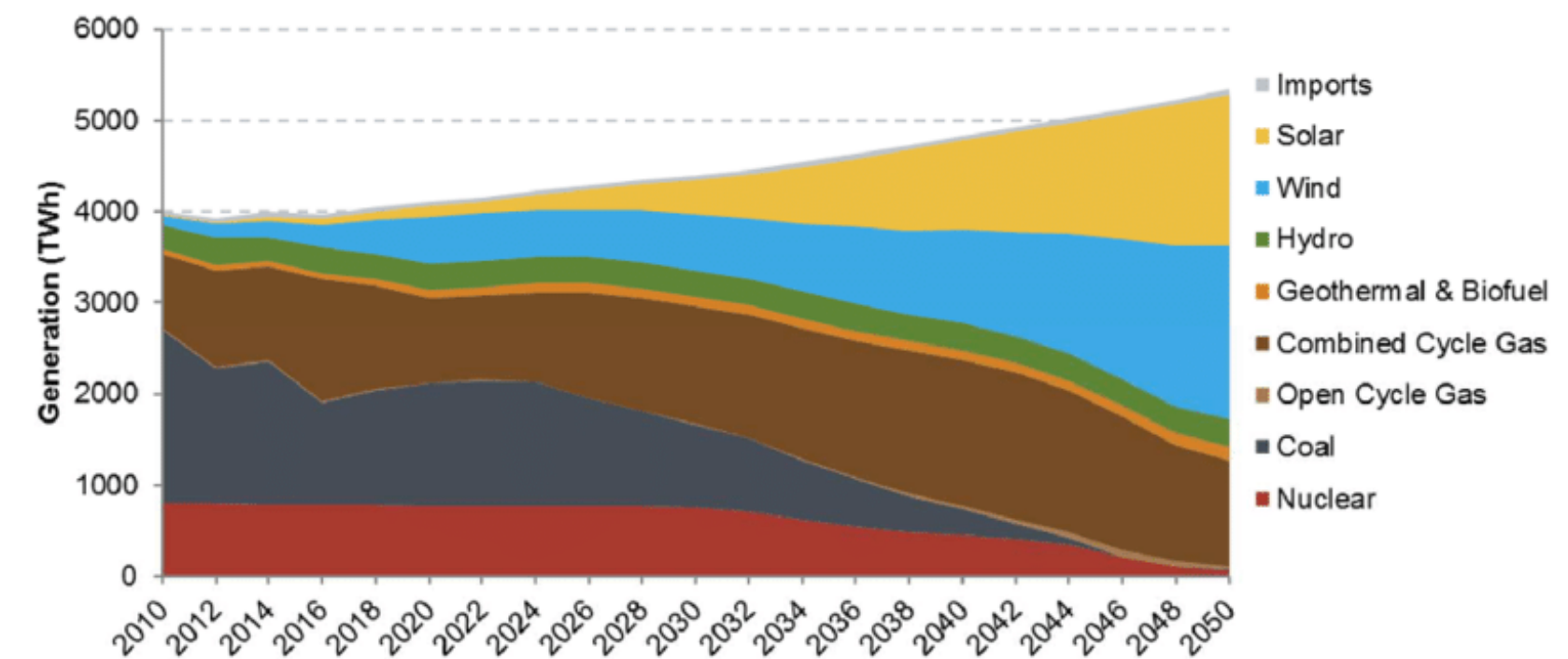
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# Rising of renewable energy

## Projected increase in Renewable energy in Europe and USA.



\*<https://www.eea.europa.eu/en/analysis/maps-and-charts/share-of-eu-energy-consumption-figures>



\*[https://www.researchgate.net/figure/Renewable-Energy-Projections-for-the-US-Source-National-Renewable-Energy-Laboratory\\_fig1\\_320769019](https://www.researchgate.net/figure/Renewable-Energy-Projections-for-the-US-Source-National-Renewable-Energy-Laboratory_fig1_320769019)

# Gas generation technology

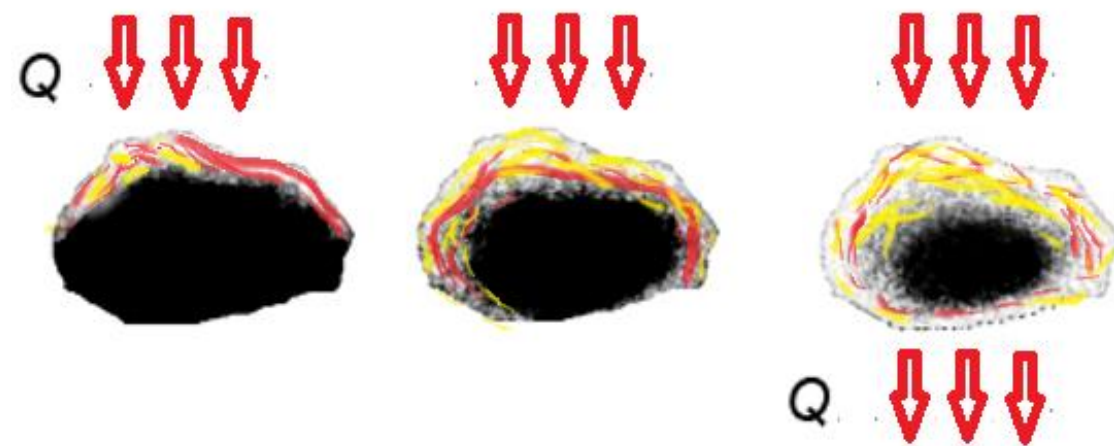
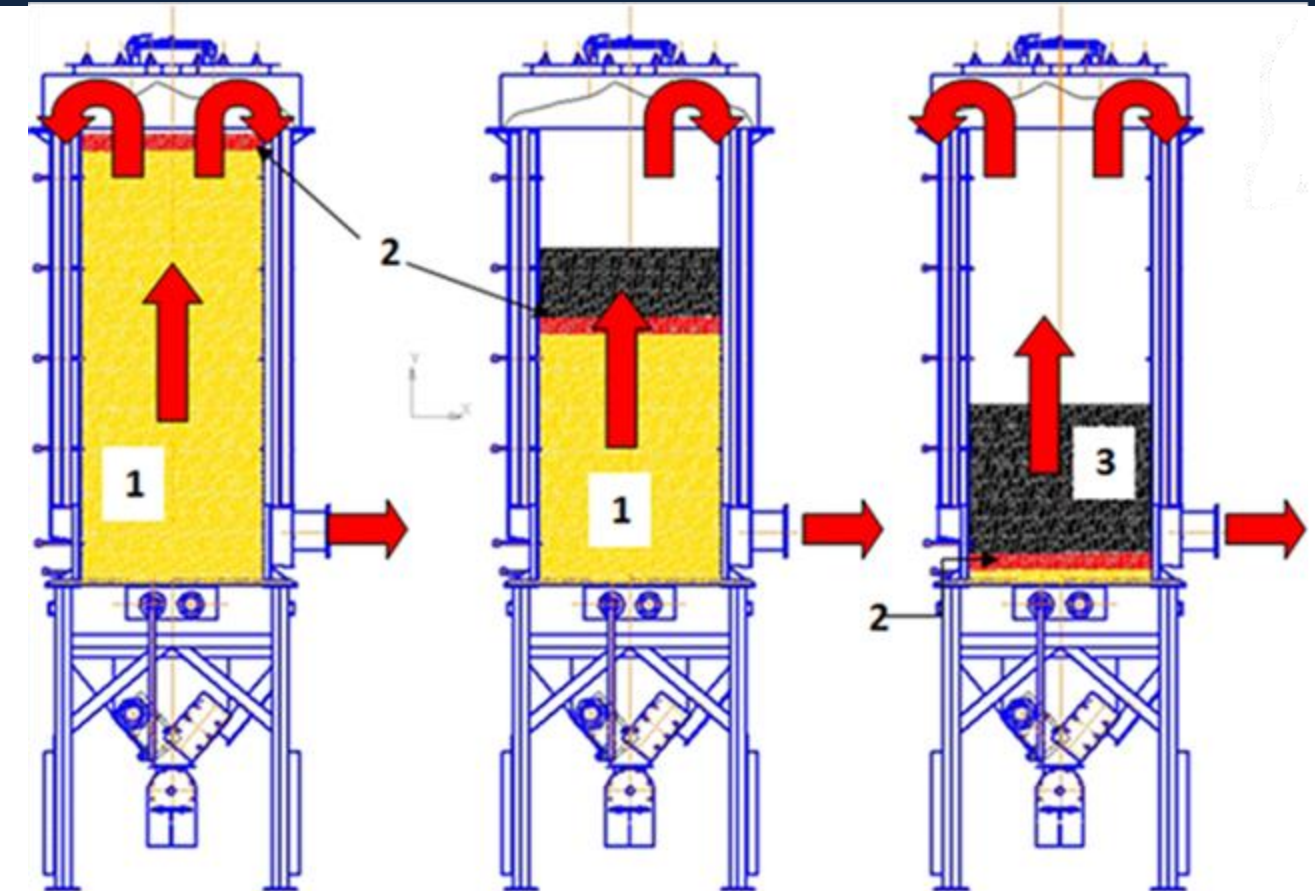
Schematic diagram of a periodic gas generator

(1) - fuel reserve layer;

(2) - heating, oxidation and reduction layers;

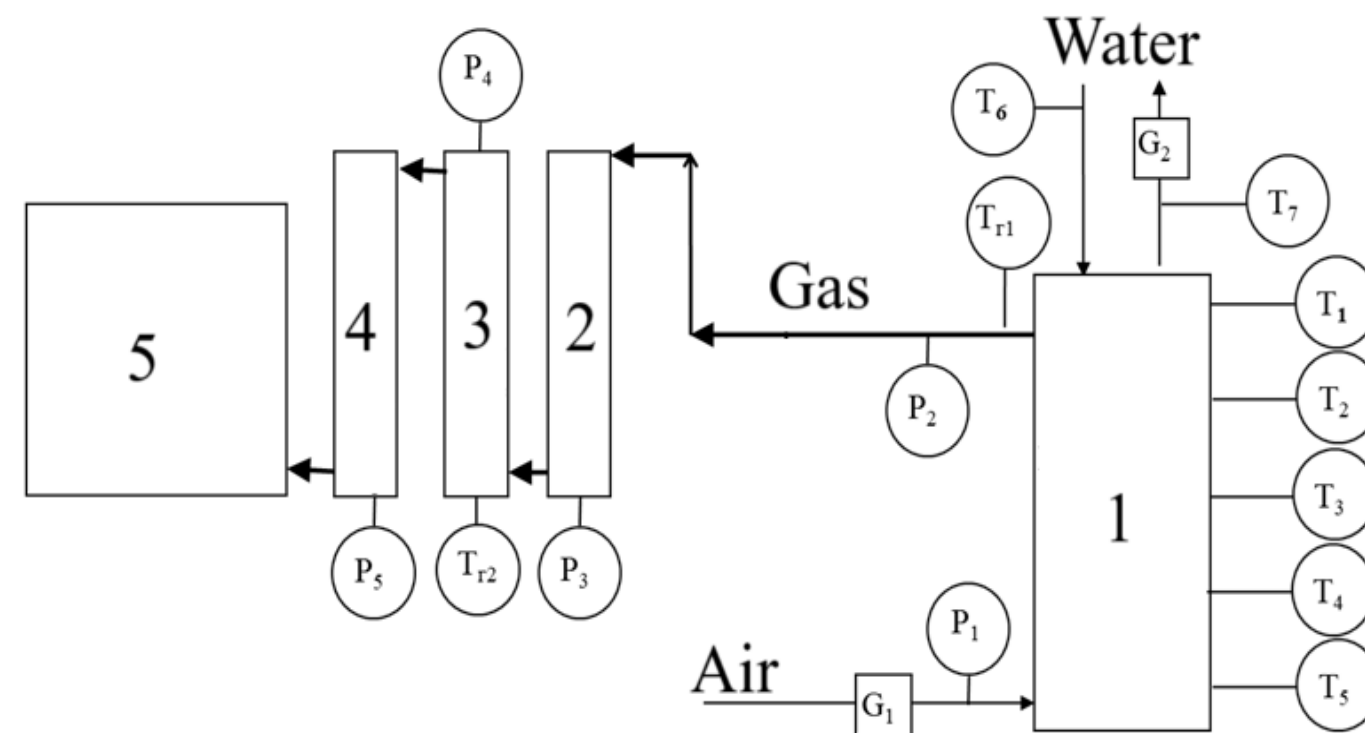
(3) - coke-ash residue layer;

► - direction of movement of the generator gas.



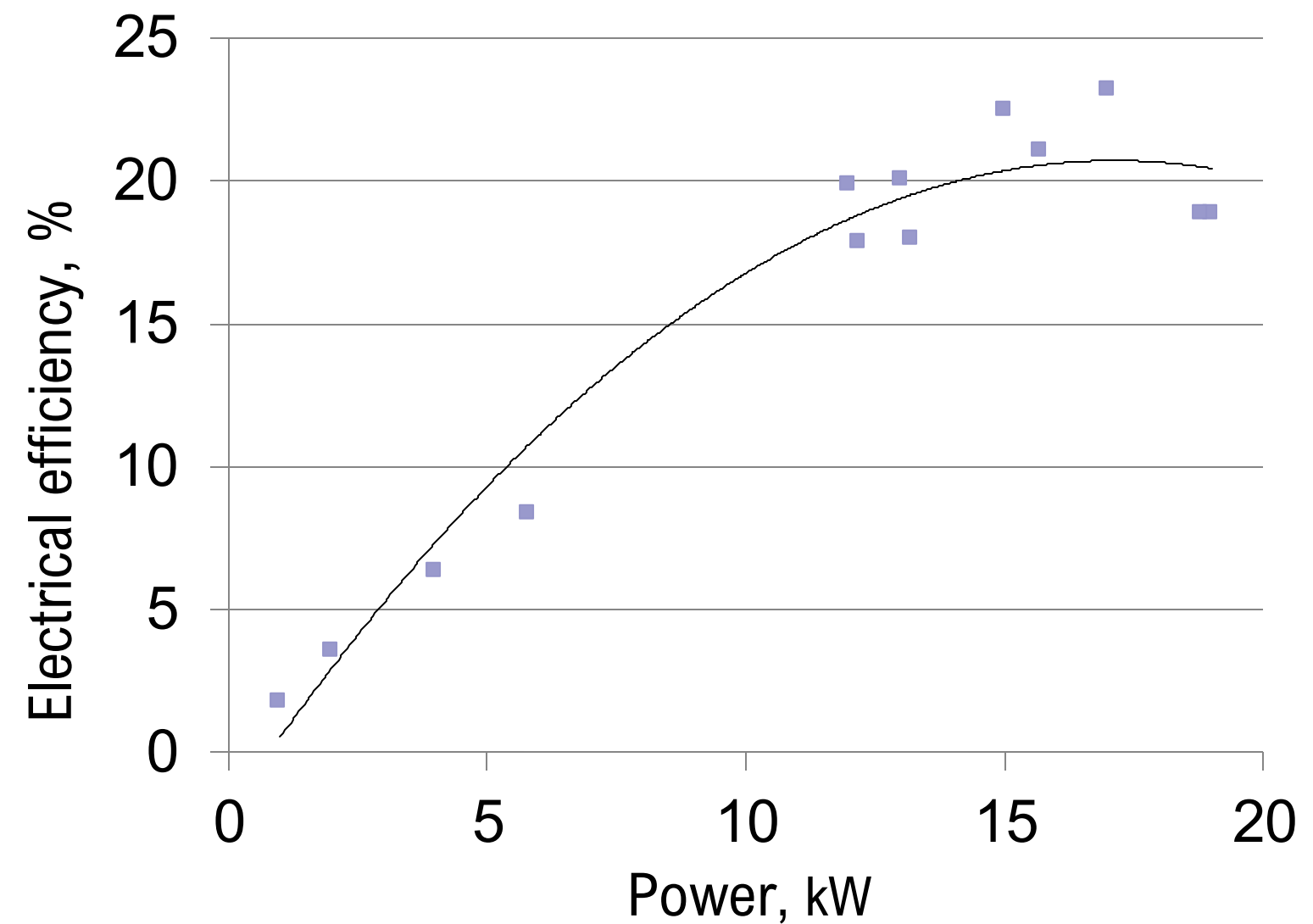
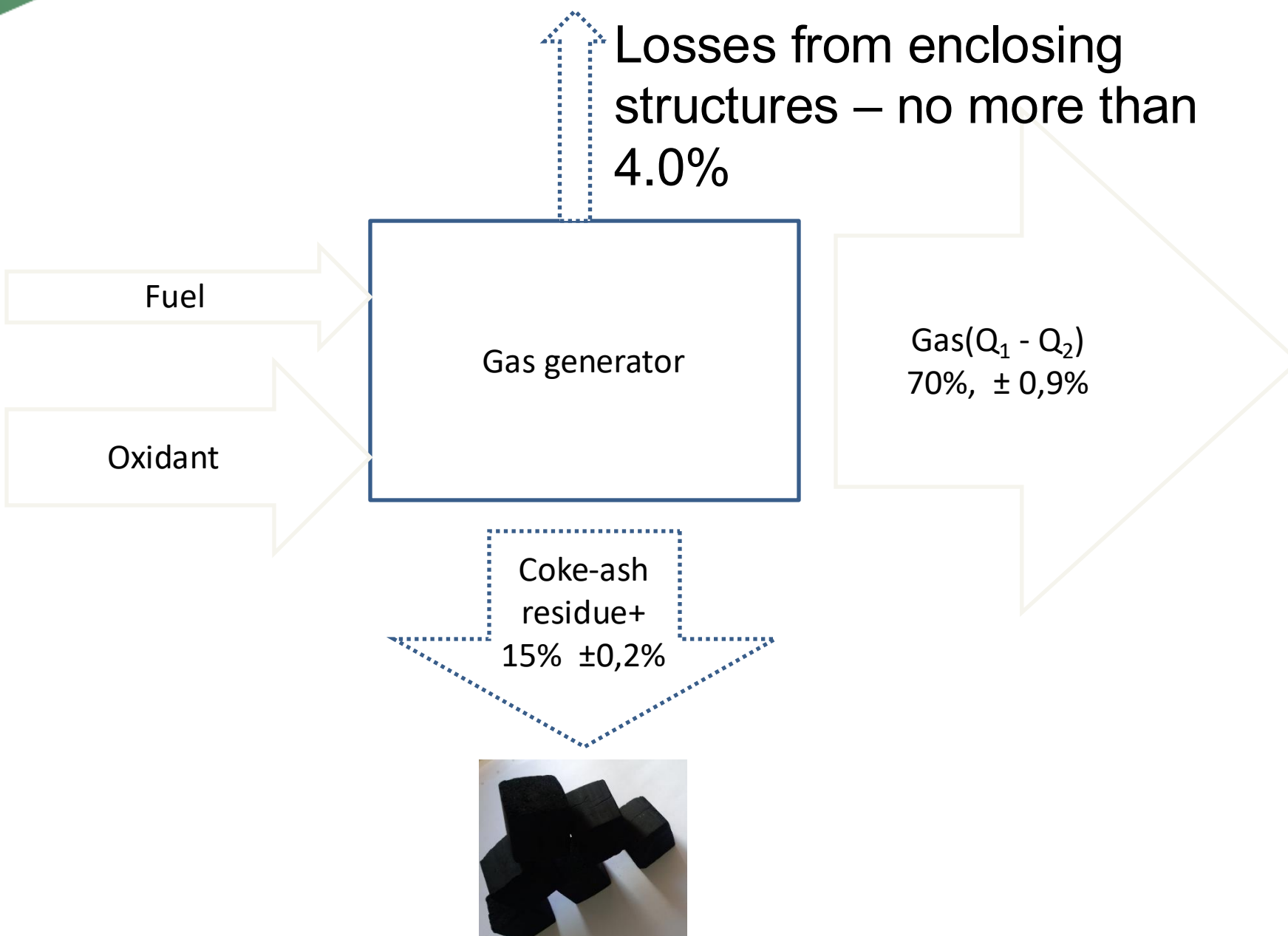
Scheme of the process development in a gas generator using the "return wave" principle

The main focus of the Alternative Fuels Technology Department is to generate electricity by using generator gas obtained from local fuels at a piston power plant to create autonomous or mobile sources of electrical energy.



The basis of the installation is a periodic gas generator 1. The generator gas cleaning system includes a heat exchanger-cooler 2, a coarse filter 3 and a fine filter 4, after which the purified generator gas enters a generator based on a piston machine 5.

# Experimental results



Energy balance of the process and electrical efficiency of the experimental system as a whole

# Experimental results

№	Complex capacity, % of nominal	Emissions, ppm		Emissions, g/kWh	
		CO	NO <sub>x</sub>	CO	NO <sub>x</sub>
1	2,5	2822	618	2,95	1,06
2	10,0	2952	589	3,08	1,01
3	15,0	4661	574	4,87	0,98
4	32,5	2015	575	2,10	0,98
5	37,5	2458	490	2,57	0,84
6	42,5	2472	445	2,58	0,76
7	58,7	2270	336	2,37	0,57
8	76,0	2140	269	2,23	0,50

Environmental standards: EURO-5: CO - 4.0 g/kW\*h, NO<sub>x</sub> - 2.0 g/kW\*h  
EURO-6: CO - 4.0 g/kW\*h, NO<sub>x</sub> - 0.4 g/kW\*h

Tests conducted on this unit showed the possibility of the unit operating on various types of fuel such as wood chips, sunflower husk pellets, straw, lignite and other. Data obtained during the tests indicate that the electrical efficiency of this unit reaches 22-24% in the optimal mode.

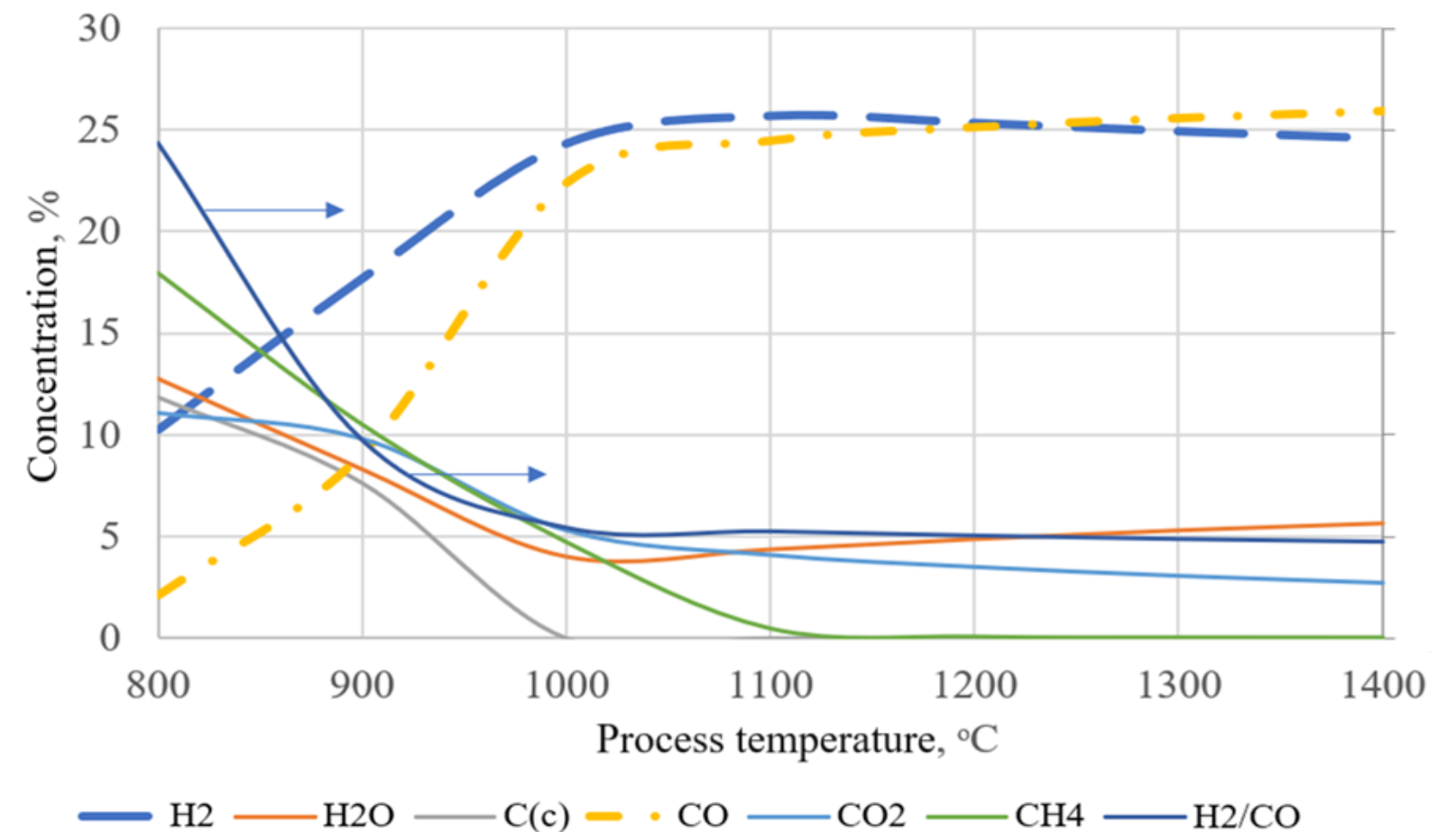


Currently, an industrial installation with a capacity of 75 kW for electricity is being tested.

# Technology for processing carbon-containing raw materials into synthesis gas

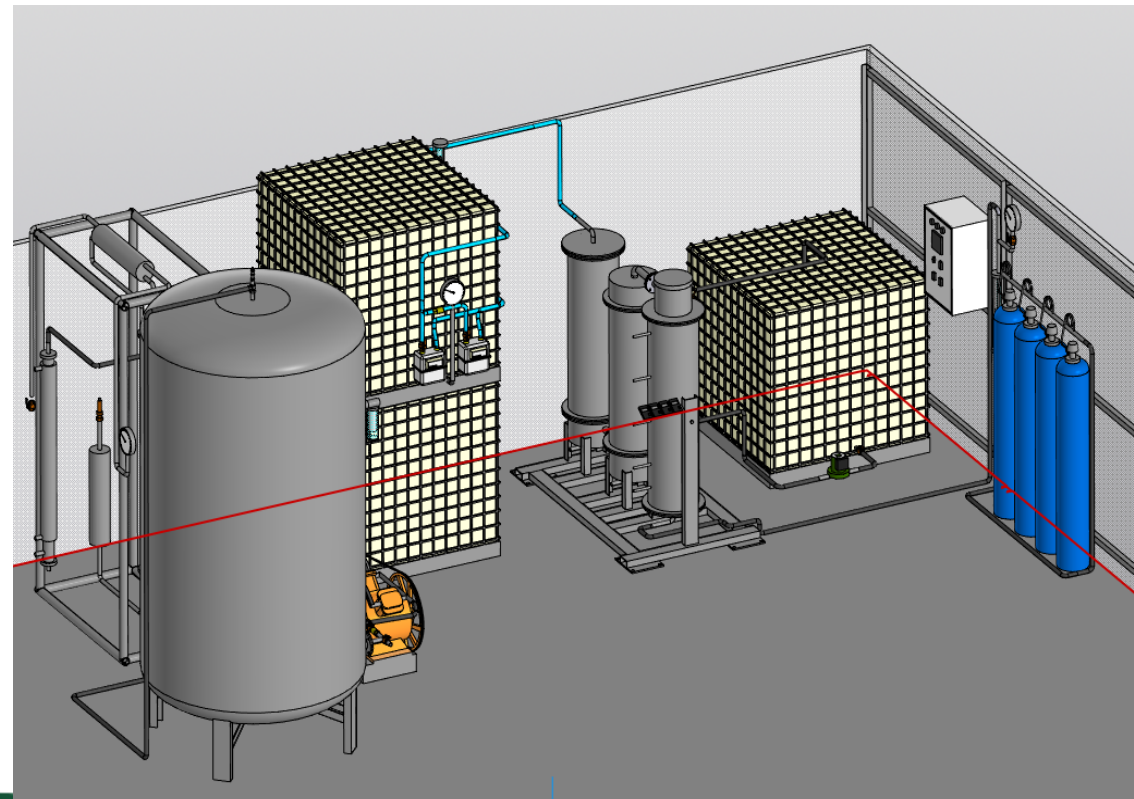
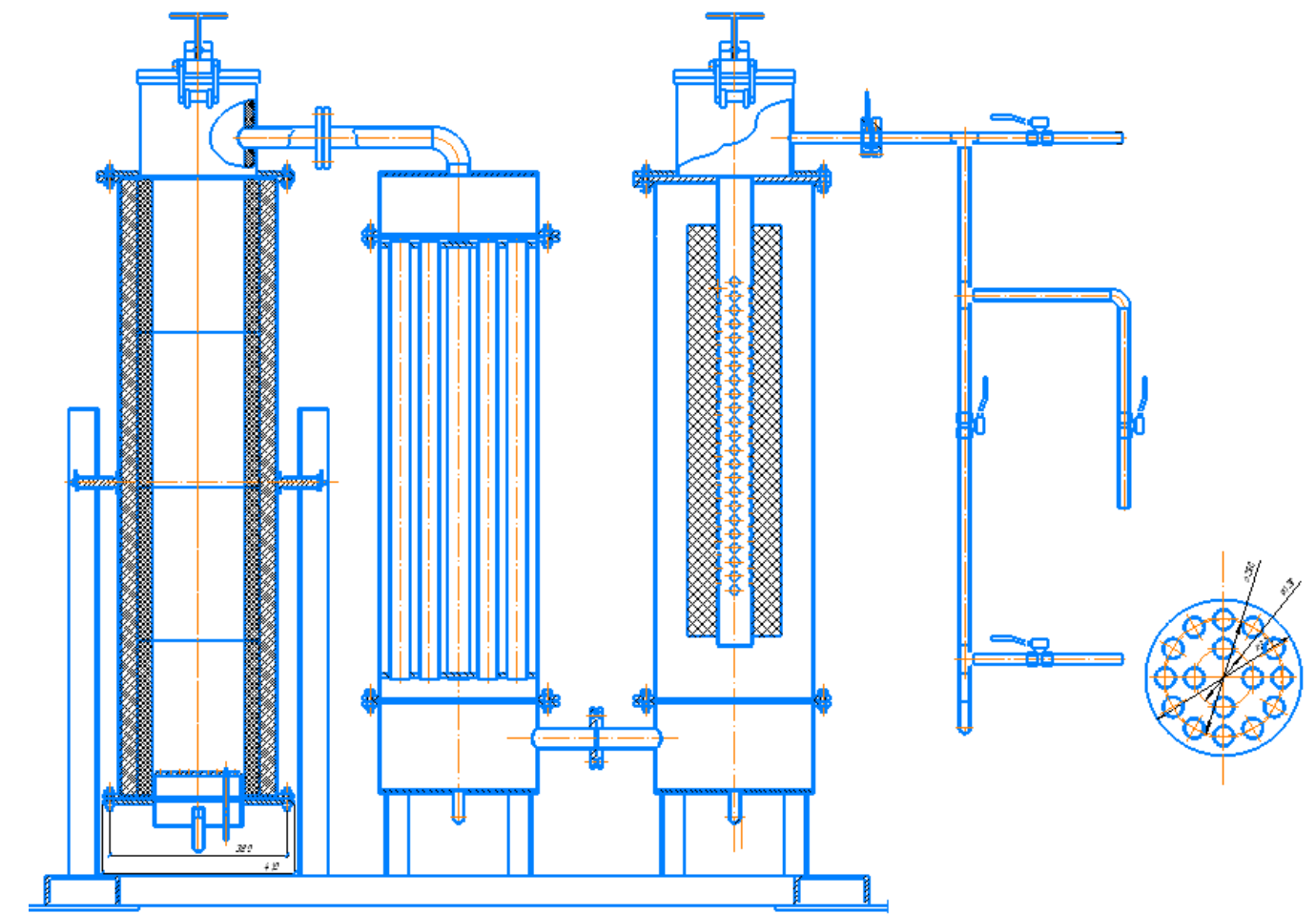
The second area of work of the department is obtaining generator gas with a given ratio of  $[H_2]:[CO]$ .

Mathematical analysis showed that the given ratio of  $[H_2]:[CO]$  can be obtained in a fairly narrow range of modes under conditions of low process temperature and high humidity and ensuring the formation of a solid carbon residue.



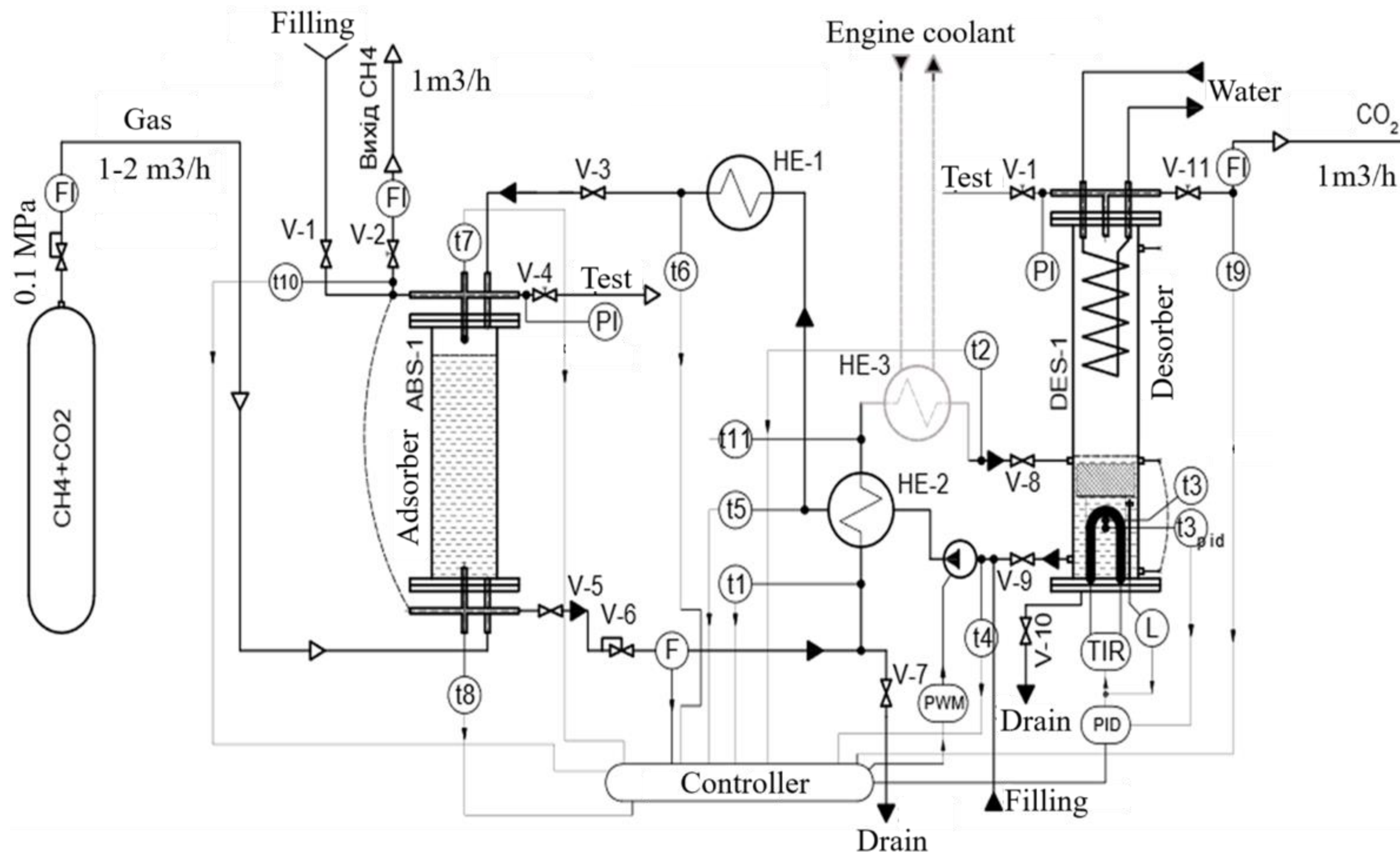
Results of modeling the process of oxygen gasification of wood chips with a humidity of 30%

Based on the results of mathematical modeling, design documentation was developed and an experimental setup was created.



Current experimental.

# Principle diagram of the facility for removing CO<sub>2</sub> from gasification products

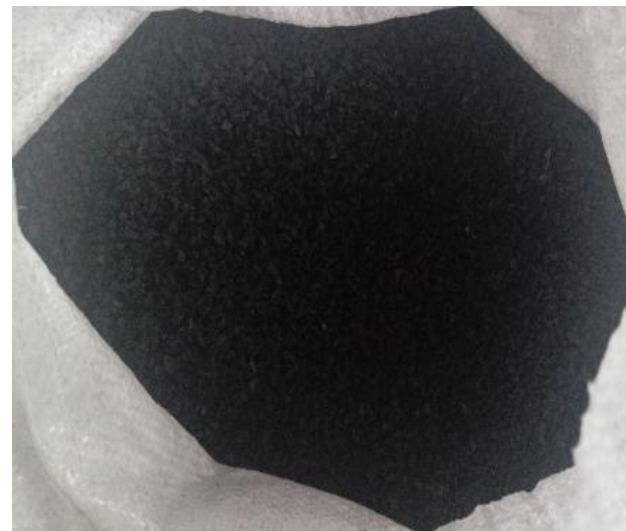


# Experimental results

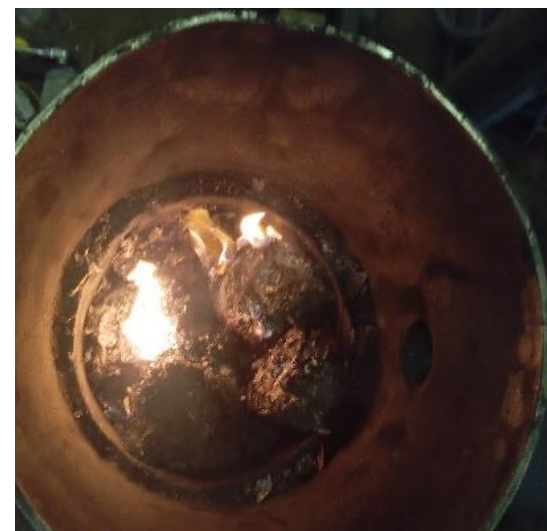
Lignite



Rubber



Biofuel



Problems with  
working on  
pure oxygen

# Experimental results

Components	Average composition of generator gas, %	Gas composition after adjustment, %
H <sub>2</sub>	21,23	41,65
N <sub>2</sub>	41,86	36,61
CO	19,65	17,19
CH <sub>4</sub>	2,31	2,02
CO <sub>2</sub>	12,05	0,00
C <sub>2</sub> H <sub>4</sub>	0,03	0,03
C <sub>2</sub> H <sub>2</sub>	0	0,00
C <sub>2</sub> H <sub>6</sub>	0,04	0,03
H <sub>2</sub> O	2,83	2,48
Summ	100	100
Heat of combustion		
higher kcal/m <sup>3</sup>	1369	1851
lower kcal/m <sup>3</sup>	1278	1697

Gasification of various types of raw materials

Research carried out by the Department of Alternative Fuels Technology, showed the possibility of using local types of renewable fuels to replace traditional types of solid fuel.

1) Design documentation has been developed and experimental and experimental-industrial installations for obtaining electrical energy from local types of fuel have been created.

A series of experimental studies were carried out in laboratory facilities on the material and energy balance of processes, assessing the capacity of gasification/pyrolysis products to optimize the process at the stage preparation of a pilot project

2) A laboratory facility has been created for the production of synthesis gas as a result of heterogeneous catalytic processes for the production of rare synthetic products. A tool has been created that makes it possible to carry out a wide range of advanced processes in the synthesis of rare products through gasification of solid carbonaceous resources;  
a nomenclature of input materials has been identified that is technically feasible and economically processed for the production of rare synthetic products;

**Thank you  
for your attention**