



# Methods of improving production safety and methane management at DTEK Energy coal mines.

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## Renewable Energy

One of the three largest investors in the renewable energy sector of Ukraine. Company implements projects in the field of solar and wind energy production.



## DTEK ENERGY

TPP's production capacity exceeds 17 GW. Company provides a closed cycle of electricity production from coal. Full cycle of coal mining: coal mining and preparation, mining equipment production.



## DTEK OIL&GAS

Top player of gas production among private companies in Ukraine. It effectively drills deep wells, which was achieved by investments in modern equipment and innovation techniques.



## DTEK POWER GRID

It supplies and distributes electricity to 3.6 million customers.

# DTEK GROUP OPERATING GEOGRAPHY



Thermal generation



Wind power



Mining and coal enrichment



Production of mining equipment



Distribution of electricity



Solar power



Gas production

# DTEK IS THE LARGEST PRIVATE ENERGY COMPANY IN UKRAINE



PRODUCTION INDICATORS IN 2017

Coal production

**27.7**  
million tons

Gas production

**1.7**  
billion cubic meters

Electricity  
generation

**36.5**  
billion kW \* h

Electricity  
distribution

**43.2**  
billion kW \* h

Green energy

**637.8**  
million kW \* h



# SUMMARY

In 2018, the problems of 2017 continued to arise, as the resource of anthracite coal mined at non controlled by the Ukrainian authorities was lost. The transport blockade of railways continues. Significantly increased imports of thermal coal.

With a shortage of steam coal:

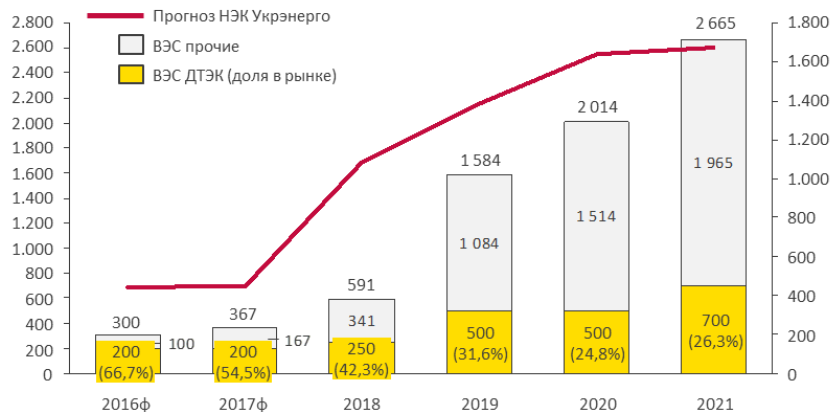
DTEK constantly increases the volume of Ukrainian coal production while state-owned coal mines continuing to decline in coal excavation.



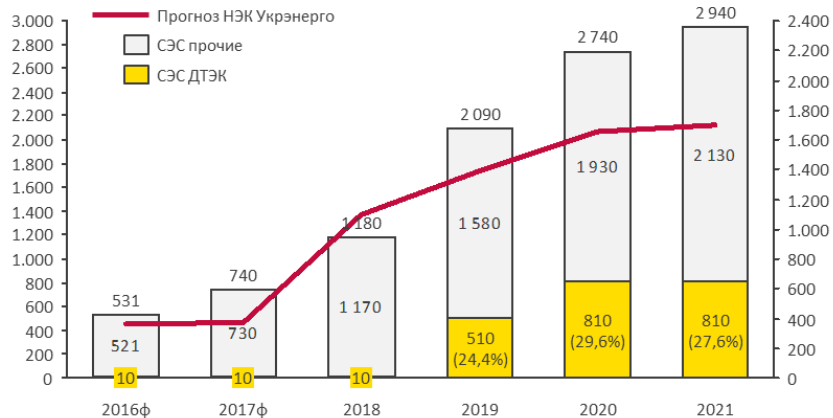
- Lack of budget financing, own funds and investments do not allow to improve (prevent deterioration) to support Ukrainian coal production;
- The rate of liquidation of unprofitable mines remains insufficient;
- There is a decline in the prestige of mining labor, the outflow of qualified personnel;
- The cash cost of coal production remains above the selling price;

# RENEWABLE ENERGY DEVELOPMENT

## Прогноз установленной мощности ВЭС, МВт (на конец года)



## Прогноз установленной мощности СЭС, МВт (на конец года)



## Комментарии

### Ожидаемый ввод новых ВЭС

По проектам:

- 2018 (224 МВт)
  - ДТЭК ВИЭ – 50 МВт
- 2019 (994 МВт)
  - ДТЭК ВИЭ – 250 МВт

### Ожидаемый ввод новых СЭС

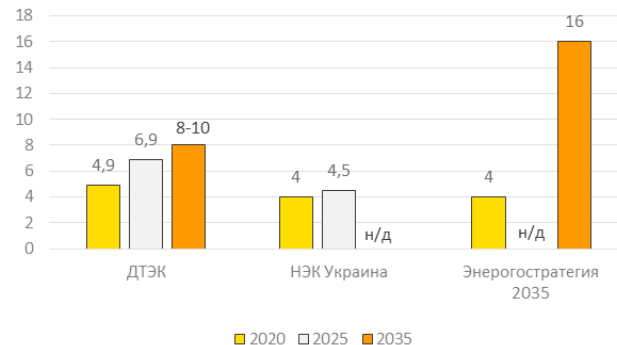
- 2019 (910 МВт)
  - ДТЭК ВИЭ – 500 МВт

На 1 октября 2018 года Украина располагает генерирующими мощностями возобновляемых источников энергии:

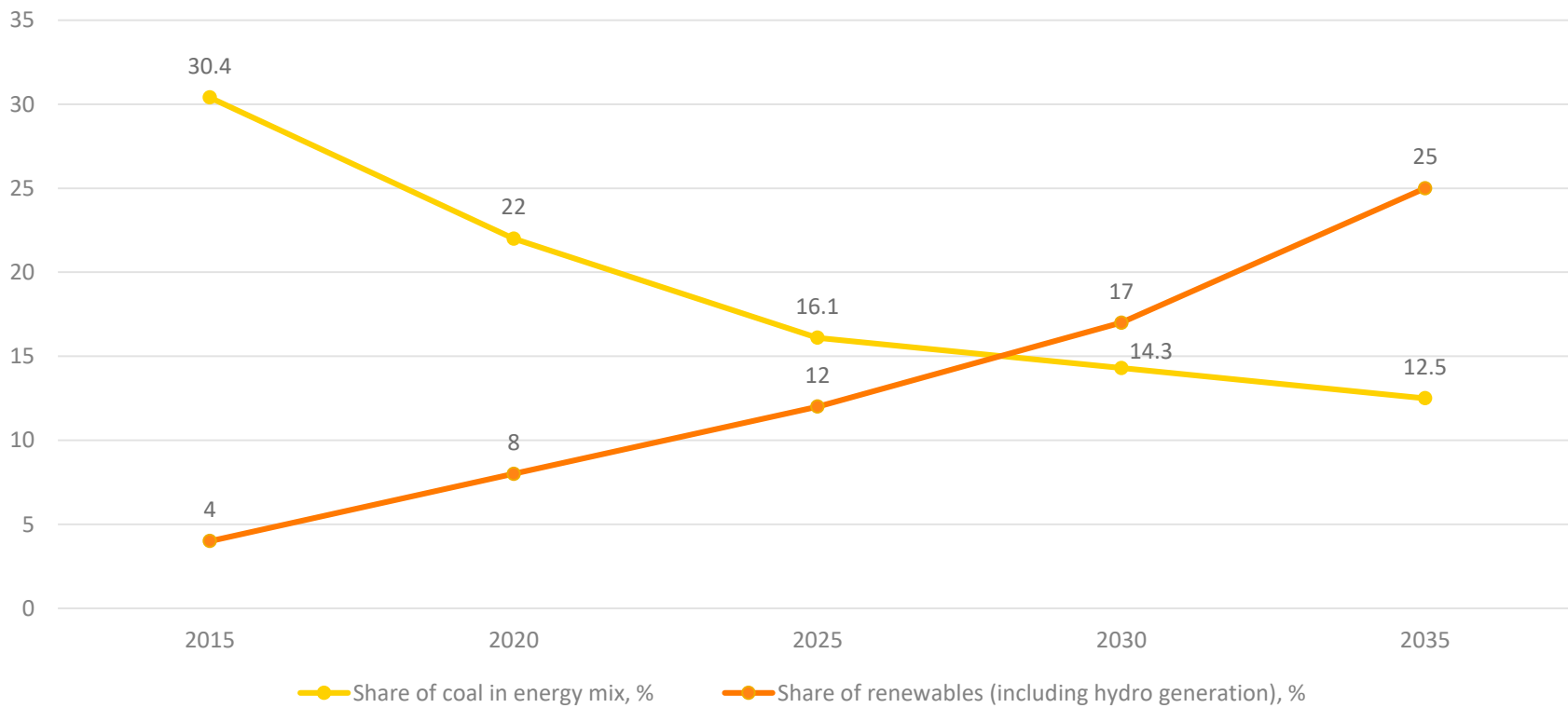
ВЭС – 552 МВт  
 СЭС – 1096 МВт  
 Биомасса – 44 МВт  
 Биогаз – 45 МВт  
 Малые ГЭС – 96 МВт

Доля возобновляемой энергетики в общем объеме производства электроэнергии в 2018 году составляет 1,8%, а доля стоимости 8,3%. СЭС и ВЭС составляют 97% новых мощностей, введенных в 2018 году.

## Прогнозы развития ВИЭ, ГВт



# COAL AND RENEWABLE ENERGY USE INDICATORS IN ACCORDANCE WITH THE ENERGY STRATEGY OF UKRAINE UNTIL 2035



# COAL INDUSTRY OF UKRAINE IN THE LIGHT OF THE EU PROJECT

## The transition platform for coal regions to clean energy

Both directions of the project are relevant for the coal sector of Ukraine:

- the use of modern coal technologies for mines that continue to produce coal;
- economic restructuring and support for regions in which coal mining is stopped or is in declining.

### Decarbonisation - clean coal technologies

On June 18<sup>th</sup> 2018, the Cabinet of Ministers of Ukraine approved the “Strategy for Low-Carbon Development of Ukraine until 2050,” which includes reducing greenhouse gas emissions, abandoning fossil fuels and starting investing in renewable energy sources. Having developed a low-carbon development strategy, Ukraine has assumed responsibility for the transition of the country's economy to low-carbon development.

The total amount of all GHG emissions into the atmosphere (60% overall) – comes from coal mines CH<sub>4</sub> and CO<sub>2</sub>. In 2017, DTEK Energy's mines emitted 371 thousand tons of greenhouse gases (CH<sub>4</sub> and CO<sub>2</sub>) to the atmosphere, including CH<sub>4</sub> 158 thousand tons, the volume of waste dumps was increased by 7.4 million tons, mine waters into river basins 37 million m<sup>3</sup>.

### Decrease of CH<sub>4</sub> and CO<sub>2</sub> emission projects

- Stepnaya mine – implementation of a pilot project of 1.56 MW cogeneration plant for the utilization of coal mine methane. As a result of the installation, electrical and thermal energy is generated for the needs of the mine. The planned commissioning period is the first half of 2019. Replication of the project in other mines of the company based on the experience gained from the pilot project in the period up to 2025.
- DTEK mines – the use of coal mine methane discharged by means of ventilation to the surface as a fuel source for generating electrical and thermal energy. Potential for the implementation of this direction are two DTEK's mines.
- Blagodatnaya mine – Ukraine's first industrial Heat Pumping hot water installation with a heating capacity of 800 kW is in operation using low-grade heat of mine water. Replaces coal mine boiler.



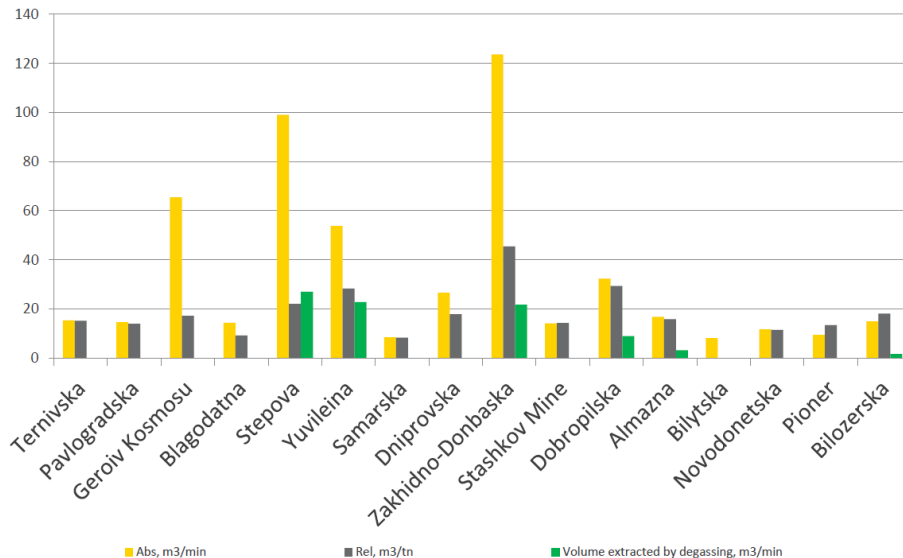
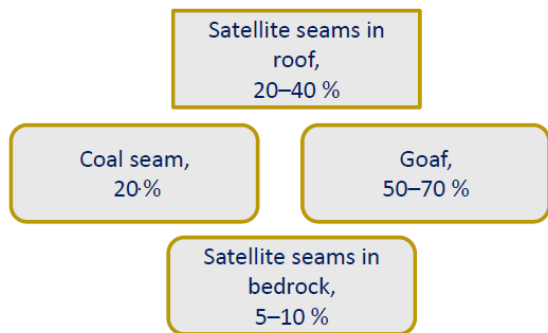
## PROBLEMS OF METHANE EMISSION AT DTEK ENERGY LLC COAL MINES ARE:

Increase of depth extraction and loads on longwalls leads to increase of absolute methane emissions in mining sections.

The capacities of ventilation systems to dilute methane with fresh air to the safe concentration established by the Safety Rules are limited by the maximum admissible average velocity of air and through the workings depending on their cross-section. Due to this, the gas factor may limit the loads on production faces in mining sections with high gas emission.

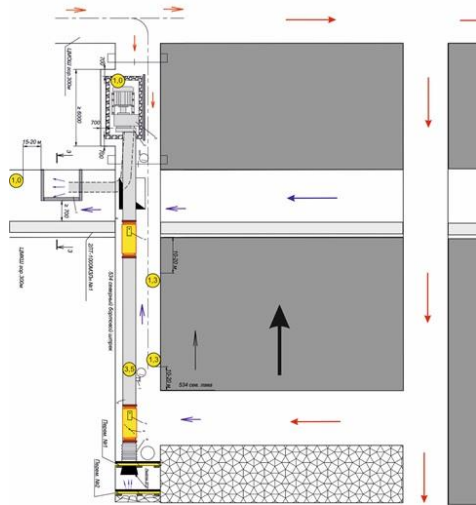
One of the most efficient ways to ensure safety of air conditions in high gas emission mining sections and eliminate the gas factor limitation on production faces loads is degassing of methane emission sources.

Main sources of methane emission at DTEK Energy LLC coal mines are:

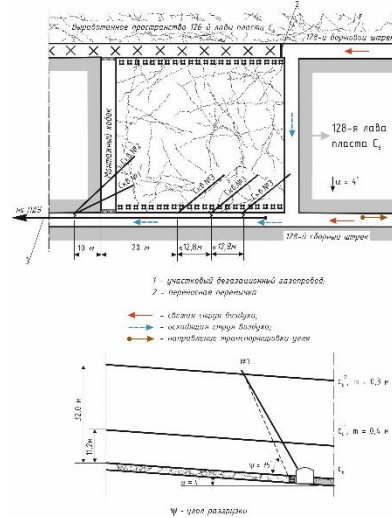


# METHODS OF METHANE MANAGEMENT AT THE LONGWALL AREA

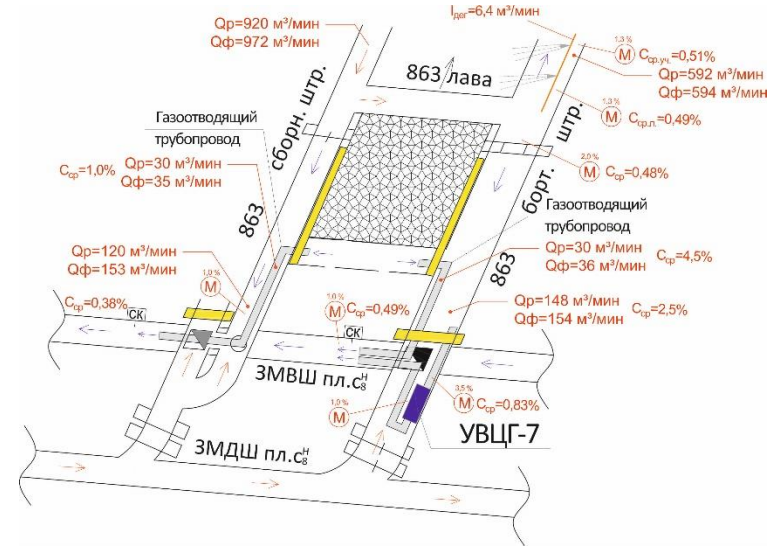
Gas extraction by means of a VMTSG gas suction fan



Degassing wells



Complex degassing combining wells drilling and gas transportation from the goaf

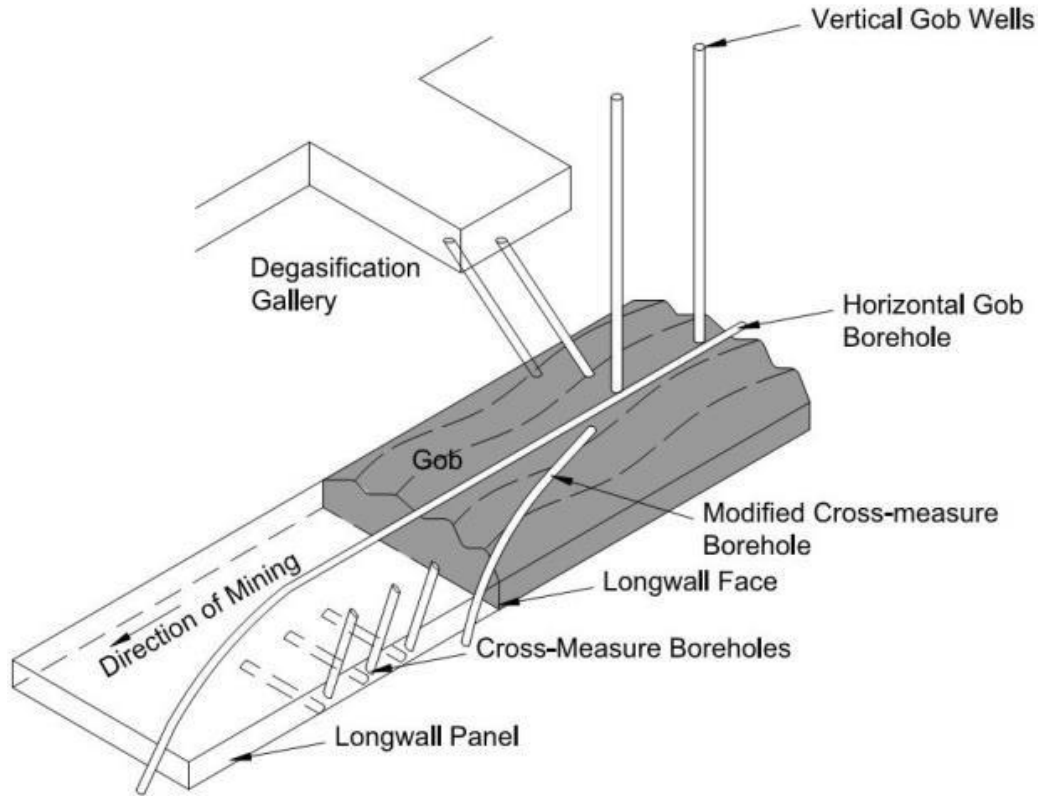


# THE MAIN PROBLEMS IN THE FIGHT AGAINST METHANE EMISSIONS AT DTEK ENERGO MINES



1. Coal methane content increases with increasing of working depths (up to 880 m).
2. With an increase of gas content and depth of mining, the danger of a sudden gas and rock outbursts increases (the Dobropolyeugol mines)
3. The increase of gas emission intensity is caused by an increase in the productivity efficiency of production and an increase gas content in coal seam.
4. Pre-degassing is often difficult or impossible due to the low permeability of coal and host rocks.
5. Wells drilled from the surface into the gulf are ineffective due to the large depth and mining of several layers.
6. Wells drilled from the surface into the coal seam for a short time and then their work is not effective.
7. The negative impact of reducing the section of workings due to convergence and heaving of the soil on the efficiency of ventilation

# DECREASING OF GAS EMISSION FROM THE GOAF

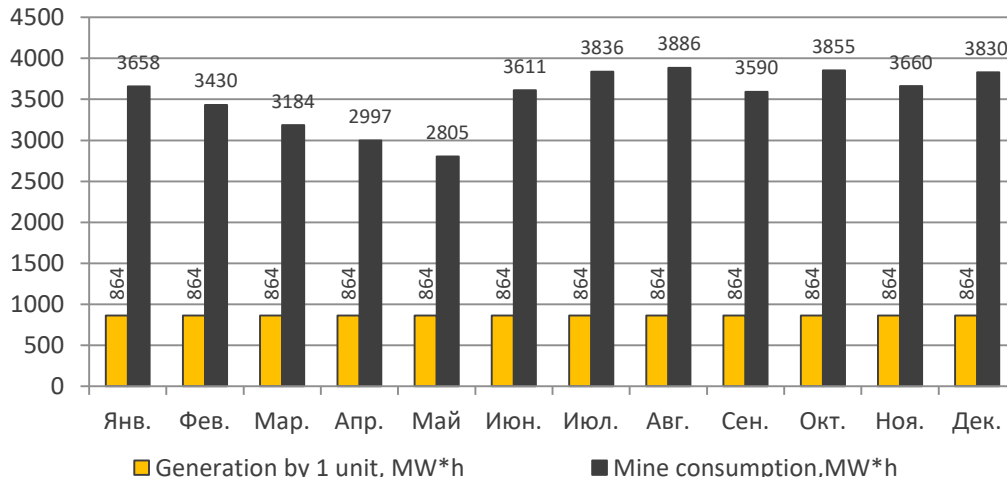


# OPPORTUNITIES OF COGENERATION

## PILOT PROJECT AT STEPNAJA MINE



Cogeneration unit

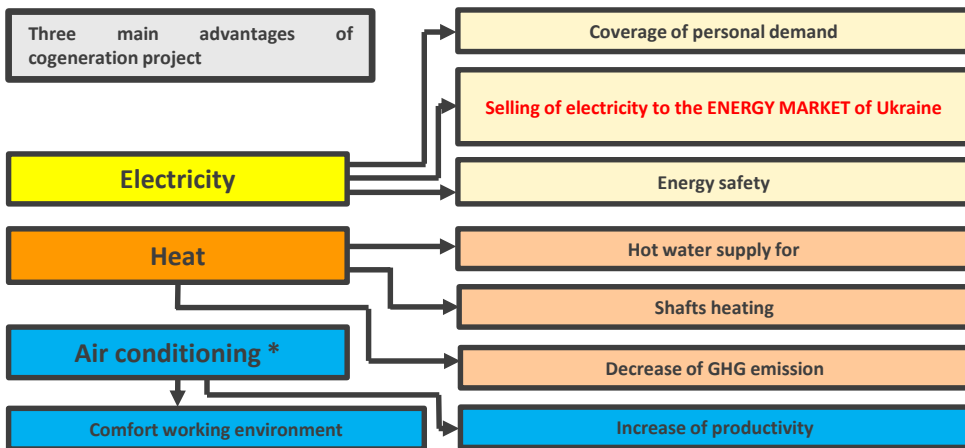
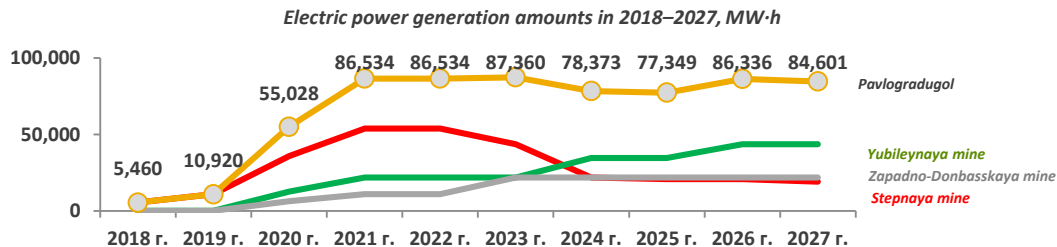


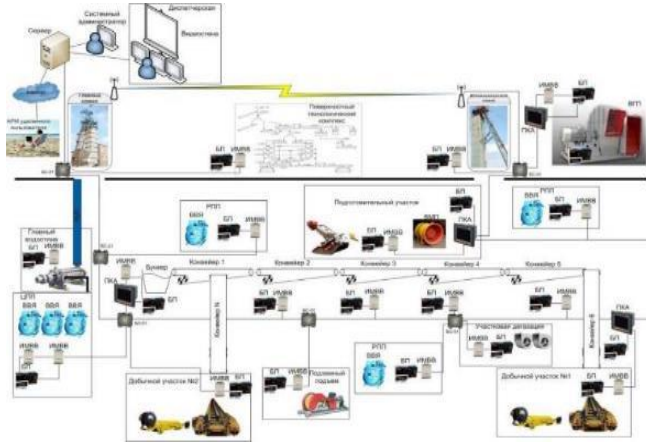
Electricity produced by CU



# METHANE COGENERATION

The Project objective - the use of mine methane as an energy resource, and reduction of pollutants emissions to the atmosphere.





As company is not able to solve the safety problems by means of only gas sensors implementation, the decision has been made to launch a long-term SMART-MINE project, the priority areas in which there will be primarily issues of accident prevention and emergency situations.

1. The final results of the main objectives of the project are planned to create a dynamic mine ventilation model that will be updated and replenished in real time based on sensors measurements.
2. Second step will consist by adding the workers positioning sensors, proximity sensors, mine ambient sensors and CO2 sensors.

**Purpose.** The rationale for the creation and use of information-measuring SMART technology for monitoring the mine ventilation system based on a comprehensive analysis of the initial information.

**Practical significance.** The results will increase the relevance of the mathematical model of the ventilation system with its real counterpart. The implementation of the pilot project is not only automatic control, but automatic security management.

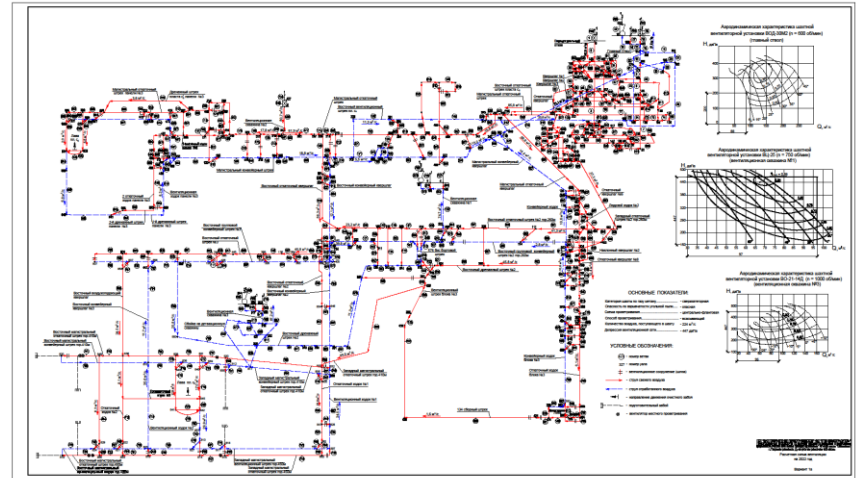
A virtual mathematical model of the mine ventilation network has been created.

This model receives data from barometric (absolute) pressure sensors located at key points of the mine's ventilation network, air flow velocity sensors in the workings and pipelines of local ventilation fans, and the position of the ventilation doors. According to sensor data, the mine ventilation network is calculated in real time. So at any given time, we can know the real state of ventilation at any point of the mine, and model various situations.

Using the same model and data from temperature sensors, smoke sensors, carbon monoxide CO, indicator gas sensors, a special algorithm is used to search for the expected source of endogenous or exogenous fire and to display on screen the positions of the emergency response plan corresponding to the found fire source.

Functions performed:

- Calculation of underground air distribution;
- Calculation of air flow resistance;
- Fire simulation;
- Selection of characteristics of AIV;
- Simulation of dead-end ventilation circuit;
- Simulation of the reverse mode of ventilation;
- Pressure in knots;
- Search for routes miners;
- Calculation of routes VGSCH;
- PLA preparation;
- Automation of depression shooting underground facilities;







**Thank you for your attention!**

