An overview of the Ukrainian policies and measures that promote CMM and VAM use, and the existing projects that use or destroy methane recovered from coal mining
DTEK GROUP OPERATING GEOGRAPHY

- Thermal generation
- Power distribution
- Wind power
- Solar power
- Mining and coal enrichment
- Gas production
- Production of mining equipment
In Ukraine, the potential of waste industrial gases is underestimated, despite the successful use in world practice

- Mine methane reserves in Ukraine are 150 billion m³. About 0.6 billion m³ is released annually. The level of utilization in Ukraine until 2014 was only 4%, while in the countries of leaders (the Czech Republic, Germany, China, the USA) it reached 80%
- Now in the territory controlled by Ukraine there are 16 mines of DTEK ENERGO (Pavlogradugol, Dobropolyeugol), of which 10 mines have the potential to use methane mine gas as fuel.

REGULATION:
Ukraine follows the world trends and adapts strict EU environmental standards:
- 2016 - the signing of the Paris Agreement by Ukraine;
- 2018 - approval by Ukraine of a Low Carbon Development Strategy by reducing the use of traditional sources;
- In accordance with the Association Agreement with the EU, Ukraine intends to introduce a national scheme for trading in greenhouse gas emissions.
# Potential Use of Mine Methane in the Mines DTEK ENERGO

<table>
<thead>
<tr>
<th>DTEK Energy LLC mines</th>
<th>Category of gas hazard</th>
<th>Gas volume</th>
<th>Gas suction</th>
<th>Degassing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Abs, m³/min</td>
<td>Rel, m³/tn</td>
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</tr>
<tr>
<td>Pavlogradsko</td>
<td>beyond categories</td>
<td>15,32</td>
<td>15,18</td>
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<tr>
<td></td>
<td>beyond categories</td>
<td>65,45</td>
<td>17,11</td>
<td>VMTsG-7 fan</td>
</tr>
<tr>
<td></td>
<td>beyond categories</td>
<td>99</td>
<td>22</td>
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<tr>
<td></td>
<td>beyond categories</td>
<td>53,72</td>
<td>28,29</td>
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<td></td>
<td>beyond categories</td>
<td>26,52</td>
<td>17,88</td>
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<td></td>
<td>beyond categories</td>
<td>123,6</td>
<td>45,49</td>
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<tr>
<td></td>
<td>category III</td>
<td>14,12</td>
<td>14,22</td>
<td>VMTsG-7 fan</td>
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<tr>
<td>Stashkov Mine</td>
<td>category III</td>
<td>32,31</td>
<td>29,27</td>
<td>VMTsG-7 fan</td>
</tr>
<tr>
<td></td>
<td>beyond categories</td>
<td>16,71</td>
<td>15,8</td>
<td>VMTsG-7 fan</td>
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<tr>
<td></td>
<td>category III</td>
<td>11,7</td>
<td>11,4</td>
<td>VMTsG-7 fan</td>
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<td>14,88</td>
<td>18,03</td>
<td>VMTsG-7 fan</td>
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</table>

<table>
<thead>
<tr>
<th>Pavlogradsko</th>
<th></th>
<th>Volume, m³/min</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>26,97</td>
<td>Vacuum Pump Station underground well</td>
</tr>
<tr>
<td></td>
<td></td>
<td>22,8</td>
<td>Underground Degassing Station underground well</td>
</tr>
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<td></td>
<td></td>
<td>21,76</td>
<td>Vacuum Pump Stations 1 &amp; 2 underground well</td>
</tr>
<tr>
<td>Stashkov Mine</td>
<td></td>
<td>8,91</td>
<td>Vacuum Pump Station goaf gas offtake</td>
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<tr>
<td></td>
<td></td>
<td>3,18</td>
<td>Vacuum Pump Station goaf gas offtake</td>
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<tr>
<td></td>
<td></td>
<td>1.63</td>
<td>Vacuum Pump Stations 1 &amp; 2 goaf gas offtake</td>
</tr>
</tbody>
</table>

DTEK Energy LLC mines

- Category of gas hazard
- Gas volume: Abs, m³/min; Rel, m³/tn
- Gas suction: VMTsG-7 fan
- Degassing: Volume, m³/min; Method
**CHRONOLOGY OF REGULATORY POLICY ON THE USE OF METHANE**

Changes in the rent for the use of subsoil.
Article 258 of the Tax Code of Ukraine,
Article 243 of the Tax Code of Ukraine

<table>
<thead>
<tr>
<th>Mineral group</th>
<th>The interest rate of the rent for the use of subsoil as a percentage of the value of the commodity output of the mining enterprise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural gas produced from deposits up to 5000 m</td>
<td></td>
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<tr>
<td></td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>7,5 $ / 1000 m³</td>
</tr>
<tr>
<td>Ecological tax</td>
<td>5 $ / 1000 m³</td>
</tr>
</tbody>
</table>
In 2017, DTEK and UMG (an asset of the SCM group) signed a memorandum of partnership providing for the introduction of 8 cogeneration plants from 2018. The construction of a pilot plant with a capacity of 1.56 MW is planned this year. The concept of the entire project is to sell electricity to Energy Market, while the by-product - heat from cooling Caterpillar's internal combustion engines - will be used to heat water in the boiler rooms of the mines.

In addition, a reduction in emissions of pollutants into the atmosphere will be achieved and, as a result, an increase in the environmental friendliness of production. The total amount of generated electricity is planned to increase from 5.5 million kWh in 2019 to 85 million kWh / year until 2030.
opportunities of cogeneration

**Pilot Project at Stepnaya Mine**

“Stepnaya” mine - dangerous for gas content.
Gas emission - 98 m³/min
Including degassing - 30-40 m³/min

Gas emission - 98 m³/min
Including degassing - 30-40 m³/min

Methane volume which can be used - 28 m³/min

Cogeneration unit

Generation by 1 unit, MW*h
Mine consumption, MW*h

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.

Electric power generation amounts in 2018–2027, MW·h

Three main advantages of cogeneration project

- Coverage of personal demand
- Selling of electricity to the ENERGY MARKET of Ukraine
- Energy safety
- Hot water supply for
- Shafts heating
- Decrease of GHG emission
- Increase of productivity

Electricity

Heat

Air conditioning *

Comfort working environment

Pavlogradugol
Yubileynaya mine
Zapadno-Donbasskaya mine
Stepnaya mine

2018 г.
2019 г.
2020 г.
2021 г.
2022 г.
2023 г.
2024 г.
2025 г.
2026 г.
2027 г.

Three main advantages of cogeneration project

Electricity

Heat

Air conditioning *

Coverage of personal demand

Selling of electricity to the ENERGY MARKET of Ukraine

Energy safety

Hot water supply for

Shafts heating

Decrease of GHG emission

Increase of productivity

Comfort working environment
Ш/у ПОКРОВСКОЕ
For the implementation of this program, the mobile drilling complex of Sense EDM was acquired with the creation of a structural unit for the construction and maintenance of wells.
USE OF ALL GAS POTENTIAL OF A MINE

Optimization of the degassing system

1. Increased production
2. Increased security

Mine Gas Utilization

- Heat
- Electricity
- Mine air cooling
- Emission reduction
DIFFICULTIES IN APPLYING THE EXPERIENCE OF DEALING WITH METHANE EMISSIONS AT DTEK ENERGO MINES

1. Pre-degassing is often difficult or impossible due to low permeability of coal.

2. Wells drilled from the surface into the developed space turn out to be ineffective due to the large depth and mining of several layers.

3. The wells drilled from the surface into the reservoir work for a short time (2-7 days) and then their work is not effective

4. Coal methane content increases with depth

5. With an increase in gas content and depth of mining, the danger of a sudden release increases

6. The negative impact of reducing the section of workings due to convergence and heaving of the soil on the efficiency of ventilation

7. The increase in gas emission intensity is caused by an increase in the productivity of production and an increase in gas content
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
**Potential Use of Coal Mine Methane**

In the mines of DTEK LLC, it is potentially possible to use 400 m³/min of methane emitted from the air flow in 9 mines (14 shafts) with a concentration of 0.15 to 0.6%.

<table>
<thead>
<tr>
<th>Mine</th>
<th>Category of gas hazard</th>
<th>The volume of methane in the air flow, m³/min</th>
<th>Number of ventilation shafts, pcs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ternivska</td>
<td>beyond categories</td>
<td>16,06</td>
<td>1</td>
</tr>
<tr>
<td>Geroiv Kosmosu</td>
<td>beyond categories</td>
<td>76,75</td>
<td>2</td>
</tr>
<tr>
<td>Stepova</td>
<td>beyond categories</td>
<td>82,2</td>
<td>1</td>
</tr>
<tr>
<td>Yuvileina</td>
<td>beyond categories</td>
<td>57,47</td>
<td>2</td>
</tr>
<tr>
<td>Dniprovska</td>
<td>beyond categories</td>
<td>22</td>
<td>2</td>
</tr>
<tr>
<td>Zakhidno-Donbaska</td>
<td>beyond categories</td>
<td>90</td>
<td>2</td>
</tr>
<tr>
<td>Dobropilska</td>
<td>beyond categories</td>
<td>23,11</td>
<td>2</td>
</tr>
<tr>
<td>Almazna</td>
<td>beyond categories</td>
<td>16</td>
<td>1</td>
</tr>
<tr>
<td>Bilozerska</td>
<td>beyond categories</td>
<td>17</td>
<td>1</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td><strong>400,59</strong></td>
<td><strong>14</strong></td>
</tr>
</tbody>
</table>
FINDINGS:

Implementation of methane utilization projects will allow:
for Ukraine:
- to improve the environmental situation in the cities of presence as a whole, by reducing greenhouse gas emissions of methane;
- to reduce the consumption of natural gas and coal by thermal power plants in Ukraine to generate electricity.

for DTEK:
- to increase the safety of mining operations, reduce accidents and injuries at work;
- increase coal mining by reducing downtime associated with dangerous concentrations of methane;
- Increasing the company's PR rating
- to improve the social status of workers in the enterprise;
Thank you for your attention!