Experience with the utilization of coal mine gas from abandoned mines

in the region of North-Rhine-Westphalia, Germany
History of coal mining in Germany

- Industrial coal mining started in the 19th century in Germany
- The peak was reached in the middle of the 1950th

- Some data:

<table>
<thead>
<tr>
<th></th>
<th>1956</th>
<th>2015</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal extraction in tons (t)</td>
<td>150 mil.</td>
<td>12 mil.</td>
<td>0</td>
</tr>
<tr>
<td>Number of employees</td>
<td>&gt; 600,000</td>
<td>12,000</td>
<td>??</td>
</tr>
<tr>
<td>Number of mines</td>
<td>183</td>
<td>3</td>
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</table>

- The coal resource would last for approx. 500 to 600 years
- The coal geographic is difficult (up to 1500m), therefore the costs are very high and hardly economic.
History of the use of methane

- From abandoned mines it started already in 1990.
- Until 1997, methane was only of interest in areas with abandoned mines when the leaking gas represented danger for the inhabitants.

Degassing pipes

Sucking station
History of the use of methane

- Methane is 25 times more harmful for the environment than CO2
- Not using this energy would be like missing a good opportunity
The first plant „Mont-Cenis“

- The first plant was established in the course of the production of an energy park in the town of Herne (Ruhr District) in 1997.

- In 2000 Renewable Energy Law (0.0767 €/kWh) includes coal mine methane.

Power prices in 2017:

- $P < 1000$ kW $\rightarrow 0.0654$ €/kWh

- $P > 1$ MW $< 5$ MW $\rightarrow 0.0417$ €/kWh (not used)

- $P > 5$ MW $\rightarrow 0.0369$ €/kWh (uneconomical)
Schematic composition
of coal mine methane utilisation plant
Licenses extraction and exploring hydrocarbons

Licenses for extraction and exploring hydrocarbons

Year: 2000-2016
- Production license
- Exploring license
Number of CHP
Install Power of CHP

Power installed MW

<table>
<thead>
<tr>
<th>Year</th>
<th>Ibbenb</th>
<th>Active</th>
<th>Abandoned</th>
</tr>
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<tr>
<td>2001</td>
<td>5</td>
<td>18</td>
<td>27</td>
</tr>
<tr>
<td>2002</td>
<td>9</td>
<td>57</td>
<td>27</td>
</tr>
<tr>
<td>2003</td>
<td>40</td>
<td>27</td>
<td>27</td>
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<tr>
<td>2004</td>
<td>56</td>
<td>27</td>
<td>27</td>
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<tr>
<td>2005</td>
<td>100</td>
<td>27</td>
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</tr>
<tr>
<td>2006</td>
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</table>
Produced heat by CMM CHP

Heat production MWh

- Ibbenb
- active
- abandoned

23.10.2017
Avoided CO2 emissions by burning CMM

CO2 avoided [mio.t]

- Ibbenb
- active
- abandoned

23.10.2017
Some data from plants in operation

The following diagrams show typical developments in the utilization of gas to the closed mines.

- Methan content
- Power production
- Gas pressure in abandoned mine
CMM Utilisation Case 2

Surface Borehole 30 m  
Borehole Gob 106 m
CMM Utilisation Case 2

CMM utilisation Wilberd 1

- Power [kW]
- CH4-Borehole [%]
- CH4-Surface [%]
- Pressure in abandoned mine [mbar abs]
CMM Utilisation Case 2
Active Mine -> Abandoned Mine

Change of gas components from active to abandoned mine

CH4, O2 [%]

- CH4 [%]
- O2 [%]
- Power produced by CMM [MW]

[Month]

active mine

closing phase
12 month
no coal production
open shafts

abandoned mine,
all shafts filled,
old mine area sealed
CHP plant examples
Drilling installation and CHP plant examples
Thank you for your attention

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