AMM project development in Germany: regulations, financing, examples of projects
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>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>
</tr>
<tr>
<td>Number of employees</td>
<td>&gt; 600.000</td>
<td>12.000</td>
</tr>
<tr>
<td>Number of mines</td>
<td>183</td>
<td>3</td>
</tr>
</tbody>
</table>

- The coal resource would last for approx. 500 to 600 years
Licenses extraction and exploring

Licenses in NRW

26.02.2020
Licenses extraction and exploring

License with AMM extraction
License without AMM extraction
Number of CHP

CHP installed

<table>
<thead>
<tr>
<th>Year</th>
<th>Active</th>
<th>Abandoned</th>
<th>Saar</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2001</td>
<td>16</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>2002</td>
<td>44</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>2003</td>
<td>63</td>
<td>28</td>
<td>0</td>
</tr>
<tr>
<td>2004</td>
<td>19</td>
<td>40</td>
<td>0</td>
</tr>
<tr>
<td>2005</td>
<td>24</td>
<td>40</td>
<td>0</td>
</tr>
<tr>
<td>2006</td>
<td>27</td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>2007</td>
<td>27</td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>2008</td>
<td>22</td>
<td>23</td>
<td>0</td>
</tr>
<tr>
<td>2009</td>
<td>18</td>
<td>16</td>
<td>0</td>
</tr>
<tr>
<td>2010</td>
<td>18</td>
<td>16</td>
<td>0</td>
</tr>
<tr>
<td>2011</td>
<td>18</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>2012</td>
<td>18</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>2013</td>
<td>18</td>
<td>9</td>
<td>0</td>
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<tr>
<td>2014</td>
<td>19</td>
<td>13</td>
<td>0</td>
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<tr>
<td>2015</td>
<td>18</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>2016</td>
<td>18</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>2017</td>
<td>18</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>2018</td>
<td>19</td>
<td>15</td>
<td>0</td>
</tr>
</tbody>
</table>
Power Production

Power Production MWh

- Ibbenb
- active
- abandoned
- Saar

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Avoided Emissions

CO2 avoided [mio.t]

- Ibbenb
- active
- abandoned
- Saar

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Contenerised degassing plant

Up to four compressors (Roots-type) per unit

The compressors’ configuration allows a fluent regulation

Each compressor with its equipment is build as small plant for itself, having a complete speed control and safety features

The configuration is optimised in regards of costs, operation conditions, maintenance and service

Investments mobile plant for AMM capture
Regulations for AMM Extraction

Main Criteria

- Licenses are given by the regional coal authority
- Every qualified company can apply for a license
- Existing facilities can be used by the new license owner (specially mine venting pipes, old mine roads)
- Fixed technical regulation for extracting stations
Financing

- Operator get a fixed tariff for fed in power for 20 years
- Power grid has to take the whole production
- The operator does not receive any grand for the installation
- Rights from avoided emissions fall to the state, no green certificates or similar
Financing

Feed-in tariff for power is regulated by renewable Law (EEG)

<table>
<thead>
<tr>
<th>Year</th>
<th>&lt; 0.5 MW</th>
<th>&lt; 1MW</th>
<th>&gt;1 MW</th>
<th>&gt; 5MW</th>
<th>Degression</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>7.67</td>
<td>7.67</td>
<td>6.65</td>
<td>6.65</td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>7.67</td>
<td>6.65</td>
<td>6.65</td>
<td>(6.65)</td>
<td></td>
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<tr>
<td>2008</td>
<td>7.16</td>
<td>7.16</td>
<td>5.16</td>
<td>4.16</td>
<td>1.50%</td>
</tr>
<tr>
<td>2012</td>
<td>6.84</td>
<td>6.84</td>
<td>4.93</td>
<td>3.98</td>
<td>1.50%</td>
</tr>
<tr>
<td>2016</td>
<td></td>
<td></td>
<td>4.30</td>
<td>3.80</td>
<td>1.50%</td>
</tr>
<tr>
<td>2020</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>
Financing

Tariffs for fed in power regulated by renewable Law (EEG)

After 2020 - current status (Feb. 2020)

- No fed-in tariff
AMM Powerproduction Case 1

Surface Borehole 30 m

Borehole Gob 106 m

Borehole Degassing Plant

Surface Degassing Plant
AMM Powerproduction Case 1
AMM Powerproduction Case 2

CH4 [%]

CMM utilisation Corvin 2

- CH4 [%]
- Pressure in abandoned mine [mbar abs]

kW

A-TEC, 2017
AMM Powerproduction Case 3

MW
Niederberg 1 + 2
CH4 %

Year


0,0 0,5 1,0 1,5 2,0 2,5 3,0 3,5 4,0 4,5 5,0

50 55 60 65

0

abandoned Shaft

CHP's in old building
AMM Powerproduction Case 4

![Graph showing MW and CH4% for Lohberg from 2000 to 2020](image)

- **Active mine**
- **Abandoned mine**
- **Leakages**

CHP's

Filled shaft

26.02.2020
Mine Minister Achenbach plant, Lünen, Germany
1900 – Mine started
1992 – Mine closed
2000 – AMM extraction start
2007 – AMM extraction stopped, Mine flooded
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