Renewables and coal mine methane in German Legislation

Recommendations for Ukraine

Clemens Backhaus
Contents

- CMM in Germany
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- Development of CMM installations
- Examples of installations
- Technologies for CMM utilisation
- Economics for CMM power production
CMM in Germany 1

68 Licenses, 24 Exploration permits 31.12.2010

Source: Abt. B Bez.-Reg. Arnsberg
CMM in Germany 2

Revenues by EGG

*EEG = renewable Law Germany

<table>
<thead>
<tr>
<th>Year</th>
<th>Power</th>
<th>kW &lt; 500</th>
<th>kW &gt;1000kW</th>
<th>Max &gt;5000 KW</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td></td>
<td>7,67</td>
<td>6,65 (&gt;500kW)</td>
<td>6,65</td>
</tr>
<tr>
<td>2009</td>
<td></td>
<td>7,67</td>
<td>5,16</td>
<td>4,16</td>
</tr>
<tr>
<td>2012</td>
<td></td>
<td>6,84</td>
<td>4,93</td>
<td>3,98</td>
</tr>
</tbody>
</table>

In 2000 CMM included in Group landfill gas and sewage gas. The production of these gases is not part of the utilization and not part of the power production costs.

The power production from CMM was scheduled to be part of the emission trading under Kyoto protocol. So the invertors could receive additional income for emissions reduction. This was withdrawn by government in 2005. After this point no new investments for CMM was made.
CMM in Germany 2

• The price for the power fed to the grid is paid from the grid owner to the plant operator

• More costs are spread across all electricity consumers
  (spezial regulations in the law)

Download EEG in English
CMM in Germany 2

Taxes on Gas extraction in Germany

Active mines

0,00 Euro/m³ methane on active mines

Methan has to be extracted for safety reasons. Extraction and utilization of this gas should not be effected negative by taxes

Abandoned mines

0,00 Euro/m³ methane on abandoned mines

If the extraction of gas occurs for safety reasons

0,03 Euro/m³ methane on abandoned mines

If the extraction of gas is not occurs for safety reasons

The legal text:
http://esb.bezreg-arnsberg.nrw.de/a_1/a_1_021/
CMM in Germany - 3

Number of CHP in NRW

CMM as fuel

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Source Abt. 8 Bez.-Reg Arnsberg
CMM in Germany - 4

Installed Power from CMM in NRW

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Source Abt.8 Bez.-Reg Arnsberg
CMM Germany - 5

Power production from CMM in NRW

Source Abt.8 Bez.-Reg Arnsberg
CMM Germany – 6 in NRW

Power production by renewables in 2008

CO₂ reduction by Renewables in 2008

Source Abt.8 Bez.-Reg Arnsberg

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No. 10
CMM Germany - 7

Wind energy installed power as comparison

Source: BMU

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CMM installations

• 2000 - 2002
CMM installations

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Technologies for CMM utilisation

CMM Utilisation Opportunities

**High-Quality Gas**
> 50% CH₄
- Natural gas pipelines
- Vehicle fuel (CNG, LNG)
- Local distribution
- Power generation
- Heat generation
- (Fuel cells)

**Medium-Quality Gas**
25 – 50% CH₄
- Power generation
- Heat generation
- Boiler fuel
- Ventilation air heating
- Coal drying
- Industrial applications
- (Fuel cells)

**Low-Quality Gas**
< 25 % CH₄
- Thermal Oxidation
- Catalytic Oxidation
- Combustion
- Use as additional Fuel for Gas engines

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Technologies for CMM utilisation

CMM Utilisation Opportunities

Medium-Quality Gas
25% < CH4 < 50%

- Power generation
- Heat generation
- Combined heat & power generation
- Boiler fuel
- Coal mine heating
- Ventilation air heating
- Coal drying
- District heating
- Industrial applications

- Power production on site from own resources
- Saving of coal for own heat requirements
- Additional revenues from emissions trading
- Additional stimulation of mine degassing
- Increase of mine safety

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## Projekte CMM Ukraine

### Investment

<table>
<thead>
<tr>
<th></th>
<th>Projekt 1,0 MWel</th>
<th>Projekt 2,0 MWel</th>
</tr>
</thead>
<tbody>
<tr>
<td>yearly operation hour (full load) h</td>
<td>5.800</td>
<td>5.800</td>
</tr>
<tr>
<td>max electric power kW</td>
<td>1.000</td>
<td>2.000</td>
</tr>
<tr>
<td>plant consumption kW</td>
<td>60</td>
<td>110</td>
</tr>
<tr>
<td>net power kW</td>
<td>940</td>
<td>1.890</td>
</tr>
</tbody>
</table>

#### Costs

<table>
<thead>
<tr>
<th></th>
<th>€</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHP</td>
<td>650.000</td>
</tr>
<tr>
<td>Transformer</td>
<td>40.000</td>
</tr>
<tr>
<td>compressorstation</td>
<td>200.000</td>
</tr>
<tr>
<td>bohrhole</td>
<td>0</td>
</tr>
<tr>
<td>buildings</td>
<td>120.000</td>
</tr>
<tr>
<td>permissions</td>
<td>40.000</td>
</tr>
<tr>
<td>planning</td>
<td>60.000</td>
</tr>
<tr>
<td>other</td>
<td>40.000</td>
</tr>
<tr>
<td>Sum investment</td>
<td>1.150.000</td>
</tr>
</tbody>
</table>

#### Investment

- Total Investment: € 1.150.000
- Total Investment: € 1.950.000

#### Annuity per annum

- Annuity per annum Projekt 1,0 MWel: € 177.930
- Annuity per annum Projekt 2,0 MWel: € 301.708

### Operation

<table>
<thead>
<tr>
<th></th>
<th>Projekt 1,0 MWel</th>
<th>Projekt 2,0 MWel</th>
</tr>
</thead>
<tbody>
<tr>
<td>amount of electricity sold kWh</td>
<td>5.452.000</td>
<td>10.962.000</td>
</tr>
<tr>
<td>average electricity price EUR/kWh</td>
<td>0.060</td>
<td>0.060</td>
</tr>
<tr>
<td>Revenues power p.a. €/a</td>
<td>327.120</td>
<td>657.720</td>
</tr>
</tbody>
</table>

#### Operating revenue p. a. €/a

- Operating revenue p. a. Projekt 1,0 MWel: € 196.870
- Operating revenue p. a. Projekt 2,0 MWel: € 411.070

### NET INCOME (incl. Capital costs) €

- NET INCOME Projekt 1,0 MWel: € 18.940
- NET INCOME Projekt 2,0 MWel: € 109.362

### Payback time simple

- Payback time simple Projekt 1,0 MWel: 5,8 years
- Payback time simple Projekt 2,0 MWel: 4,7 years

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CMM economics

power price determines the economy

Revenues per Year from CMM power production

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Thank you for your attention

Clemens Backhaus

A-TEC Anlagentechnik GmbH
Moers, Germany
Tel.: +49 2841 88 43850
ba@atec.de

for Russian language
Sergej Wagner
Tel.: +49 2841 88 43 856
wa@atec.de