Jenbacher gas engines

Barbara Marschik
Jenbacher gas engines
Jenbacher gas engines

- GE Energy’s Jenbacher product team has its headquarters in Jenbach, Austria
- Worldwide network of sales and service offices
- Nearly 5 decades of experience in the development and production of gas engines for efficient power supply
- Worldwide installed base: 4 GW
Specialist for efficient gas engines - Natural gas segment

Production and delivery of plants for decentralized energy supply based on natural gas

- Lowest emissions of all fossil fuels
- Most important fossil energy source
- Well developed natural gas supply system
Specialist for efficient gas engines - Biogas & special gases

Plants that produce energy using gas from landfill sites, agriculture, mining or the chemical & other industries

• Highly efficient
• Substitution of conventional fuels
• Alternative disposal of problem gases
• Avoiding liberation of methane
# Products and services from one source

**Business Areas**
- Natural Gas
- Bio- and Special Gases

**Products & Solutions**
- Gas Engines
- Generator Sets
- Cogeneration
- Trigeneration
- Turn-Key Container Solutions

**Service**
Jenbacher Customers

... expanding boundaries
The customer’s benefits

Key features

• High electrical and overall efficiencies
• Minimum emissions:
  LEANOX® lean mixture combustion
• Maximum operational safety and availability
• High power density

R & D

• Intensive customer contacts allow constant feedback to Research & Development
• Own R & D department in Jenbach
• Specialization in utilizing special gases
Order intake 2004 – Top countries

- Netherlands: 18%
- Pakistan: 10%
- Italy: 9%
- Germany: 8%
- Ukraine: 7%
- Great Britain: 6%
- Russia: 6%
- Japan: 4%
- Others: 27%
Product line 2005

- **Electrical output [kW]**
- **Thermal output (70°/90°C) [kW]**

Natural gas standard:
NOx ≤ 500 mg/Nm³
(dry Exhaust gas; based on 5 % O₂)

<table>
<thead>
<tr>
<th>Model</th>
<th>Electrical Output kW</th>
<th>Thermal Output kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>JMS 208</td>
<td>330</td>
<td>361</td>
</tr>
<tr>
<td>JMS 312</td>
<td>625</td>
<td>746</td>
</tr>
<tr>
<td>JMS 316</td>
<td>835</td>
<td>997</td>
</tr>
<tr>
<td>JMS 320</td>
<td>1064</td>
<td>1200</td>
</tr>
<tr>
<td>JMS 420</td>
<td>1416</td>
<td>1498</td>
</tr>
<tr>
<td>JMS 612</td>
<td>1820</td>
<td>1808</td>
</tr>
<tr>
<td>JMS 616</td>
<td>2433</td>
<td>2420</td>
</tr>
<tr>
<td>JMS 620</td>
<td>3041</td>
<td>3047</td>
</tr>
</tbody>
</table>
Full range of Services – on site in more than 30 countries

• Spare parts
• Service Contracts (CSA’s)
  … the best possible fulfillment of individual customer requirements
• Remote diagnosis and remote servicing
  The in-house Competence Center ensures timely and accurate technical support.
• Training Center
  Offers specific participant oriented training courses – at the customer site or in Jenbach

• Approximately 25% of Jenbacher sales comes from Service
• More than 40% of all Jenbacher service sales come from CSA’s.
Biogas – a renewable energy source

Cows Give Both – Milk and Power: Using Biogas in Gas Engines
Biomass Digestion
Advantages of Anaerobic Digestion

For farmers, the agricultural & food industry:
• improvement of manure properties: odor reduction, elimination of acid components, viscosity decrease, mineralization of organic nitrogen, reduction of pathogenic germs and weed seeds
• additional incomings from heat and power production
• waste water treatment without costly sewer connection

For the environment:
• reduction of methane and ammonia emissions from manure
• reduction of nitrate wash-out into groundwater
• recycling of fertilizer compounds from organic wastes
• reduction of carbon dioxide emissions by substitution of fossil resources
# Biogas Yields

<table>
<thead>
<tr>
<th></th>
<th>Gas m³ / t dry matter</th>
<th>amount m³ / t wet matter</th>
<th>Power generation kWh / t wet matter</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Manure</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cattle manure</td>
<td>210</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>Chicken manure</td>
<td>340</td>
<td>10</td>
<td>140</td>
</tr>
<tr>
<td><strong>Fresh plant parts</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grass</td>
<td>500</td>
<td>110</td>
<td>220</td>
</tr>
<tr>
<td>Clover</td>
<td>420</td>
<td>90</td>
<td>180</td>
</tr>
<tr>
<td>Corn plant</td>
<td>650</td>
<td>250</td>
<td>500</td>
</tr>
<tr>
<td>Sugar beet leaves</td>
<td>390</td>
<td>90</td>
<td>180</td>
</tr>
<tr>
<td>Potato leaves</td>
<td>500</td>
<td>110</td>
<td>220</td>
</tr>
<tr>
<td><strong>Silages</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grass silage</td>
<td>450</td>
<td>190</td>
<td>380</td>
</tr>
<tr>
<td>Corn silage</td>
<td>590</td>
<td>200</td>
<td>400</td>
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<tr>
<td><strong>Hay</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barley hay</td>
<td>240</td>
<td>220</td>
<td>440</td>
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<tr>
<td>Oat hay</td>
<td>280</td>
<td>250</td>
<td>500</td>
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<tr>
<td>Wheat hay (raw)</td>
<td>155</td>
<td>135</td>
<td>270</td>
</tr>
<tr>
<td>Wheat hay (fine)</td>
<td>300</td>
<td>260</td>
<td>520</td>
</tr>
<tr>
<td><strong>Wastes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bio waste</td>
<td>250</td>
<td>130</td>
<td>260</td>
</tr>
<tr>
<td>Food waste</td>
<td>480</td>
<td>110</td>
<td>220</td>
</tr>
</tbody>
</table>
Biomass Digestion

Siggerwiesen/Austria

3 x JMS 316 GS B/L.L

Plant Output
1,629 kW_{el}
Thermal Output
2,373 kW

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomass</td>
<td>19,900 to/year</td>
</tr>
<tr>
<td>Biogas production</td>
<td>3,036,000 m³/year</td>
</tr>
<tr>
<td>Compost production</td>
<td>4,950 m³/year</td>
</tr>
<tr>
<td>Landfill gas</td>
<td>2,371,000 m³/year</td>
</tr>
<tr>
<td>Electricity production</td>
<td>6,510 MWh/year</td>
</tr>
<tr>
<td>Heat production</td>
<td>3,260 MWh/year</td>
</tr>
</tbody>
</table>
Biomass Digestion Siggerwiesen

- Delivery
- Mechanical Treatment
- Tunnelcomposting
- Final Stabilisation
- Digester
- Dewatering
- Steam
- Biogas
Biomass Digestion Siggerwiesen

Gasometer 2,500m³

Landfill gas  Biogas  Gas compressor

Flare  Desulpherisation

Steam boiler  Gas engines

Heat  Electricity
Delivered Engines – NG / NNG Application
1988 – 2004

- Pipeline Gas: 66%
- Landfill Gas: 20%
- Sewage Gas: 6%
- Biogas: 6%
- Coal Mine Gas: 2%

Total: 100%
AD of biomass - Germany

Gut Wolfring / Germany

1 x JMC 208 GS-B.L

Electrical Output: 330 kW

Thermal Output: 421 kW
AD of biomass St. Veit/Glan / Austria

St. Veit /Austria
1 x JMC 320 GS-B.LC

Electrical Output: 1,065 kW
Thermal Output: 1,052 kW
Biogas Plant

Japan/Food industry
JMS 316 GS-B/N.L
Biogas/Natural gas

Electrical Output:
522 kW
Utilization of landfill gas

background and experience
1 ton domestic waste => 150 - 250 Nm³ Landfill gas over a period of 15 - 25 years
LHV = approx. 4.5 - 5 kWh/Nm³
40 - 50% collectable from a covered landfill

Source: Biogasvolume and Properties; U. Loll, ATV Seminar 2/99 Essen; Germany
Delivered Engines – NG / NNG Application
1988 – 2004

- Pipeline Gas: 66%
- Landfill Gas: 20%
- Sewage Gas: 6%
- Biogas: 6%
- Coal Mine Gas: 2%

Pipelines Gas: 66%
Utilization of Landfill Gas

NENT/Hong Kong
2 x JGC 320 GS-L.L

Electrical Output: 2 x 922 kW
Utilization of Landfill Gas

Simeprodeso /MEX
7 x JGC 320 GS-L.L

Electrical Output:
7,042 kWel
Utilization of Landfill Gas

Arpley/UK
18 x JGC 320 GS-L.L
Electrical Output: 18,612 kWel
Utilization of Coal Mine Methane
Coal mine methane utilization
Delivered Engines – NG / NNG Application
1988 – 2004

- Pipeline Gas: 66%
- Landfill Gas: 20%
- Sewage Gas: 6%
- Biogas: 6%
- Coal Mine Gas: 2%
- Other gases: 66% (Pipeline Gas)
Active Mine Fenne/Germany

Fenne/Germany

14 x JMS 620 GS S.LC

Electrical Output:
40 MWel

Total Operating Hours:
175 000
GWh: 474
Closed Mine Shirebrook/UK

Shirebrook Colliery/UK
5 x JMS 616 GS-S.L
Electrical Output: 10 MW
Total Operating Hours: 178 000
GWh: 310
CDM possibilities with Jenbacher gas engines
Natural Gas - The Cleanest Fossil Fuel

CO₂ formed by the combustion of fossil fuels
[kg CO₂/kWh fuel input]

Source: Third Report of the Parliamentary Commission on „Preventive Measures to Protect the Earth`s Atmosphere“ published in October 1990
Example for specific CO2 – production of different technologies

=> 0.669 kg CO₂

Total 0.963 kg CO₂

=> 0.294 kg CO₂

Total 0.5 kg CO₂

=> 48% CO₂-reduction with Cogeneration

*) Source: “Ganzheitliche Bilanzierung der Energiebereitstellung”
FfE-Studie; Energy Mix Germany 1996: 0.669 kg CO₂/kWh_el
Natural Gas - CHP

Theoretical Emission Reduction Potential:

0.5t / MWh * 8000hr / year
⇒ appr. 4,000t CO₂ / MWel / year
⇒ appr. € 20,000 / MWel / year

Assumption: Energy Mix Germany; 40% el. Efficiency; 8,000 OH/y; 1ton CO₂: 5€
Biogas

Emission Reduction Potential:
0.963 t / MWh * 8000 hr / year
⇒ appr. 7,700t CO₂ / MWe / year
⇒ appr. € 38,500/year

Theoretical example for:
St. Veit, Austria
Engine type: 1 x JMC 320 GS-B.L.
Electrical output: 1.065kW
Emission Reduction Potential: 8200t CO₂ / year
(eq. 40,000 €)

Assumption: Energy Mix Germany; 40% el. Efficiency; 8,000 OH/y; 1ton CO₂: 5€
Coal Mine Gas

Emission Reduction Potential:

2.5 kWh coal mine gas => 1 kWhel
2.5 kWh coal mine gas = 0.18 kg CH₄ (GWP CH₄ = 21)
=> 3.76 kg CO₂-equivalent
=> 4.22 kg/kWhel CO₂ reduction by CHP with CMM

4.22t / MWh * 8000hr / year
⇒ approx. 34,000t CO₂ / MWel / year
⇒ approx. € 170,000 / MWel / year

Theoretical example for:
Tahmoor Colliery/ Australia
Engine Type: 7 x JGS 320 GS-S.L
Electrical Output: 7 MW
Emission Reduction Potential: 240,000t CO₂/year (eq. 1.2 Mio. €)

Assumption: Energy Mix Germany; 40% el. Efficiency; 8,000 OH/y; 1ton CO₂: 5€
Landfill Gas

Emission Reduction Potential

Landfill Gas has to be flared:
0.669 t / MWh * 8000 hr / year
⇒ appr. 5,350t CO₂ / MWel / year
⇒ appr. € 27,000/year

Landfill Gas doesn’t have to be flared:
4.43 t / MWh * 8000 hr / year
⇒ appr. 35,000t CO₂ / MWel / year
⇒ appr. € 175,000/year

Theoretical example for:
Landfill site Nent, Hongkong
Engine type: 2 x JGC 320 GS-L.L

Electrical output: 1,844 kW
Emission Reduction potential: 9 865t CO₂/year
(€ 50,000)

Assumption: Energy mix Germany; 40% el. Efficiency; 8,000 OH/y; 1ton CO₂: 5€
CDM – a key component

• Biogas power generation projects in several cases viable because of CDM

• Costs of project development should be lowered and bureaucratic barriers simplified

• 2012 window is closing fast ⇒ opportunities could be lost if immediate action is not taken

• Jenbacher gas engines offer the benefit of both: useful utilization of renewable energy sources for power generation & creating carbon credits

Potential is enormous