Co-generation Utilizing Biogas from Sludge Treatment

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Presentation Outline

• Capturing Energy Value in Sludge
• Utilization of Biogas Generated from Sludge Treatment
• Case Study: Cd. Juarez
• Additional Co-generation References
• Summary
Capturing the Energy Value in Sludge – Target Energy Neutrality

- **Context:**
  - Energy potential in Sludge represents twice the electrical consumption in treatment plants
  - Sludge treatment represents *15% of the total electrical consumption in the plant*
  - Digestion produces **biogas**, which can have a significant impact on the plant Energy balance

- **Objectives:**
  - Implement sludge treatment to limit Energy consumption
  - Aspire to achieve Energy Neutrality
Utilization Options for Biogas from Sludge Treatment

- **Renewable Heat Source**: Heat recoverable and usable within digestión/drying processes (reducing the need for import natural gas)

- **Co-generation (CHP)**: Simultaneous Heat & Power Production

- **Biomethane Production**: Upgrade biogas to Biomethane for pipeline injection or transformed into biofuel to offset diesel
Utilization of Biogas from Sludge Treatment – Co-generation

- Simultaneously produces electricity & heat from biogas
- Renewable Heat is used for digester & building heating
- **Renewable (Green) electricity is either used within the plant to offset import, or sold to the grid**

**Combined Heat & Power**

- 1 kg of VS
- 1 Nm³ biogas
- 6.3 kWh

**Electrical Efficiency:** 30-42%
**Thermal Efficiency:** 35-45%

- **Electricity:** 2.2 kWhe
- **Heat:** 1.8 kWht
Biogas Upgrading to Biomethane

- Biogas Upgrader: membrane
- Compliant biomethane
- Non-compliant biomethane
- Off-gas
- Moisture traps
- H₂S and VOC treatment
- Compressor
- Non-compliant biomethane + off-gas

Co-generation Utilizing Biogas from Sludge Treatment
Methanis Biogas Upgrading membrane plant

- **H₂S and VOC treatment**
- **Membranes skid**
- **Booster**
- **Compressor**
- **Dryer**
Utilization of Biogas from Sludge Treatment – Biomethane

- Stage 1: Conditioning Biogas
- Stage 2: $\text{CH}_4$ recovery rate > 99.3%
- Stage 3: To the atmosphere
  - Offgas %$\text{CH}_4$<0.5%
- To pipeline injection: 96-98% $\text{CH}_4$

The CO2 is separated from the methane
Case Study: Co-Generation at Cd. Juarez
Components of Co-Generation

- Anaerobic Digestion
- Biogas Conditioning
- Biogas
- CHP
- Renewable Heat
- Renewable Electricity
- Utilization within WWTP
- H₂S & Moisture Removal

Co-generation Utilizing Biogas from Sludge Treatment
Contractual Scheme – Pegged on existing BOT Contract

- Biogas Usufruct granted to Suez
- Auto-consumption Permit
- Instruction Letter + Lease Agreement Suez / JMAS
- BOT-type SERVICE CONTRACT (CPS)
- BOT-TARIFFS (T1, T2, T3)
- Cogen assets Transfer at the term of the Lease
- O&M Contract TARIFFS (T2, T3)
- WTP Operator & Cogen Developer
- INVESTMENT & FUNDING Structuration
- CONSTRUCTION (EPC)
- OPERATION & MAINTENANCE
- OWN STAFF
- IRREVOCABLE & EXCLUSIVE OPERATOR

COGENERATION
Combined Heat & Power Units

- **Fuel** = Biogas (Desulfurized & Dried) (60-64% methane)
- **Electrical Output**: 2x 604 kWe @ 1,800 rpm (Net, altitude corrected)
- **Continuous Service**: 24 hrs/day, 330 days/yr (>90% availability)
- **Useful Life**: 234,000 effective hours (26 years)
## Resultant Performance

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>Value</th>
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<tbody>
<tr>
<td>Biogas Production</td>
<td>Nm³/d</td>
<td>13,130</td>
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<tr>
<td></td>
<td>Nm³/h</td>
<td>547</td>
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<tr>
<td>Potential Electricity Generation</td>
<td>kWhe</td>
<td>948</td>
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<tr>
<td>Number of CHPs</td>
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<td>2</td>
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<tr>
<td>CHP Capacity (per unit)</td>
<td>kWhe</td>
<td>604</td>
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<tr>
<td></td>
<td>kWht</td>
<td>879</td>
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<td><strong>Actual Renewable Energy Generation</strong></td>
<td>kWhe</td>
<td>900</td>
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<tr>
<td></td>
<td>kWht</td>
<td>1,313</td>
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<tr>
<td>Percentage of Biogas Utilized in CHPs</td>
<td>%</td>
<td>100</td>
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- Commissioned September 2016
- Co-generation Utilizing Biogas from Sludge Treatment
## Sample of Additional Co-generation References - Suez

### Avonmouth (Bristol, UK)
- 5.75 MW electricity generation
- Co-located digestion of sludge & food waste
- Energy Positive WWTP
- Export > 1.5 MW to grid

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<thead>
<tr>
<th>Installation</th>
<th>Location</th>
<th>Production (kWh)</th>
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<td>Bordeaux</td>
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Summary

- Wastewater Sludge holds energy potential that can be captured to reduce the energy consumption
- Utilization of Biogas Generated from Sludge Treatment can be used beneficially both to create heat & electricity, as well as renewable natural gas
- Co-generation at Cd. Juarez was successfully implemented in 2016 creating 900kW of renewable electricity and 1,313 kW of renewable heat to offset the parasitic demands of the plant
Thank You

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