Green Energy from Black Water:  
The HAMBURG WATER Cycle in the Settlement Jenfelder Au  

A Lighthouse Project towards Sustainable Sanitation  

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HAMBURG WASSER supplies drinking water to more than 2 million people in Hamburg and the metropolitan area and is responsible for wastewater management.

- Owned by the Free and Hanseatic City of Hamburg
- Turnover: 505 m €
  Investment: 153 m €
- Length water + sewer network: 5400 km + 5600 km
- Water supplied: 114 m m³/a
  Sewage treated: 160 m m³/a
- Use of drinking water for toilet flushing and dilution of excrements with greywater
- Large-sized mixed sewer or wastewater and rain sewer, high fixed costs, very long depreciation time of up to 100 a and more, long-term maintenance involves continual large expenditures.
- Lack of flexibility regarding structure, technical progress and future requirements
- Current urban wastewater disposal (end-of-pipe) is energy- and water intensive, no recovery of reusables and nutrients (P, K, N, C)
Are we optimizing the right system?

**Paradigm change in water supply and waste water disposal is imminent**

- Adaptation to climate change, demographic change, etc.
- Nexus between water – food – energy – organic waste
- Closed loop approaches for water-, energy- and material flow efficiency
- Use of synergies between different infrastructure sectors
- Use of new technologies
- New business models for “classic” water utilities

Paradigm change is implemented in new concepts such as HAMBURG WATER Cycle®
Green energy from black water

HAMBURG WATER Cycle – an innovative wastewater concept based on source separation

### Amounts and Constituents

<table>
<thead>
<tr>
<th>Blackwater*</th>
<th>Greywater</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount [l/PE*d]</td>
<td>6</td>
</tr>
<tr>
<td>Dry matter [mg/l]</td>
<td>7500</td>
</tr>
<tr>
<td>Org. dry matter [mg/l]</td>
<td>6800</td>
</tr>
<tr>
<td>COD [mg/l]</td>
<td>9600</td>
</tr>
<tr>
<td>Nitrogen [mg/l]</td>
<td>2000</td>
</tr>
<tr>
<td>Phosphorus [mg/l]</td>
<td>300</td>
</tr>
<tr>
<td>Pharmaceuticals qualitative</td>
<td>high</td>
</tr>
</tbody>
</table>

*by using vacuum system

Separate treatment and processing is reasonable.
Water-saving toilet technology

Vacuum toilet and vacuum sewage system

- higher investment costs
- unusual sound
- flexible piping network
- less odors
- less flushing water (-80%)
Vacuum toilets

- 0.5 - 1.0 litres per flush, amount of blackwater 6 - 8 l per person and day
- In Europe: 5 different models used in ships and buildings

Vacuum toilets made by Vacusatec, Roediger and Jets

Test rig for vacuum toilets at Hamburg Wasser
Revitalization of the former Lettow-Vorbeck military barracks into the new urban district “Jenfelder Au”
Revitalization of the former Lettow-Vorbeck military barracks into a new urban district

- Development goals:
  - High quality but affordable living
  - Family-friendly surrounding for living and working
  - Positive impulse for the district Jenfeld
Green Energy from black Water –
HAMBURG WATER Cycle in Jenfelder Au

- 35 ha, 770 accommodation units,
- Land allocation:
  - Habitation (60%)
  - Trade & commerce (20%)
  - Green (20%)
- Low energy or passive house standard (50 – 15 kWh/m²)
- Sanitation-, energy- and zero CO₂ concept: HAMBURG WATER Cycle
- Construction: 2012-2016
HAMBURG WATER Cycle in Jenfelder Au – Wastewater concept

- Treatment of greywater on-site, potential for re-use (residential, industrial)
- Transportation of blackwater by use of vacuum technology (- 80% water)
- Blackwater remains concentrated (organic matter, nutrients, pollutants)
- Blackwater separation enables anaerobic treatment together with other biomass and therefore production of energy on-site (zero CO₂)
Blackwater separation

- Facilities of HAMBURG WASSER
- Households connected to vacuum system
- Existing buildings: conv. drainage
- Trade and commerce area: conv. drainage

- Treatment plant
- Vacuum station
The wastewater concept is linked to the energy concept to generate CO₂-neutral electricity and heat.

Local heat for one share of the houses is generated in a biogas-CHP.

Shallow geothermal energy and solar heat is used for another share of the houses.

100% heat and up to 50% electricity can be generated on-site.
Heat supply
Preferred concept

- CHP energy surplus ca. 670 MWH/a el.
  ca. 540 MWH/a therm.

- Local heat CHP & peak load heating

- Geothermal heat pump & solarthermics
  power req. < 670 MWH/a el.

- 100% heat supply
- 50% electricity
  (by use of individual photovoltaics)
International placement

- Largest separating sanitation system in Europe (ca. 600 households)
- Acid test for vacuum technology as an alternative to conventional urban drainage
- Professional operation by public utility
Benefits of the concept HAMBURG WATER Cycle

- Flexibility due to decentralized concept
- Water consumption can be reduced by using vacuum system (-30%)
- Option for water reuse (up to 75% reduction in water consumption)
- Nutrients like phosphorus and nitrate can be returned to agriculture
- System is energy self-sufficient and reaches an energy surplus respectively (zero CO₂ concept)
- Proven technology
- System is applicable on a big-city scale and can be integrated into existing infrastructure
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Summary

- Numerous framing conditions of water and waste water management are in flux, triggered and accelerated e.g. by climate change.

- It is time for new infrastructure systems and configurations in order to offer sustainable water and energy services.

- The HAMBURG WATER Cycle in the new estate “Jenfelder Au” is a step towards sustainable sanitation. It demonstrates in urban district-scale the integration of wastewater management based on source separation with energy generation. Furthermore, the loop to agriculture will be closed.

- UXO-clearance is on the way, tendering process is ongoing, civil works will start Q-4 2012, first resident is expected in 2014.
Thank you for your attention!

Questions, please!