Micro- and Small-Scale Cogeneration and Trigeneration

Johan Grope

Berliner Energieagentur GmbH

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Contents

- Berliner Energieagentur (BEA)
- Motivation for Micro- and Small-Scale Co- and Trigeneration
- International Experience: Focus Germany
- Conclusion
BEA – Facts and Figures

Established
- in 1992 as Public Private Partnership

Shareholders
- Federal State of Berlin
- Vattenfall Europe
- GASAG
- KfW Banking Group

Capital stock
2.5 million €

Annual total output
About 11.2 million €

Company earnings (EBIT)
834 k €

Know-how
55 members of staff

Energy Services
- Consulting (National & International)
- Contracting

Based in
Französische Straße 23
10117 Berlin
Phone: (030) 29 33 30 - 0
e-mail: office@berliner-e-agentur.de
Internet: www.berliner-e-agentur.de

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Energy Services

- **Consulting:**
  Advice on all aspects of efficient energy use for customers from industry and commerce as well as the housing, service and public sector

- **International Know-how Transfer:**
  Transfer of successful models of efficient use of energy and of the deployment of renewable energy to developing markets

- **Contracting:**
  Planning, financing, construction, and operation of CHP and heat stations, of special supply components such as emergency power, cooling energy and compressed air, solar energy as well as lighting systems

Generation Data

- at about 90 sites in the region of Berlin
- 54 CHP-units (incl. 5 micro-CHP), annual electricity generation approx. 12,000 MWh
- direct electricity supply for around 2,500 households in Berlin
- CO₂ savings of more than 5,000 t/a
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(Fast) **Growing energy demand** and slow increase of energy capacity supply lead to **capacity gaps**

- **Fluctuating energy supply** due to increasing share of renewable energy sources lead to **capacity gaps**

- increasing risk of blackouts
- **security of energy supply** is a mayor issue in many countries
Challenges for many developing and emerging countries:

- Security of energy supply
- High and rising energy prices
- Energy access in remote areas
- Energy efficiency and emission reduction

Additional flexible, decentralized power generation (e.g. cogeneration and trigeneration) customized to the local demand helps solving the challenges and leads to an increasing quality of energy supply for consumer
# Micro- and Small-Scale Cogeneration and Trigeneration

## Focus on Customized Energy Supply for Each Individual Consumer

<table>
<thead>
<tr>
<th>Electric Capacity</th>
<th>Field of Application</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Micro</td>
<td>one/two-family-house, commercial sector</td>
<td>Senertec D, Honda Japan</td>
</tr>
<tr>
<td>Mini</td>
<td>apartment buildings, commercial sector, hotels, nursing homes</td>
<td>MicroGen UK, Fuel Cell D. CH</td>
</tr>
<tr>
<td>Small</td>
<td>industrial sector, commercial sector, hotels, nursing homes</td>
<td>2G D, CHP Block Diesel, CHP Block Otto</td>
</tr>
</tbody>
</table>

- **Micro**:
  - Field tests since 2000
  - 5.5 kW<sub>el</sub> established
  - Electric capacity: < 15 kW<sub>el</sub>

- **Mini**:
  - Marketable 25 – 48 kW<sub>el</sub>
  - 15 kW<sub>el</sub> ... 50 kW<sub>el</sub>

- **Small**:
  - Established 1 kW<sub>el</sub> - 5 MW<sub>el</sub>
  - 50 kW<sub>el</sub> ... 2 MW<sub>el</sub>

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Trigeneration:

- Cooling energy for air conditioning or industrial purposes in buildings
- Absorption chillers powered only by heat
- Up to 30% less of primary energy needed compared to compression refrigerating production
- Higher investment costs compared to compression chiller units

Economical use depends on concrete business conditions
“Micro- and Small-Scale Cogeneration and Trigeneration: International Best Practices and Recommendations for Mexico”

Joint study with Mexican consultants GARANI Asesores en Sustentabilidad, S.C.

**Objectives BEA:**

- Identify **international best practices** (e.g. policies and support mechanisms)
- Elaborate **recommendations** for Mexico based on the analysis of local conditions and international experiences (best practices).

Project-period: November-December 2012
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Countries with Significant CHP Capacity (Small and Large Scale)

Study will focus on:
- Significant capacity of small-scale CHP
- Similar conditions to Mexico

Source: IEA 2008
Micro- and Small-Scale Cogeneration and Trigeneration

Rise in Energy Prices – Germany

Energy sources

Electricity

Increasing interest in decentralized energy supply due to high energy prices
German Energy Policy Targets – Challenges for energy supply security

Energy Concept of the Federal Government (September 2010)

- **CO₂ emissions reduction** until **2020 by 40 %**, until **2050 by 80 to 95 %** (reference year: 1990)
- **Reduction of** primary energy consumption until **2020 by 20 %**, until **2050 by 50 %** (reference year: 2008)
- **RES’ share of final energy consumption** to **18 % until 2020**, to **60 % until 2050**

Energy Transition

- **Power capacity gap**: 8,5 GW of **nuclear** power capacity **retired** in 2011, remaining 11,5 GW capacity will be retired by **2022** (original share: more than 20 % of generation capacity)

→ rising risk of blackouts!
Legal and Funding Framework – Selection

Decentralized Energy Supply

- Incentive Programme Mini-CHP
- CHP Act
- Renewable Energy Sources Act
- Energy Tax Act
- Heating Costs Ordinance
- Renewable Energy Heat Act
- Public Bank (KfW) Support Programmes
Energy Production From Small-CHP is Increasing over the Last Years

- TWh/a
- < 1 MW<sub>el</sub>
- < 50 kW<sub>el</sub>

Source: BEA, Prognos
Dynamic Growth of Decentralized CHP (< 50 kW_{el}) in Berlin

Source: BAFA 2011
BEA CHP-Units

- BEA in Berlin trailblazer in decentralized CHP for over 15 years
- 54 installed plants
- CO$_2$-savings of over 5,000 t/a
- Direct electricity supply of over 2,500 households
- Application in residential buildings, commercial sector, public sector
Micro- and Small-Scale Cogeneration and Trigeneration

CHP – Best Practice

City Carré / Commerzbank, Commercial Complex, Berlin

- Heated floor space approx. 36,000 m²
- Shopping mall, offices and hotel
- CHP unit in existing heating system
- Start of supply: 2006

Technical data:

- CHP unit with 50 kWel and 97 kWth
- Environmental effects:
- Amount of energy savings 548 MWh/a
- Reduction of CO2 emissions: 200 t/a
Main Fire Station of Berlin’s Fire Department

- Thermal output: 2,200 MWh/a
- Electric output: 1,440 MWh/a
- Heat requirement: 4,000 MWh/a
- Heating surface approx. 21,500 m²

Technical data:
- Biogas CHP: 240 kWel / 367 kWth

Project outcome:
- Environmental relief: 1,350 t CO₂/a
- CO₂ neutral heat and electricity production
Service complex “Königstadt-Terrassen”

- Service and commercial complex, 40,000 m²
- Natural gas boiler running at low temperature: 1,900 kW
- 2 natural gas operated CHP units: each 120 kW_{el}, 214 kW_{th}
- Absorption chiller unit: 350 kW
- Emergency current: 220 kVA
- Amount of energy savings: 2,500 MWh p.a.
- CO₂ savings: 700 t p.a.
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Demand for space heating and hot water generation

heating capacity in kW

hours per year

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Demand for space heating, hot water generation and absorption chiller

```
heating capacity in kW

hours per year

0  100  200  300  400  500  600  700  800  900  1000

0  1000  2000  3000  4000  5000  6000  7000  8000

demand absorption chiller
```
Covering of the heating demand

![Graph showing the heating demand covered by Boiler and Block CHP over hours per year.](image-url)
Micro- and Small-Scale Cogeneration and Trigeneration

Energy Services – General Project Scheme

Local Gas Supplier

Energy Service Company (Contractor)

Local Electricity Utility

Customer

colorbox

- back-up supply
- re-feeding

energy services

financing, planning, construction & operation of energy systems

- heating
- cooling
- electricity
- emergency power
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Micro- and small-scale cogeneration helps overcoming capacity gaps and electricity grid fluctuations.

- Systems are suitable for variety of applications:
  - Emergency power supply
  - Supply of multiple energy types to complex buildings (hospitals, shopping malls)
- Range of policy instruments supported market development
- Energy Performance Contracting can help overcoming existing barriers
- Lessons learnt (in Germany and other countries) can help establishing a market of decentralized CHP in Mexico (current study for GIZ)
Thank You for Your Attention!

Further Information later on Location or please contact:

www.berliner-e-agentur.de
office@berliner-e-agentur.de