6th CEWEP Congress 2012

Waste-to-Energy

Energy & Resource Efficiency

6-7 September 2012, in Würzburg

Good Practice:
How to improve Energy Efficiency in Waste-to-Energy Plants

Examples from Germany

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A) Examples in practise

Measures to improve energy efficiency within the plant

► Improvement of electricity generation
(new turbine, retrofit boiler system, reheater, air condenser, etc.)

► Development CHP

► Improvement of systems engineering

(e.g. reduction of pressure drops, change SCR/SNCR)

A) Examples in practise

MVA Bielefeld basic data:

MVA Bielefeld

- 3 incineration lines, boiler:
  Baumgarte, start-up 1981, APC retrofit:
  Babcock, start-up 1993/1997
- capacity 420.000 t/a,
  NCV 12.000 kJ/kg
- 1 extraction condensing turbine,
  power production 180.000 MWh/a
- heat export to district heating net
  (operator: public services Bielefeld,
  300.000 MWh/a)

A) Examples in practise

MVA Bielefeld: Improvement of steam turboset

turbine MVA Bielefeld

- Exchange of a AEG-Kanis turbine (built 1980) new: SST-400 turbine Siemens
- Extraction condensing turbine, P_{el}=39,4 MW, High-pressure steam 180 t/h, low-pressure steam-150 t/h,
- Increase of efficiency (ca. 4%) by

  - reducing gap losses
  - optimised shovel profiles
  - rotary disc valve for extraction control
  - improvement of generator efficiency

► **Increase of energy output: 9.100 MWh_{el}/a**

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A) Examples in practise

MVA Bielefeld: Development of the air condenser

Air condenser MVA Bielefeld

- Development of the air condenser and optimisation of the exhaust steam system.
- The new air condenser is linked to the old system: capacity of the new system is 90 t/h (total exhaust steam flow: 150 t/h).
- Development of the air condenser and the exhaust steam system : Decrease of system pressure from150-200 mbar to 70 mbar.

► **Increase of energy output: 18.500 MWh_{el}/a.**

Total increase of energy efficiency: 27.600 MWh_{el} => R1 + 10%

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B) Examples in practise

Measures to improve energy efficiency **outside** the plant

- Access to a district heating net or development of existing district heating nets
- Integration in energy network systems (providing base load)
- Development of process steam utilisation by connecting energy (heat) demanding industry
- Utilisation of waste heat
  e.g. for greenhouses or biomass drying
- Use of mobile heat storage tanks

B) Examples in practise

MHKW Wuppertal: basic data

MHKW Wuppertal with public swimmíng bath Neuenhof (heat export: 7.000 – 9.000 MWh/a).

- 5 incineration lines,

  capacity: 12 to 15 t/h per line

- electricity production: 2 x 20 MW
- district heating:

  3 heat exchangers with 10 MW

B) Examples in practise

MHKW Wuppertal: Development of the district heating net

- Operator of the district heating net: public services Wuppertal
- Heat producer: only MHKW Wuppertal

- New connection of an industrial area to the district heating net (4 km transmission line, DN 300)

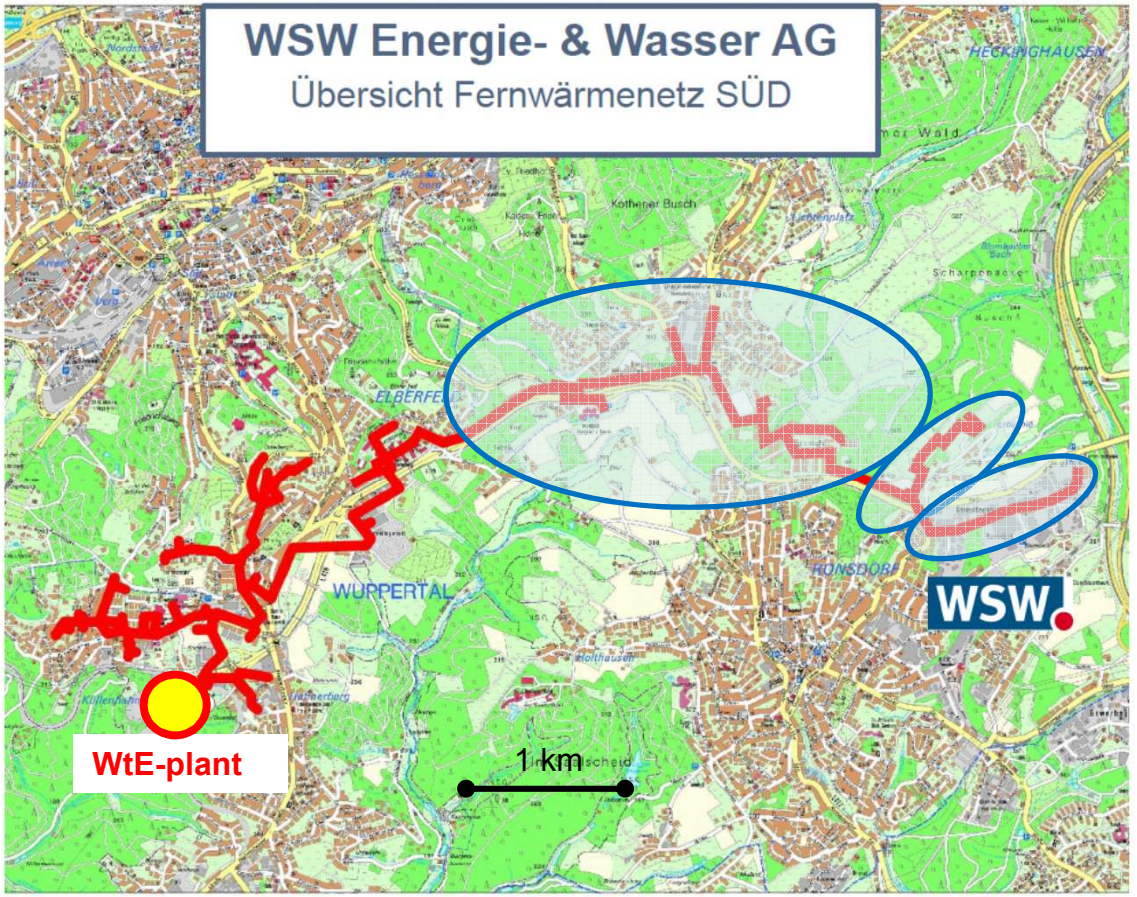
- Local by-law for the compulsary connection to the district heating net

- Use of district cooling

- **Increase of heat export: 70.000 MWh/a**

B) Examples in practise

MHKW Wuppertal: Development of the district heating net

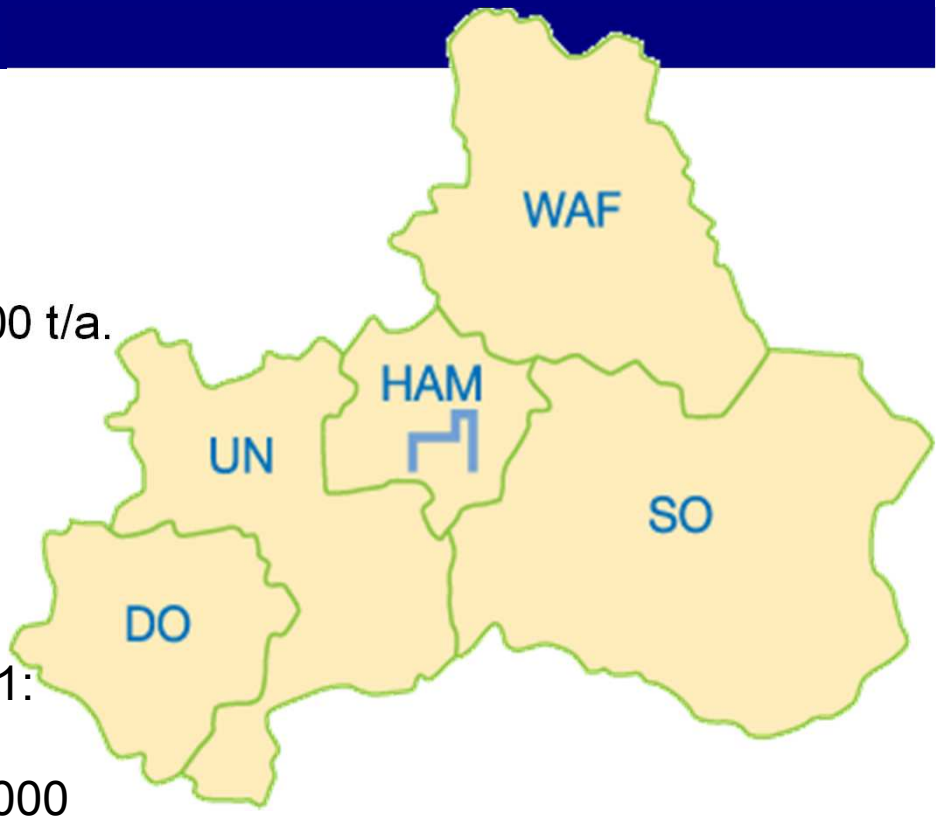


B) Examples in practise

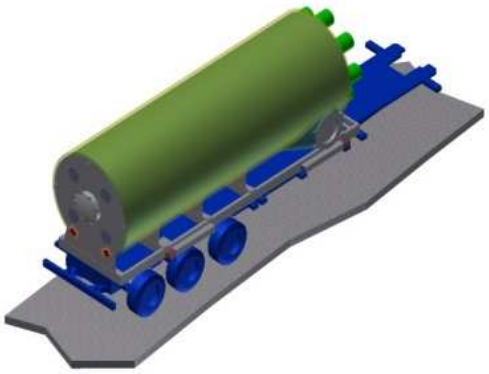
MHKW Wuppertal: Absorptioncooler
450 kW

C) An integrated approach: the MVA Hamm network

- Municipal shareholder
- Incineration capacity ca. 295.000 t/a.
- Collecting area: ca. 1,76 Mio. residents
- Energy production in 2011: 3 turbines (24,7 MW) ca. 140.000 $Mwh_{el.}/a$ for 40.000 households – ca. 50 % of all households in Hamm). Internal heat use: ca. 85.000 $Mwh_{th./}a$.



Energy efficiency projects MVA Hamm



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Energy efficiency projects MVA Hamm

Internal measures:

- New auxiliary burners-> decrease of fuel consumption
- New back pressure measurement-> increase of power production
- „Retrofit“ (Pre-heating combustion air, ignition loss bottom ash, excess air rate, combustion control system) -> increase of boiler efficiency
- ∑ **R1 + ca. 0,04**

external measures:

- Connection to district heating net – realised in Jan. 2012
- Use of mobile heat storage tank - realised in Aug. 2012 (?)
- Utilisation of waste heat for greenhouses - idea

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C) An integrated approach: the MVA Hamm network

District heating

- Supply of two district heating areas with a new transmission line of ca. 9,8 km length.
- Thermal capacity WtE: 25 MW, energy export: ca. 127.000 MWh, capital investment: ca. 17 Mio. €
- Base load: WtE, peak load: fossil fuel fired power plant

Start-up: **Januar 2012**

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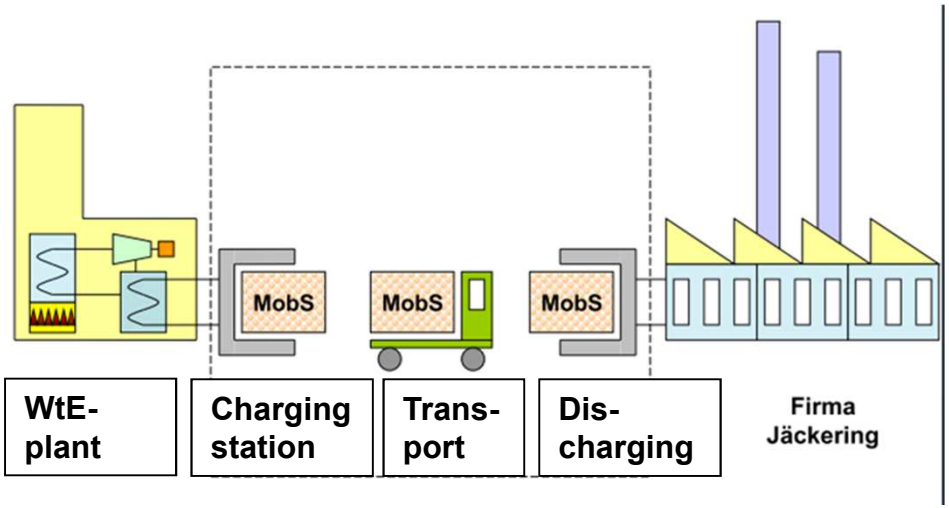
C) An integrated approach: the MVA Hamm network

Main principle mobile heat:

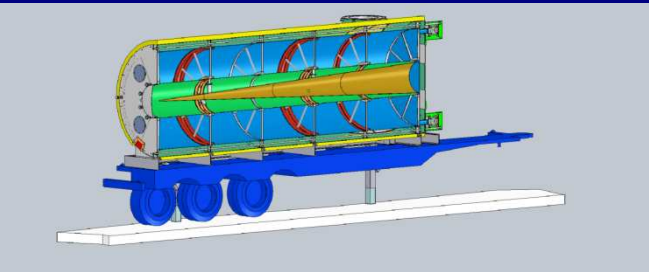


Using heat from

- steam (135°C)
- Project costs R&D (3 years: 2,4 Mio. €)

C) An integrated approach: the MVA Hamm network

Mobile heat storage tank



Heat storage tank (System MVA Hamm):

- length: 8.350 mm, width: 2.490 mm
- Therm. capacity max. 240 kW
- Total stored therm. energy max. 2,4 MWh

Based on the high capital investments min. 5.000 operational hours (200 heat deliveries) are required.

Goal: heat price less than 40 €/MWh

First container was constructed

Start-up phase: August/September 2012

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C) An integrated approach: the MVA Hamm network

Greenhouse project

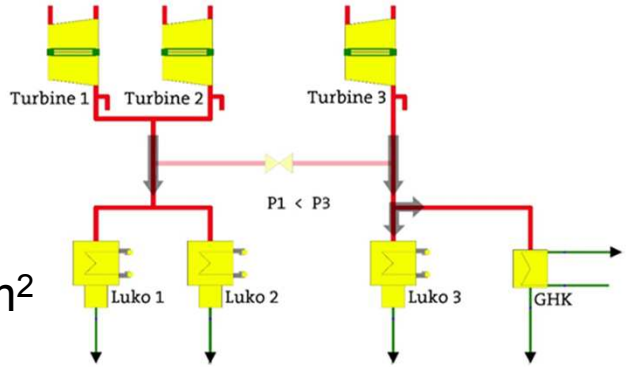
Waste heat for greenhouses (tomatoes and bell pepper)

In spite of power and district heating export another 170.000 MWh/a waste heat can be utilised in greenhouses with an additional heat exchanger (30 MW).

C) An integrated approach: the MVA Hamm network

Requirements of greenhouses

Inlet temperature:
- Mostly ± 55 °C
- Some weeks ± 70 °C



Energy demand (energy-intensive greenhouses):
- Max. capacity: 1.500 kW/10.000 m^2
- Yearly average: 3.200 MWh/10.000 m^2

Energy demand (energy-extensive greenhouses):
- Max. capacity: 1.000 kW/10.000 m^2
- Yearly average: 900 MWh/10.000 m^2

Also use for electricity and CO_2

New greenhouse project size ca. 100.000 m^2.

Intermediate results

Potential for the use of ca. 170 GWh/a waste heat for max. 600.000 – 1.000.000 m^2 greenhouses

Capital investment for start-up:

- 2 greenhouses ca. 25 Mio. € for 200.000 m^2 (plus investment for real estate)
- Heat exchanger and transmission line (ca. 5 km): ca. 10 Mio. €

Energy price << 20 €/MWh (full load operation incl. maintenance without heat safeguarding).

C) An integrated approach: the MVA Hamm network

Outlook

- Possible heat supply of 200.000 m^2-existing greenhouses (development up to 500.000 m^2)
- Supply of electricity and CO_2 from WtE under research (new study, first results: positive valuation)
- Integration of a fishfarm in the backflows . Aquacultures (e.g. african catfish) are the fastest growing sector in food production.

- Return flow heating of strawberry and asparagus farms.
- Development of a tropical gallery house (e.g. www. tropenhaus.ch)
  - cultivation and sale of tropical fruits
  - theme restaurants
  - show rooms
  - environmental education

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Thank you for listening.

Any questions?

Don´t hesitate!

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