EMSCHER GENOSSENSCHAFT EGLV.DE LIPPE VERBAND

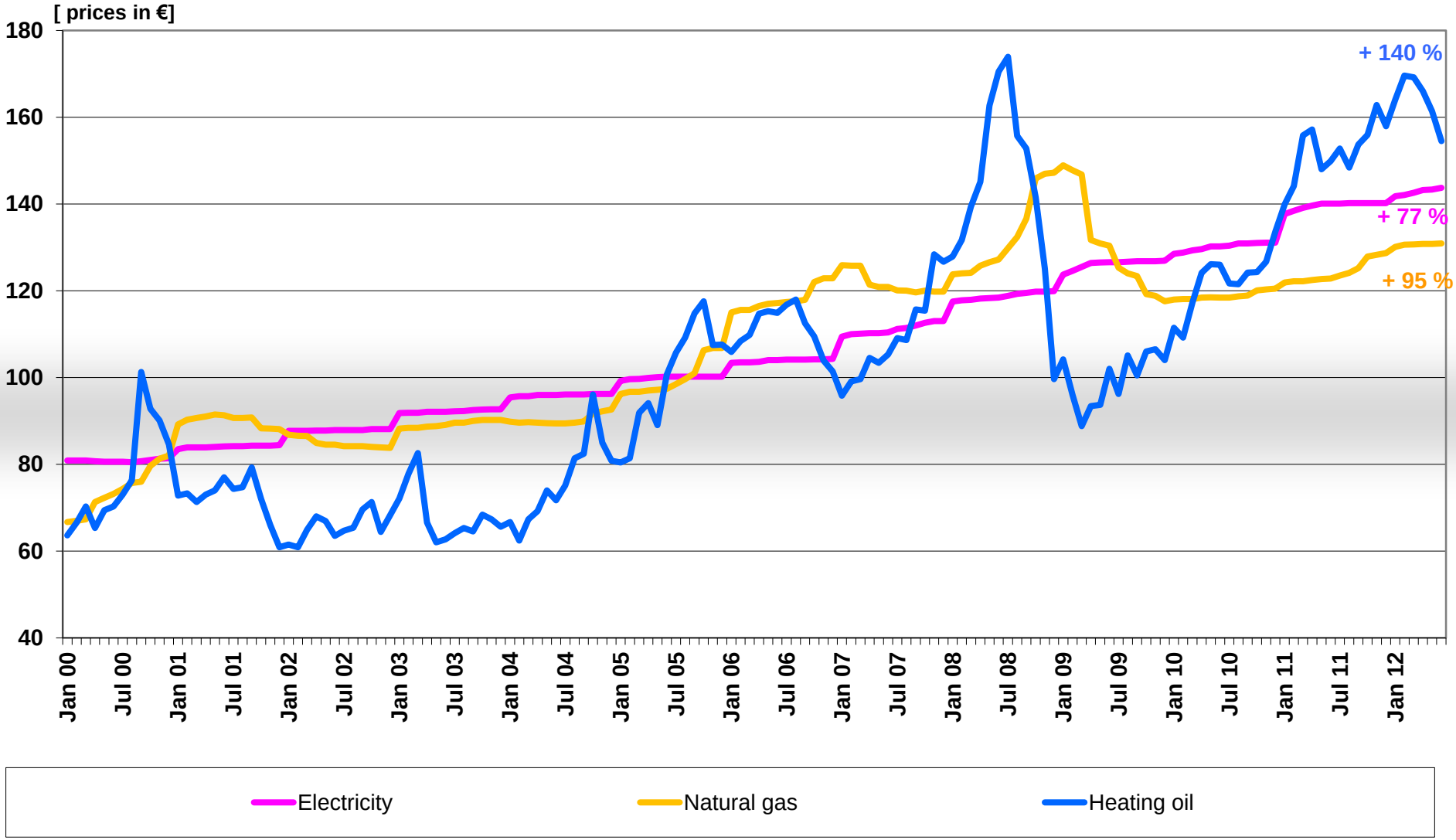
Profitability

Factors influencing profitability

- Energy costs and increases in the prices for energy costs
- System operation: monovalent, bivalent, multivalent
- Heating system design: low supply temperatures, high running time of heat pump, length of supply lines
- Contract period, state funding

Profitability

Development of energy prices since the year 2000



Comparison of profitability

12 systems in comparison

Basis:

Final report of the research project:

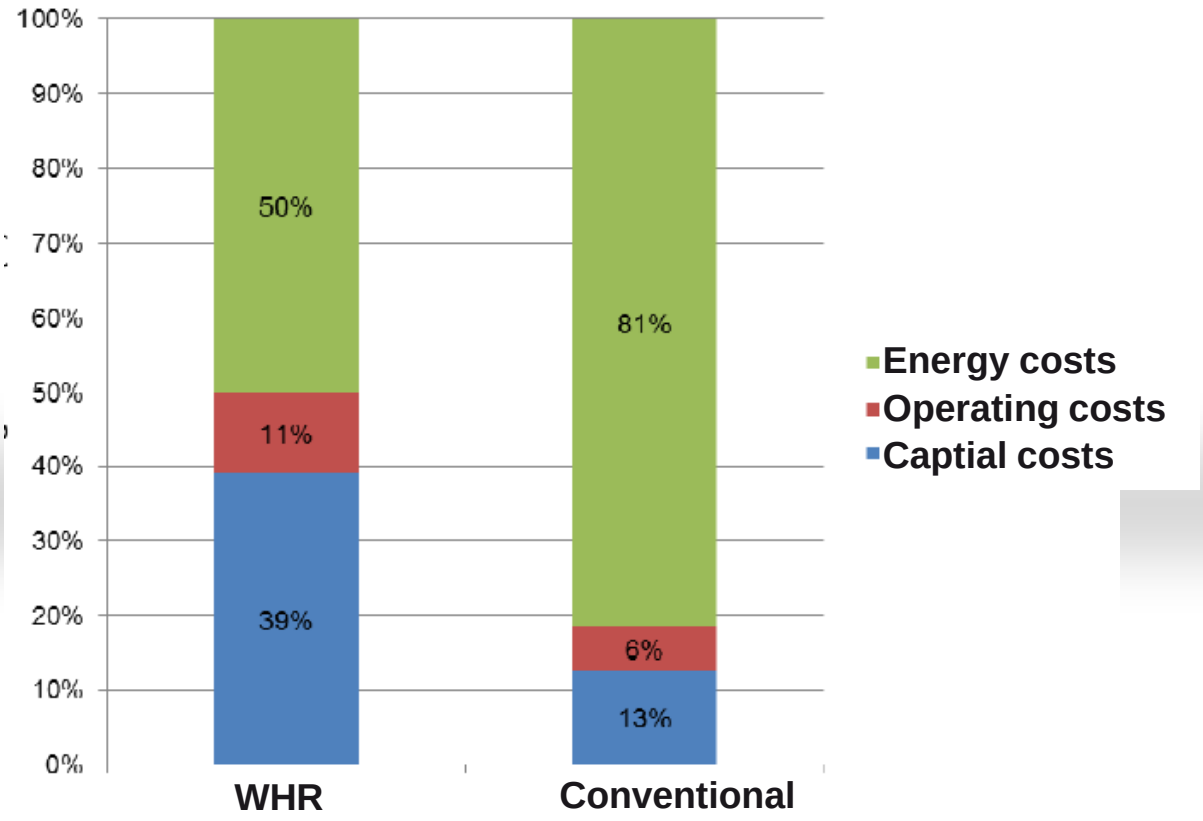
Potentials and Technical Optimisation of Wastewater Heat Recovery

Comparison of the profitability of 12 implemented systems

Final report

Cost breakdown

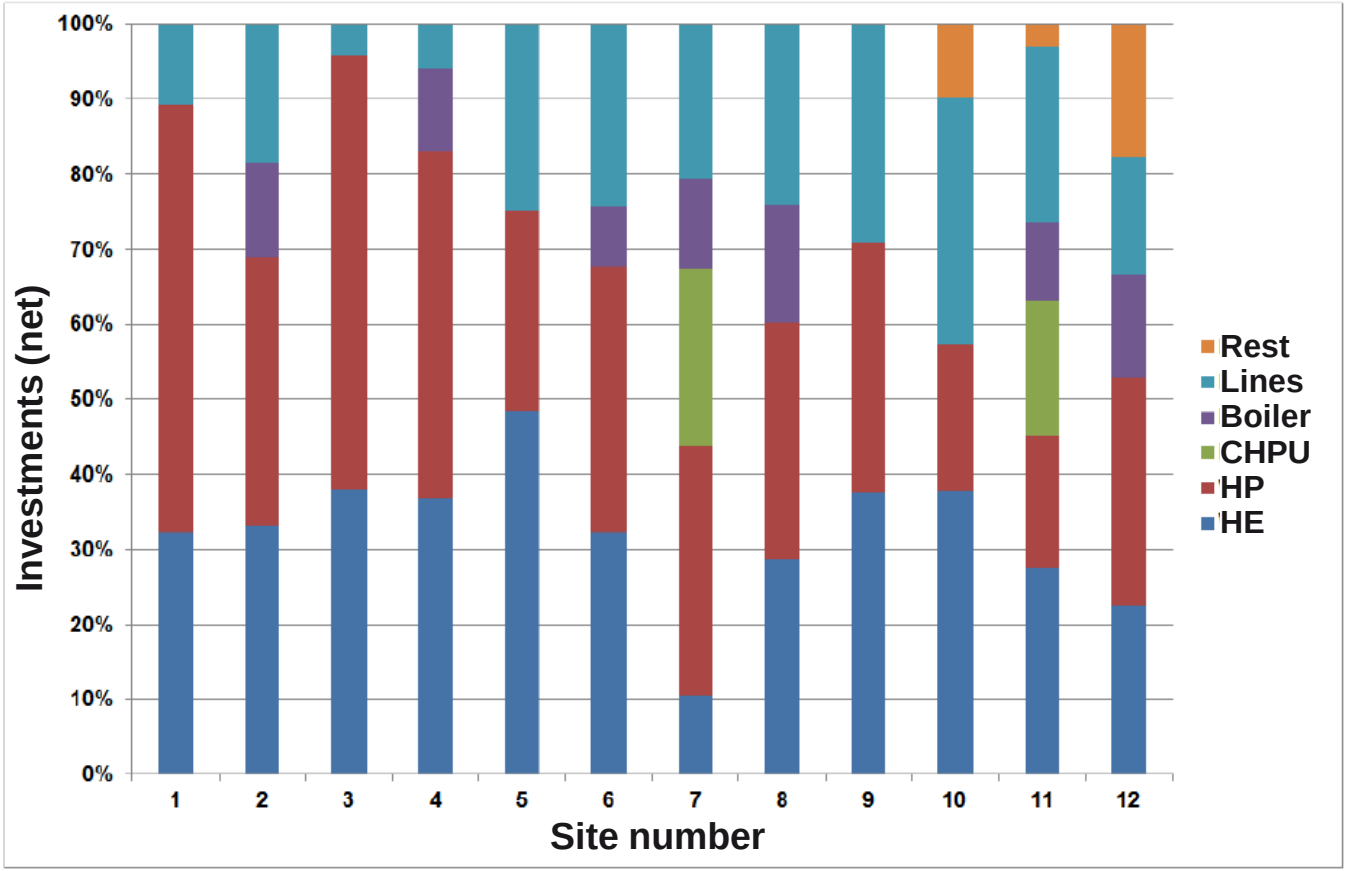
Comparison of wastewater heat recovery and conventional supply



Breakdown of costs in percent

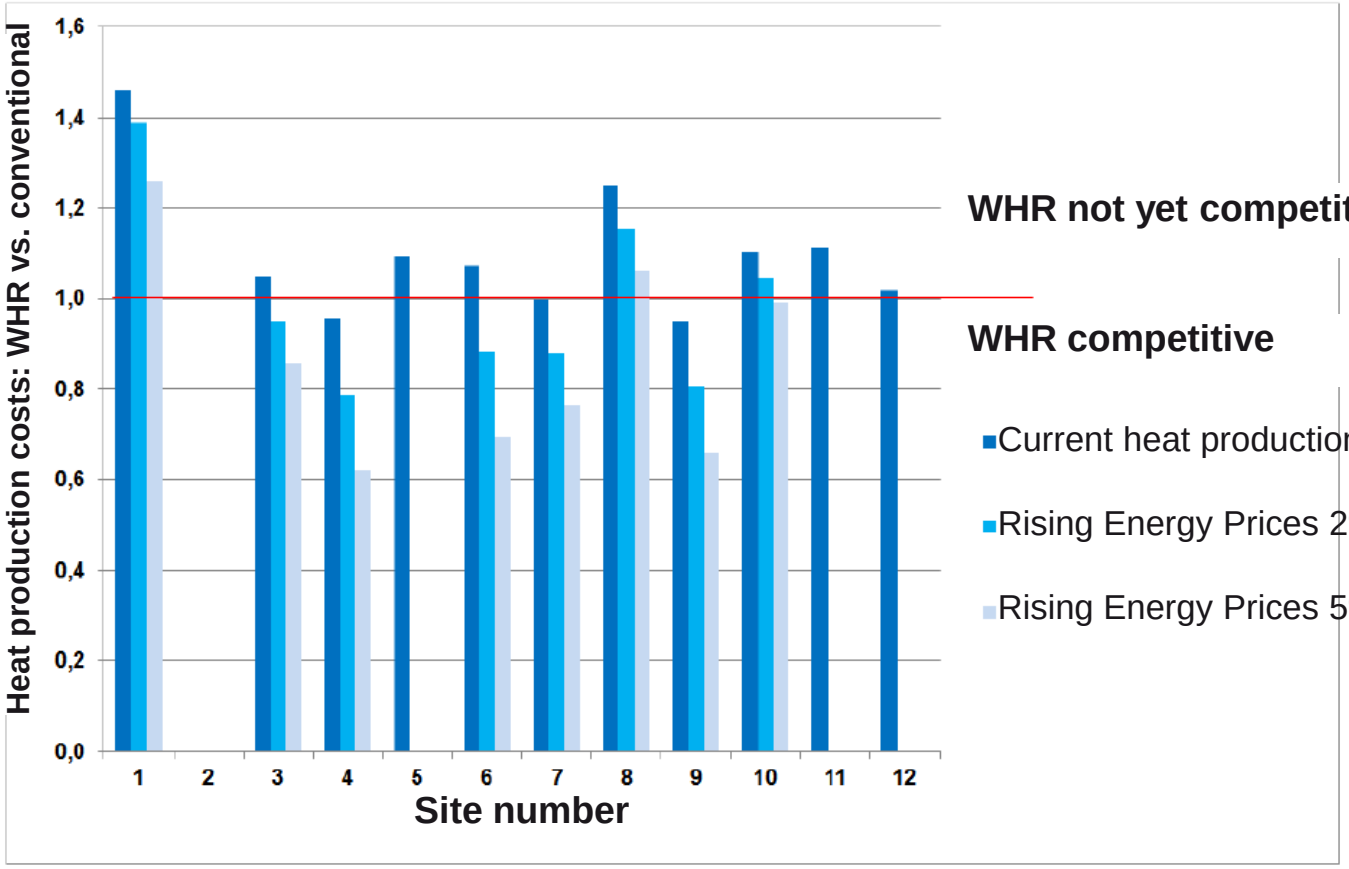
Cost breakdown

Comparison of wastewater heat recovery and conventional supply



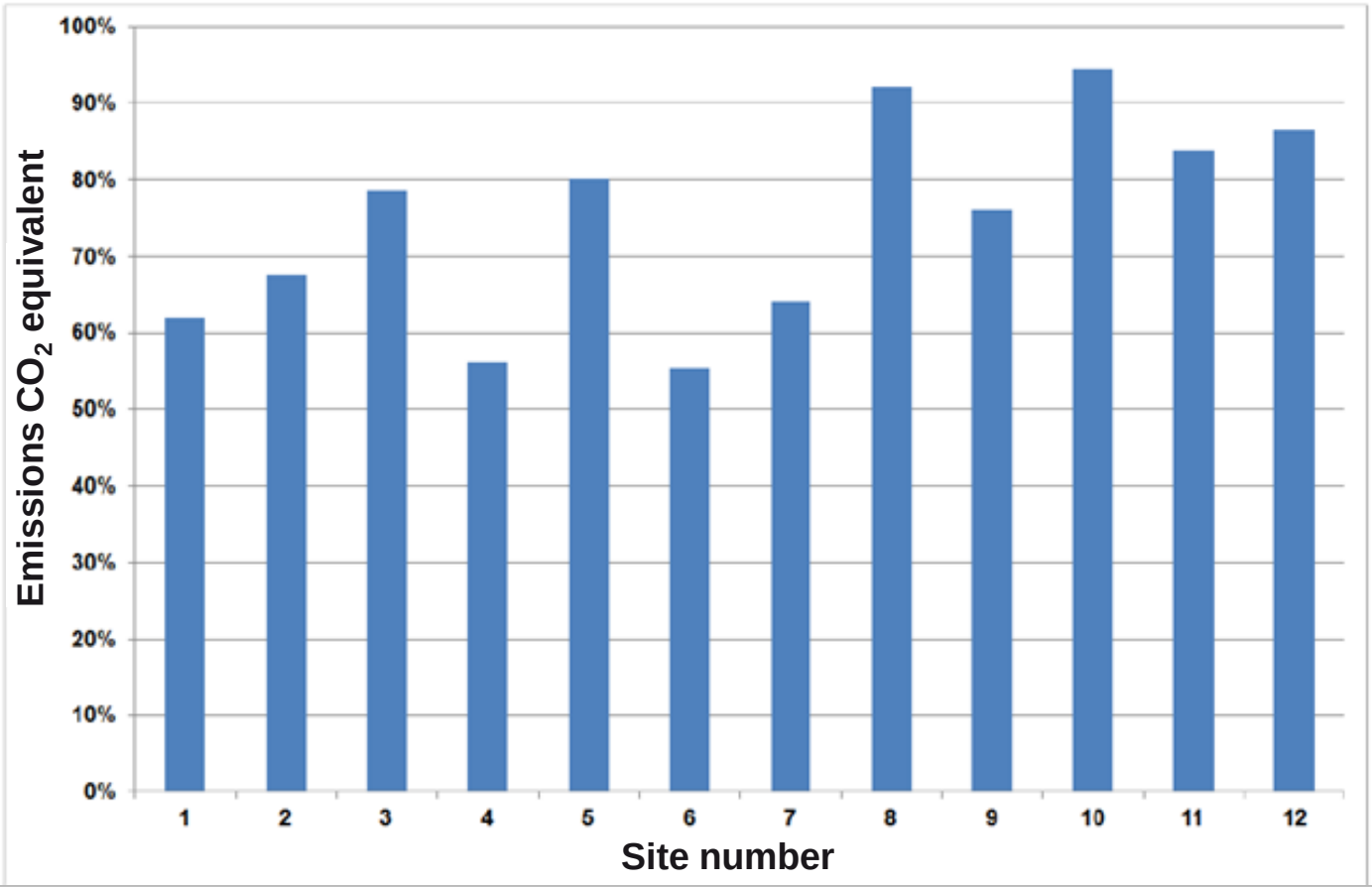
Composition of costs for the example systems

Profitability



Profitability of a wastewater heat recovery system in comparison to conventional supply with and without increase in energy prices

CO_2 reduction



CO_2 emissions in comparison to conventional supply with oil or natural gas (100%).

Nordwestbad in Bochum

Profitability analysis, economic lifetime 20 years

Cost type	HRW		Conventional
Investment costs (total)	790,000	€	51,000
Capital costs	64,200	€ p.a.	4,100
Consumption-based costs (natural gas and electricity) **With energy price increase***	120,600 **144,700**	€ p.a. **€ p.a.**	202,000 **242,400**
Operating costs (maintenance, personal, etc.)	21,700	€ p.a.	1,100
Total costs **Total costs***	206,500 **230,600**	€ p.a. **€ p.a.**	207,200 **247,600**

*** Assumed increase of energy prices about 2 % p.a.**

Promotion of renewable energy in the heating sector

Act on the promotion of renewable energies (2011)

§ 1 Renewable Energies Heat Act

1. Promotion of the further development of technologies for generation of heat and cold from renewable energies.
2. Increase in the percentage of renewable energies in the production of heat and cold to 14% by 2020.
3. Mandatory use of a share of renewable energies in new buildings and renovations of public buildings.
4. Funding volume: up to 500 million euros p.a.
5. Wastewater heat is an alternative measure.

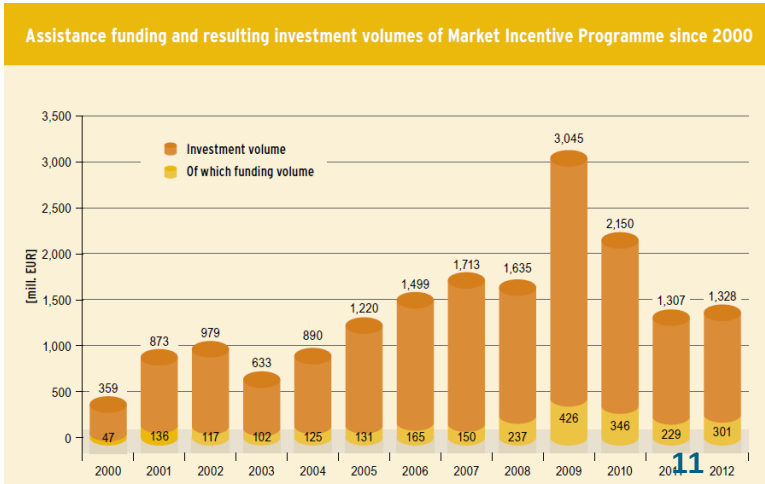
Promotion of renewable energy in the heating sector

The Market Incentive Programme

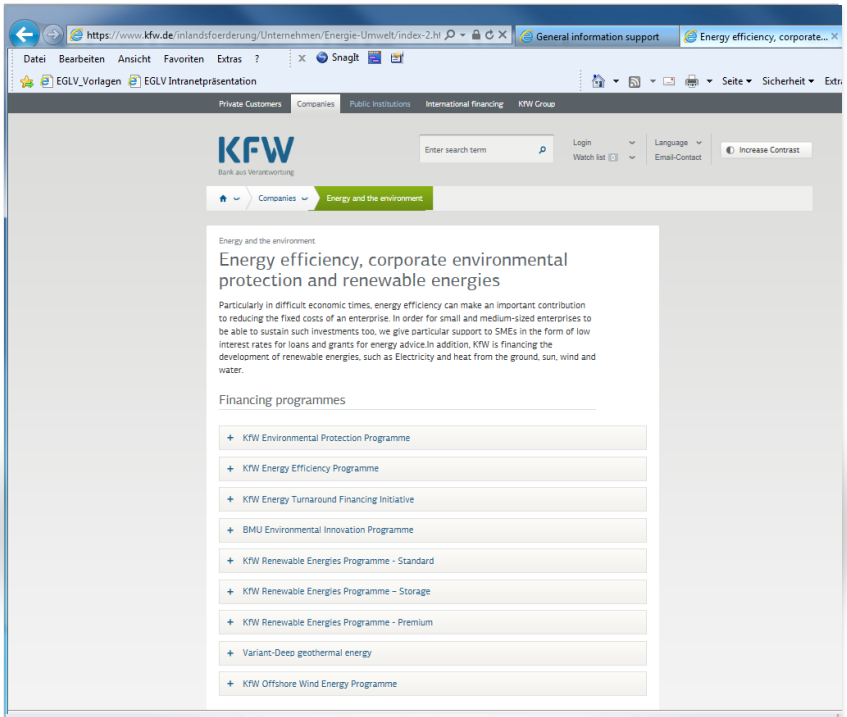
- promotes investment in renewable energy to meet demand for heating and cooling in buildings or for industrial or commercial processes.

- Federal Office of Economics and Export Control (BAFA) for small installations, primarily in existing buildings; mainly from private investors in the single-family or two-family homes segment

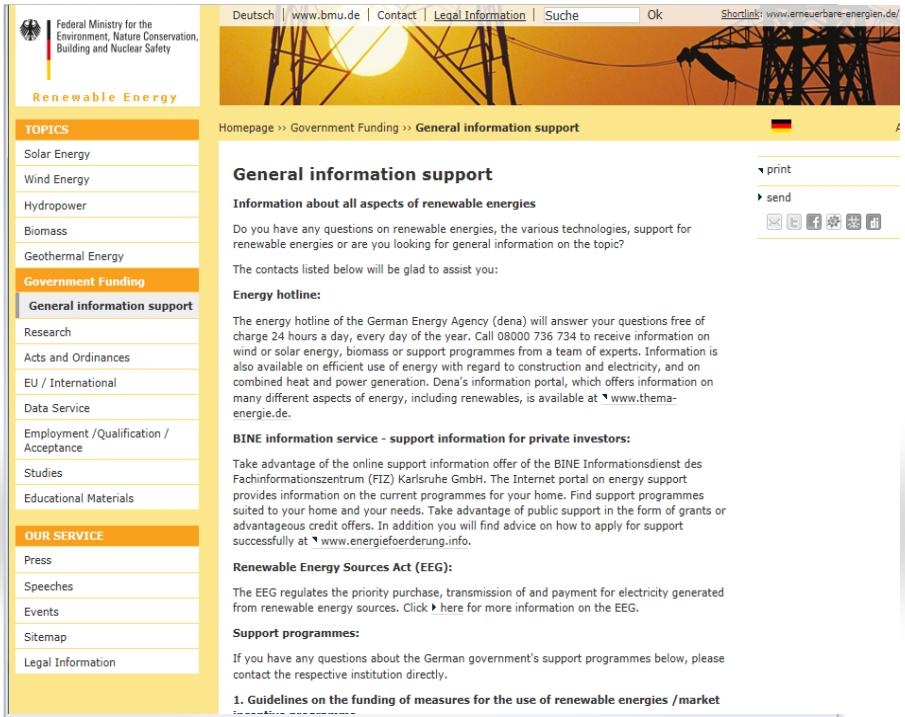
- Reduced-interest loans with repayment grants may be given under the KfW's Renewable Energies programme (premium variant) for larger heating solutions.



Information on promotion programmes



https://www.kfw.de/inlandsfoerderung/Unternehmen/Energie-Umwelt/index-2.html



http://www.erneuerbare-energien.de/en/topics/government-funding/general-information-support/?cHash=816f8cc23fe06c8f81ed0897140ba585

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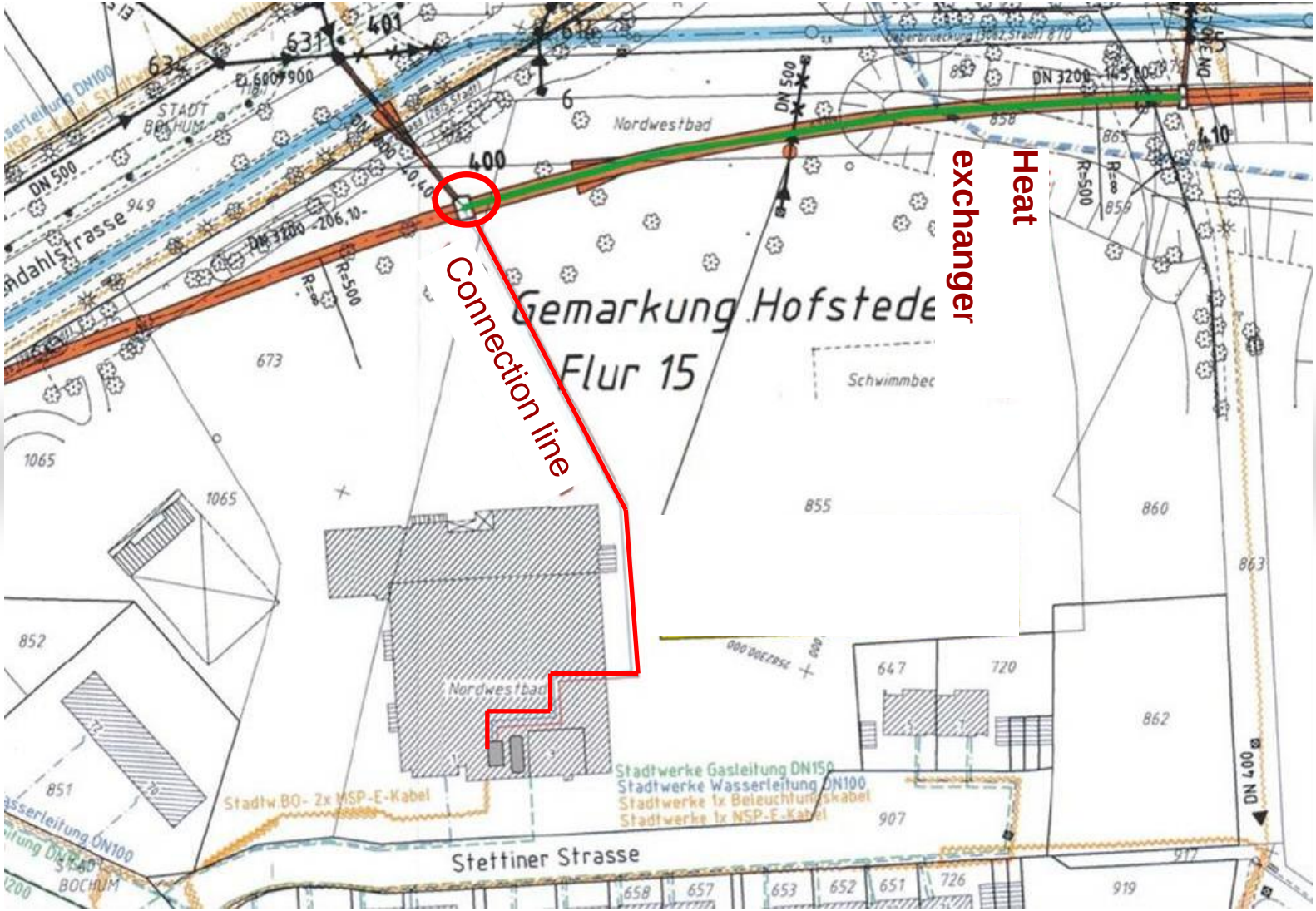
Practical experiences

Practical experiences

Swimming pool Nordwestbad, Bochum

Practical experiences

- Swimming pool Nordwestbad, Bochum



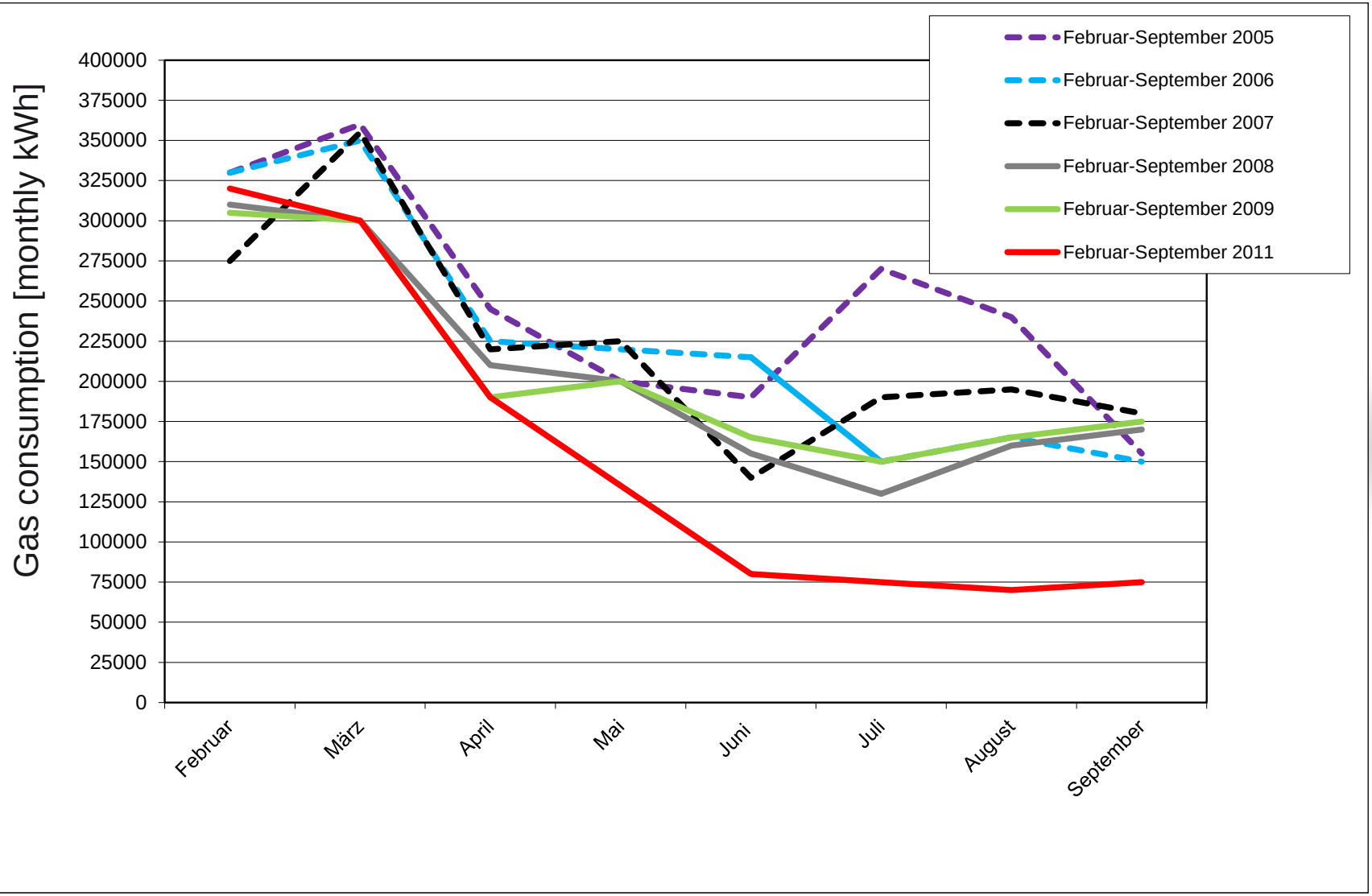
Practical experiences

Design of the WHR system

- **73% of the total heat requirement can be covered by WHR**
- **Sewer diameter DN 3000 mm; Q_{min} = 80 l/s**
- **Heat exchanger extraction rate: 150 kW**
- **Thermal output of the heat pump: 200 kW**
- **Thermal output CHPU: 90 kW**
- **Peak load boiler**

Practical experiences

Reduction in gas consumption



Site Nordwestbad Bochum

CO_2 reduction

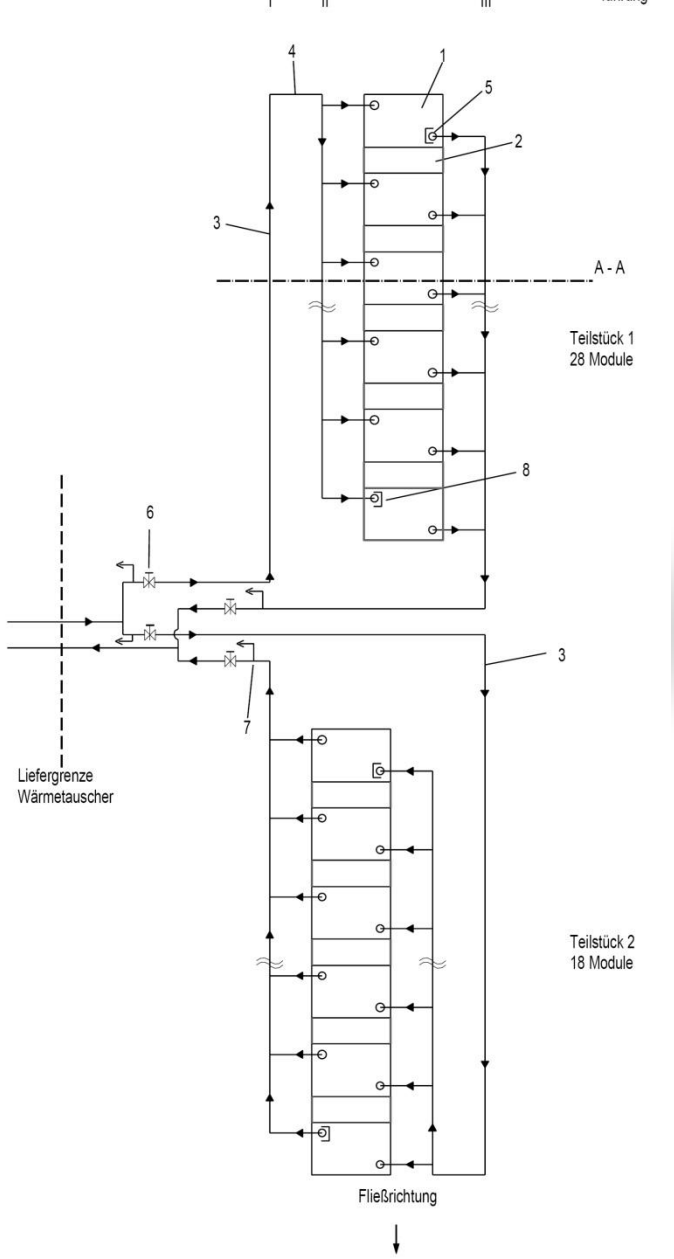
	Emission fuel	Emission electricity	Total emission	
	[t CO_2/a]	[t CO_2/a]	[t CO_2/a]	[%]
Natural gas boiler (reference)	565	-	565	100
Wastewater heat recovery	113	147	260	46
Reduction			305	54

Practical experiences – Design of the heat exchanger

Division of the heat exchanger
Section 1: 28 modules
Section 2: 18 modules

Advantages:
Operational reliability
Better control possibilities

Recommendation:
Division into two sections has proven useful, but same number of modules should be used



Practical experiences
- Heat exchanger construction

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Practical experiences - Control equiment

- Impact protection necessary
- Difficult accessibility

Recommendation:
Installation of the control fittings outside the service pit

Practical experiences - Primary lines

- Frost-free installation
- Simple PE pipes suffice, no insulation necessary

Practical experiences
- Installation of eqiupment

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Practical experiences
- Installation of eqiupment

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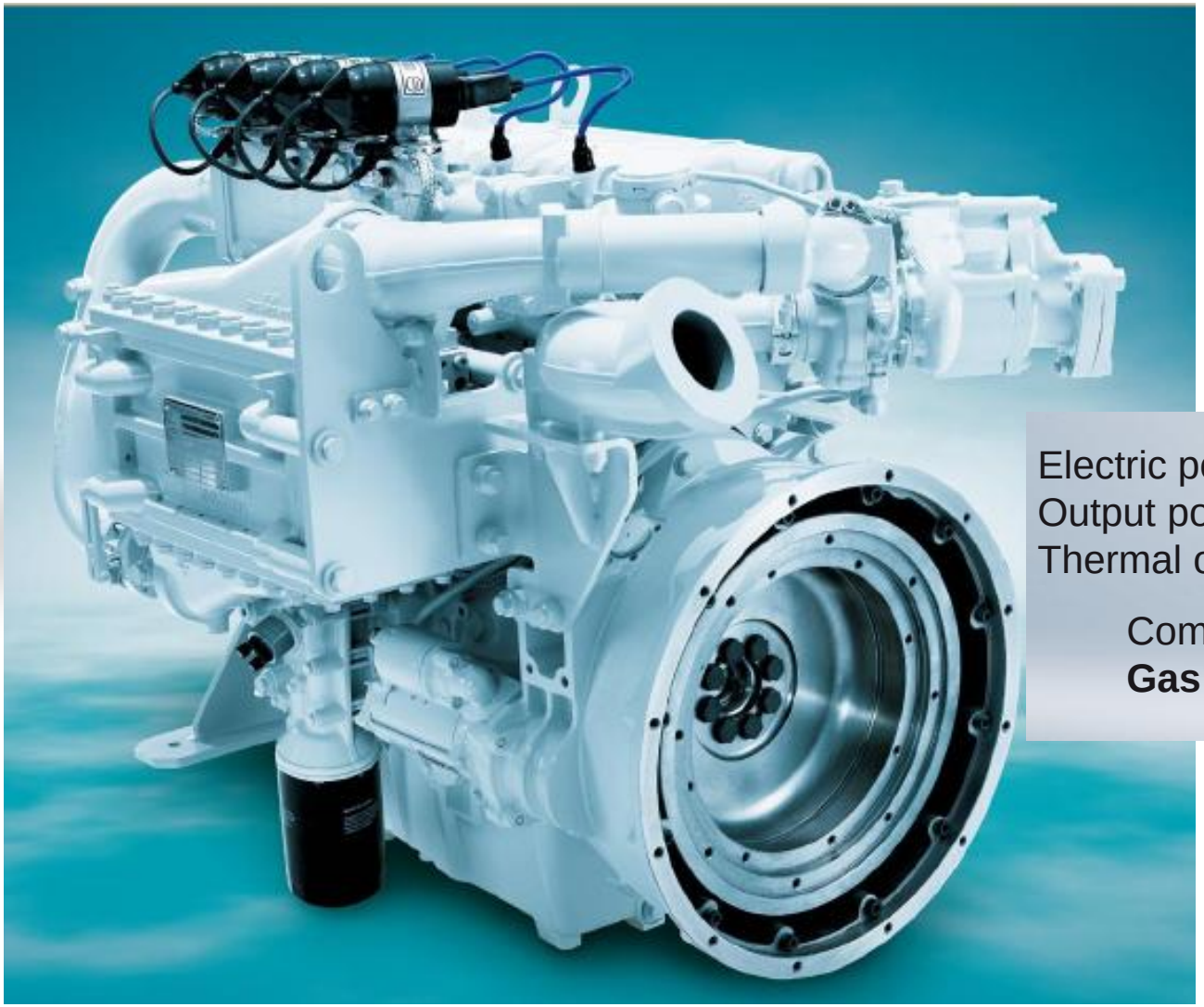
Heat pump; manufacturer Waterkotte;
output: 200 kW

CHPU module generates 50 kW electrical power -> sufficient for operation of the heat pump
and 90 kW thermal power

Practical experiences - CHPU engine



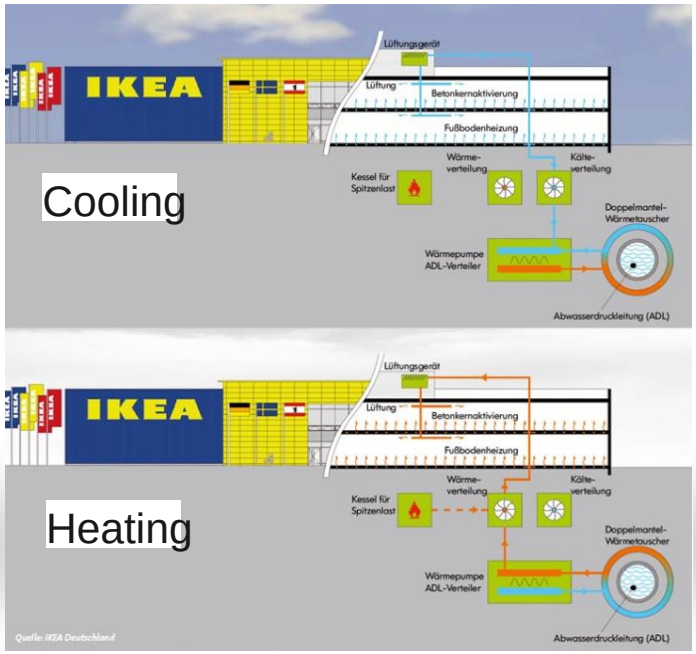
MAN E0834 LE 302

Electric power:
Output power: 50 kW
Thermal output: 82 kW

Combustion process:
Gas Otto Engine

From swimming pool to IKEA

Best practice examples

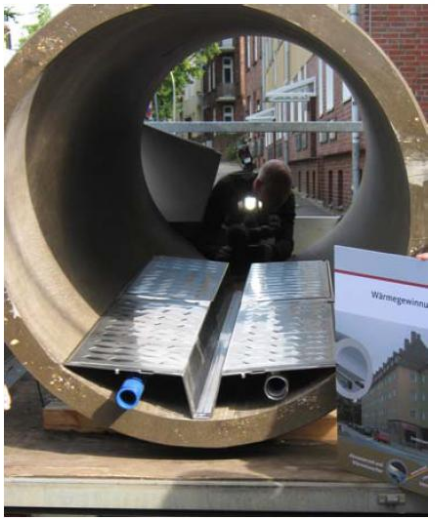


IKEA's central warehouse in Berlin
Size: more than 4000 m²,
Heat requirement: 140 townhouses

(Courtesy: IKEA Germany)

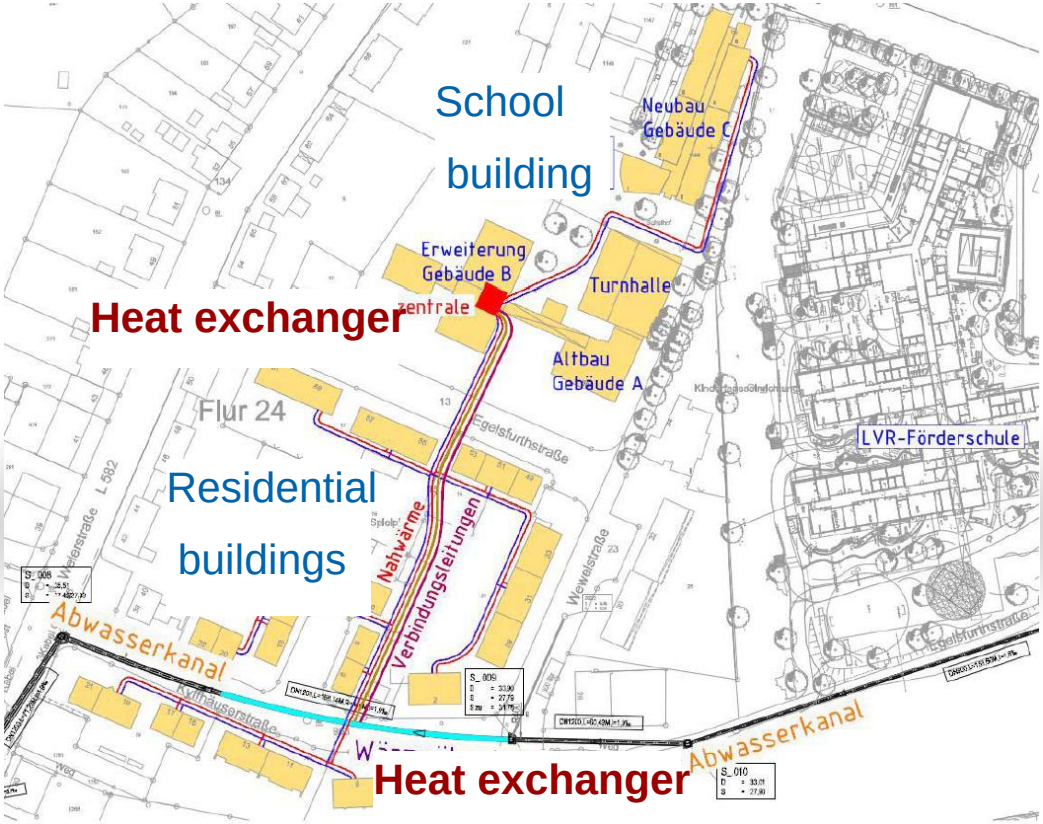
Heat supply for 19 buildings with 220 residential units.

(Courtesy: Hamburg Wasser)



Outlook

Weiherheide comprehensive school and Vivawest housing estate

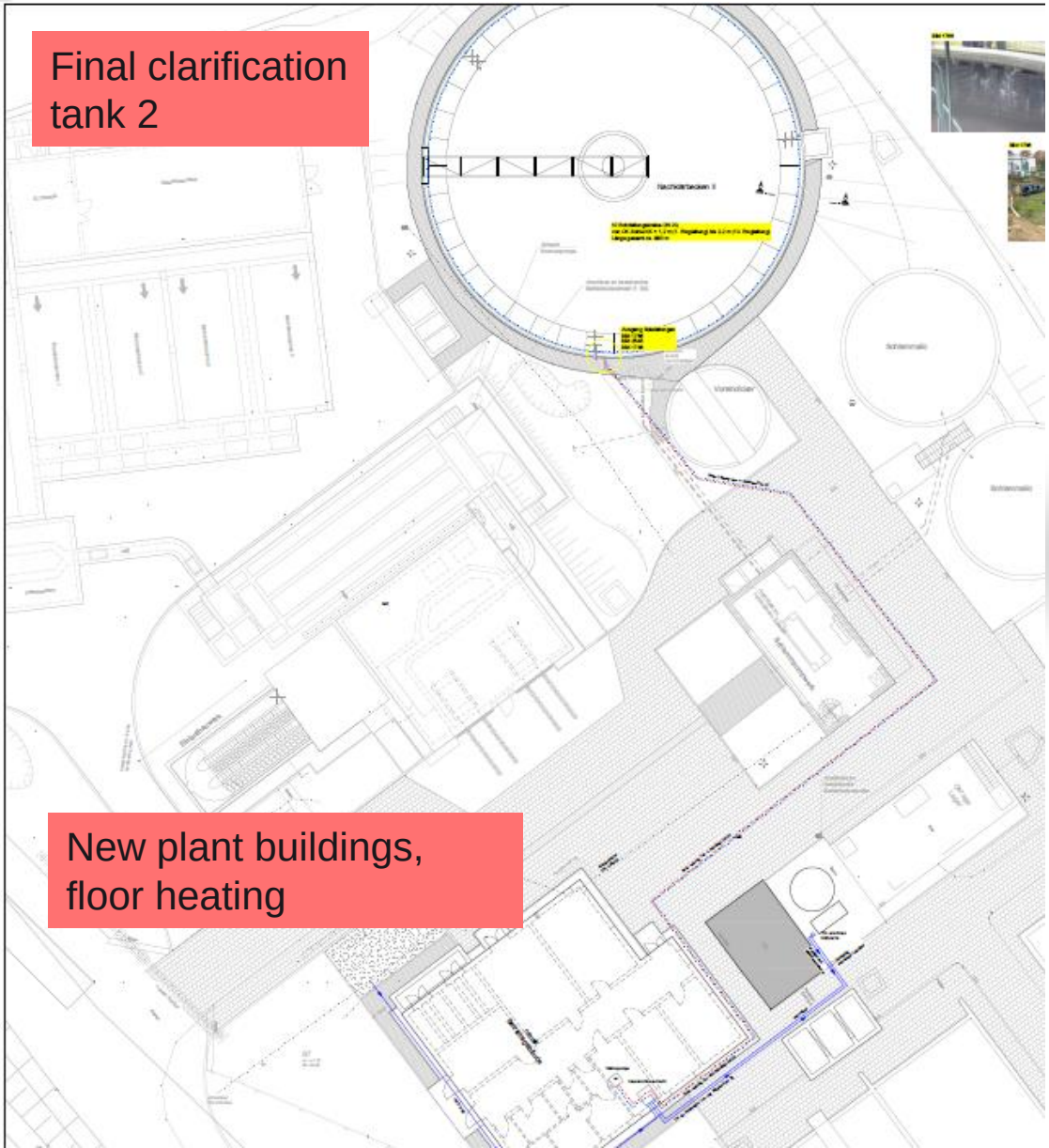


- Sewer DN 1200 mm
- Heat req.: 1600 MWh/a
- HE length: 100 m
- Extraction rate: 165 kW
- HP output: 220 kW

- Concept for local heat supply system for a school building and adjacent residential buildings in Oberhausen

Use in treated wastewater
- Hünxe wastewater treatment plant

Use in treated wastewater - Hünxe wastewater treatment plant



Heat supply for the plant buildings

Supply temperature: 35°C

Supply/Return line:
DN = 32 mm, length = 250 m

Temperature final clarification tank:
5-15°C throughout the year

Design temperature:
5°C

Temperature drop:
max. 1.5°C

Use in treated wastewater
- Hünxe wastewater treatment plant

10 pipe circuits
DN = 20 mm

Pipe length: 840 m

Heat pump output: 8.4 kW

Coefficient of performance: 4.6

78% coverage from WHR

Costs: around € 24,000

Bypass solution
School building in Duisburg

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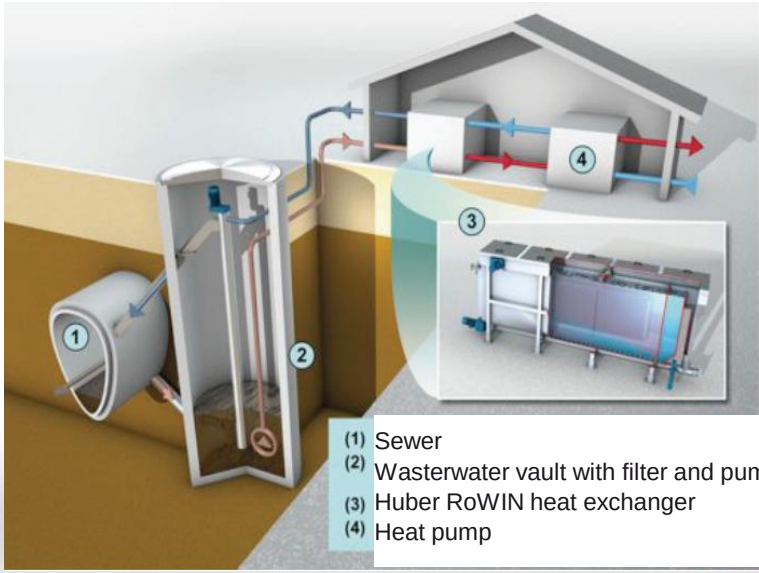


Results of the investigation

System not economical

+ No impairment of the sewer network

- High depth of the sewer > 12 m

- Construction of an extra pit

- Costs about 30% higher than gutter heat exchanger -> 30 years amortisation period

Waste Water Channel Emscher River

Main 'artery' in terms of waste water management in the new Emscher system

Baustart für Emscher-Kanal

420-Millionen-Euro-Vertrag unterzeichnet, 2017 sollen die Röhren das Abwasser aufnehmen

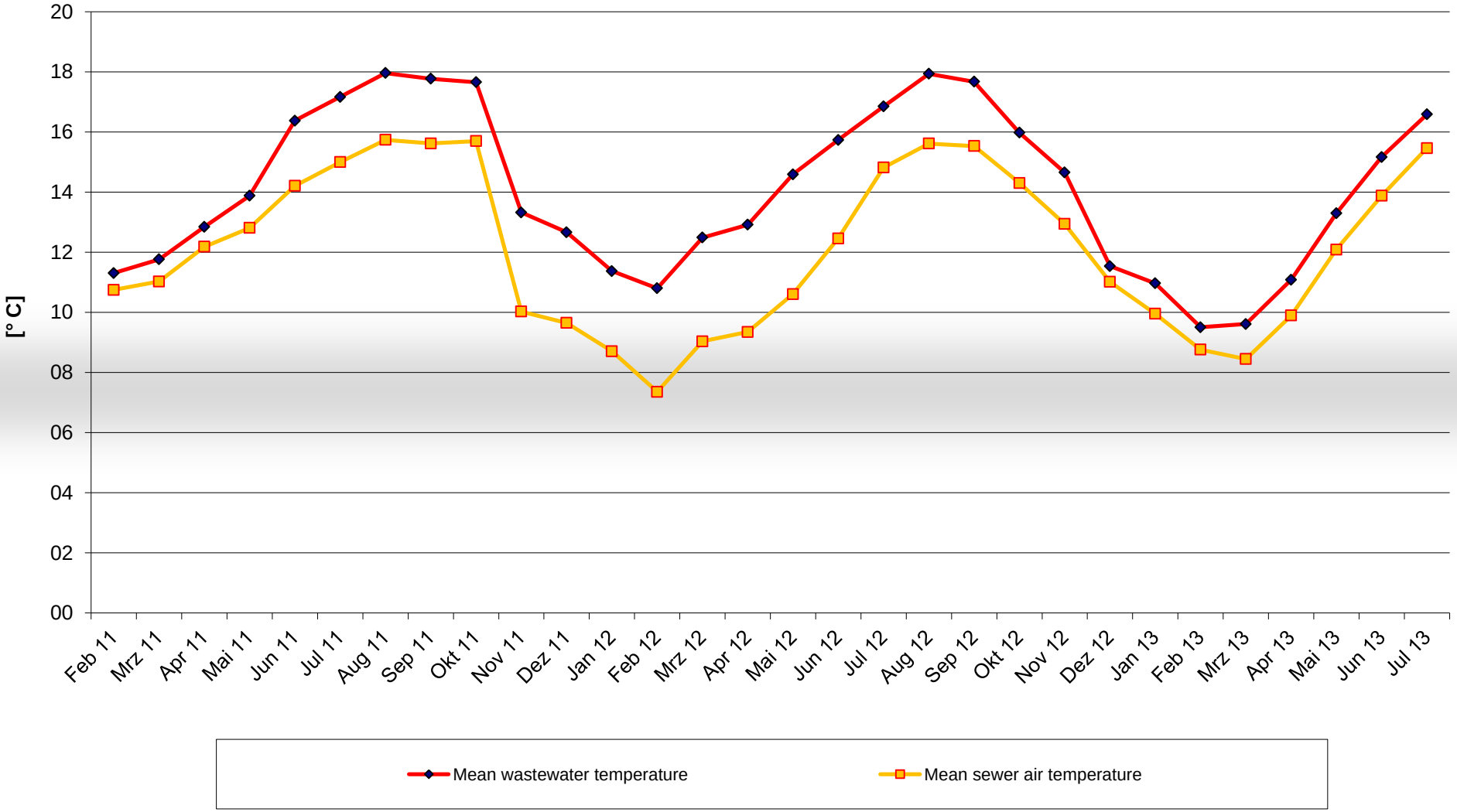
Hans-Karl Reintjens

420 Millionen Euro? Dafür könnte man locker 13 Fußballstadien á la Hafenstraße bauen, oder fast acht Folkwang-Museen. In Berlin allerdings würde es nicht einmal für ein 2,2 Kilometer kurzes U-Bahn-Teilstück zwischen Alexanderplatz und Brandenburger Tor reichen. Immerhin: Die Röhre, die Essen passieren wird, verbindet wie eine gigantische U-Bahn Dortmund mit Bottrop, genauer, mit dem Klärwerk Bottrop. Womit bereits klar ist, dass hier keine Menschen befördert werden. Im Rahmen des Emscher-Umbaus ist es vielmehr das größte Einzelprojekt: Für 420 Millionen Euro wird die Firma Wayss & Freytag Ingenieurbau eine gigantische, 55 Kilometer lange Abwasser-Leitung von Dortmund bis Bottrop

NRZ

Outlook: Usage of sewer air heat

Comparison mean wastewater temperatures vs. sewer air temperature

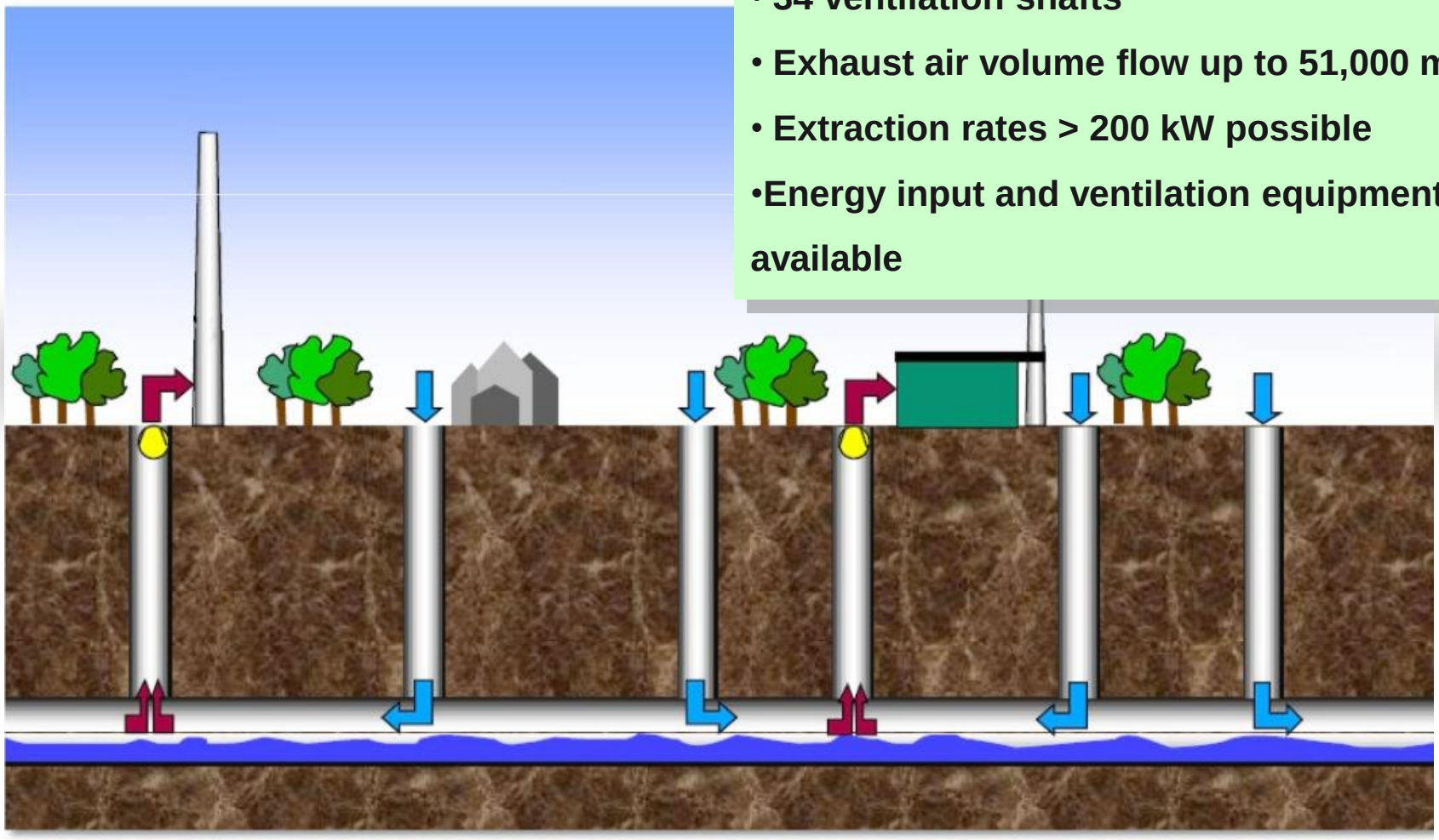


Outlook

Use of sewer air from Emscher sewage canal

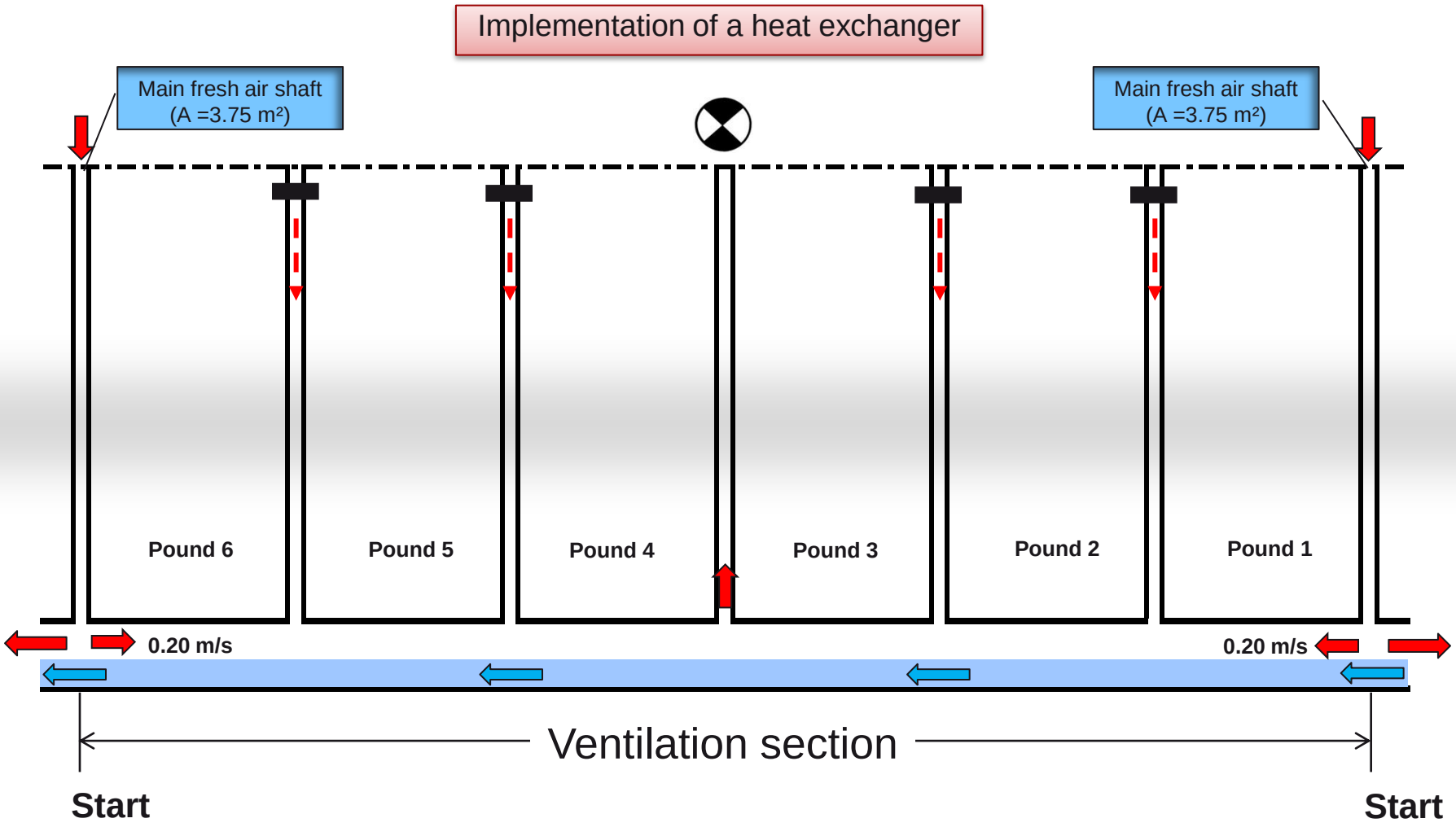
Ventilation of the Emscher sewage canal

- **34 ventilation shafts**
- **Exhaust air volume flow up to 51,000 m³/h**
- **Extraction rates > 200 kW possible**
- **Energy input and ventilation equipment are available**



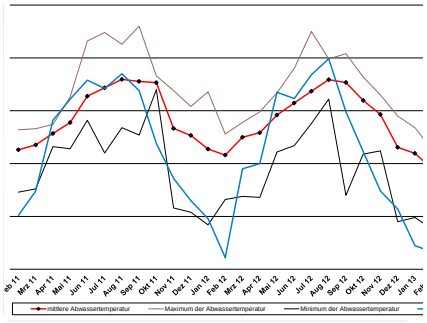
Outlook

Use of sewer air from Emscher sewage canal



Summary

- Wastewater is a local, safe and renewable source of energy with long-term availability
- Wastewater heat recovery is not a potential substitute for energy sources exploited so far, but can be a sensible addition in certain cases
- Early participation of all parties because of the higher need for coordination
- Energy maps are helpful as a planning basis, ideas then often develop in the course of talks
- The profitability of the systems will improve further



Thank you very much for your attention

Adrian Treis, Kronprinzenstraße 24, 45128 Essen, treis.adrian@eglv.de