



Profitability



Energy costs and increases in the prices for energy costs

System operation: monovalent, bivalent, multivalent

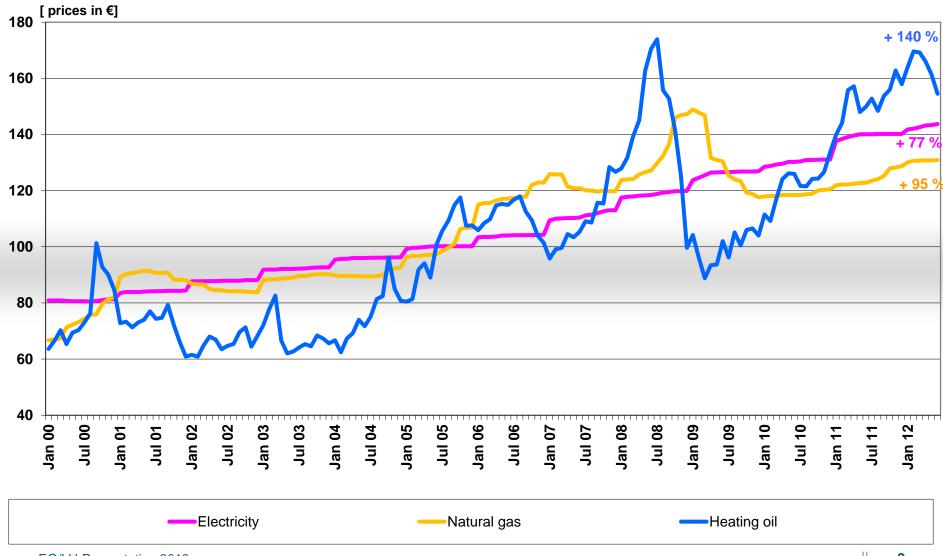
Heating system design: low supply temperatures, high running time of heat pump, length of supply lines

Contract period, state funding

Profitability



Development of energy prices since the year 2000



EG/LV-Presentation 2013

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

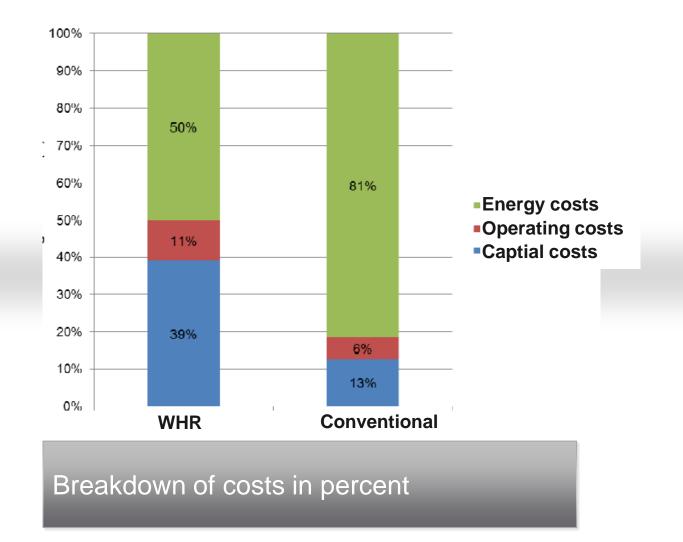




Cost breakdown



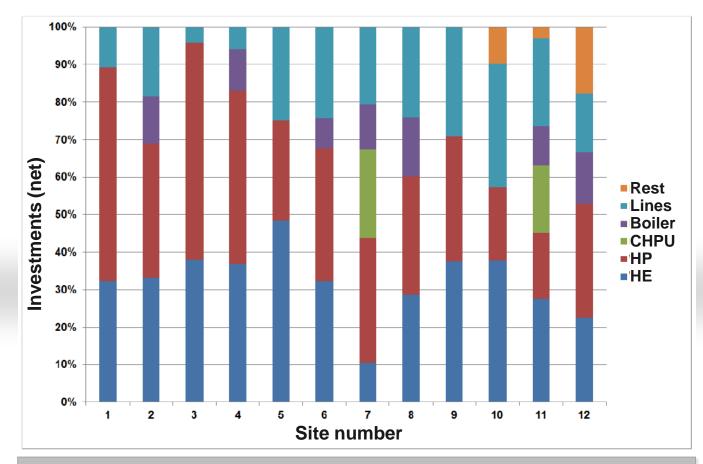
Comparison of wastewater heat recovery and conventional supply



Cost breakdown



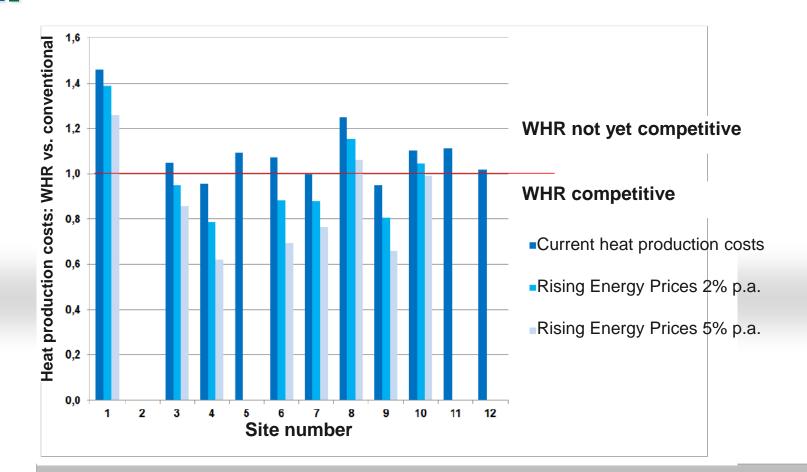
Comparison of wastewater heat recovery and conventional supply



Composition of costs for the example systems



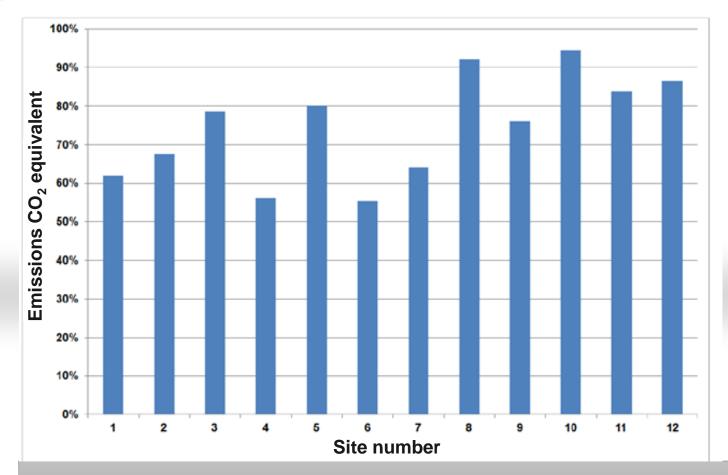




Profitability of a wastewater heat recovery system in comparison to conventional supply with and without increase in energy prices

CO₂ 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)	120,600	€ p.a.	202,000
With energy price increase*	144,700	€ p.a.	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)



- Promotion of the further development of technologies for generation of heat and cold from renewable energies.
- 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.



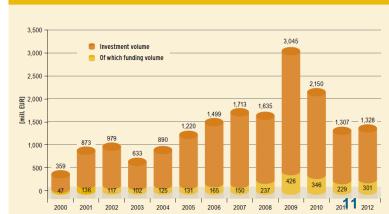
Promotion of renewable energy in the heating sector



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.





Assistance funding and resulting investment volumes of Market Incentive Programme since 2000

Information on promotion programmes



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Enter search term P Login Language V Enter search term P Watch ist V Email-Contact	
Bank aus Verantwortung	
← Companies ← Energy and the environment	
Energy ad the environment. Energy efficiency, corporate environmental	
protection and renewable energies	
Particularly in difficult economic times, energy efficiency can make an important contribution to reducing the fixed costs of an enterprise. In order for small and medium-sized enterprises to	
be able to sustain such investments too, we give particular support to SMEs in the form of low	
interest rates for loans and grants for energy advice. In addition, KTW is financing the development of renewable energies, such as Electricity and heat from the ground, sun, wind and water.	
Financing programmes	
+ KfW Environmental Protection Programme	
+ KfW Energy Efficiency Programme	
+ KfW Energy Turnaround Financing Initiative	
+ BMU Environmental Innovation Programme	
+ KfW Renewable Energies Programme - Standard	
+ K/W Renewable Energies Programme - Storage	
+ KIW Renewable Energies Programme - Premium	
+ Variant-Deep geothermal energy	
+ KNV Offshore Wind Energy Programme	
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eothermal Energy	renewable energies or are you looking for general information on the topic?	
overnment Funding	The contacts listed below will be glad to assist you:	
eneral information support	Energy hotline:	
search	The energy hotline of the German Energy Agency (dena) will answer your questions free of charge 24 hours a day, every day of the year. Call 08000 736 734 to receive information on	
ts and Ordinances	wind or solar energy, biomass or support programmes from a team of experts. Information is also available on efficient use of energy with regard to construction and electricity, and on	
J / International	combined heat and power generation. Dena's information portal, which offers information on	
ata Service	many different aspects of energy, including renewables, is available at <u>www.thema-</u> energie.de.	
nployment /Qualification / ceptance	BINE information service - support information for private investors:	
udies	Take advantage of the online support information offer of the BINE Informationsdienst des Fachinformationszentrum (FIZ) Karlsruhe GmbH. The Internet portal on energy support	
lucational Materials	provides information on the current programmes for your home. Find support programmes	
UR SERVICE	suited to your home and your needs. Take advantage of public support in the form of grants or advantageous credit offers. In addition you will find advice on how to apply for support successfully at \ www.energieforedrerung.info.	
ess	Renewable Energy Sources Act (EEG):	
eeches	The EEG regulates the priority purchase, transmission of and payment for electricity generated	
ents	from renewable energy sources. Click • here for more information on the EEG.	
temap	Support programmes:	
gal Information	If you have any questions about the German government's support programmes below, please contact the respective institution directly.	
	1. Guidelines on the funding of measures for the use of renewable energies /market	

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https://www.kfw.de/inlandsfoerderung/Unt ernehmen/Energie-Umwelt/index-2.html http://www.erneuerbareenergien.de/en/topics/governmentfunding/general-informationsupport/?cHash=816f8cc23fe06c8f81ed0 897140ba585





Practical experiences

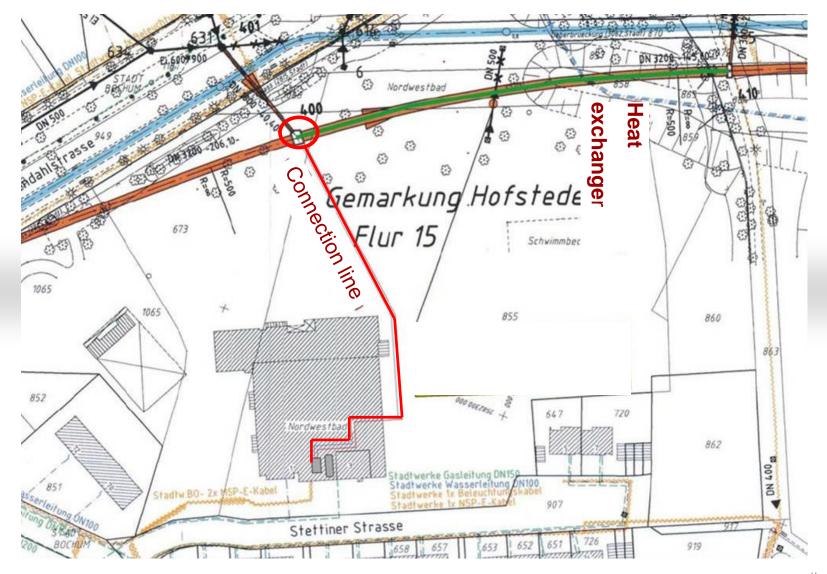
Practical experiences Swimming pool Nordwestbad, Bochum





Practical experiences

- Swimming pool Nordwestbad, Bochum



EMSCHER EGLUE VERBAND

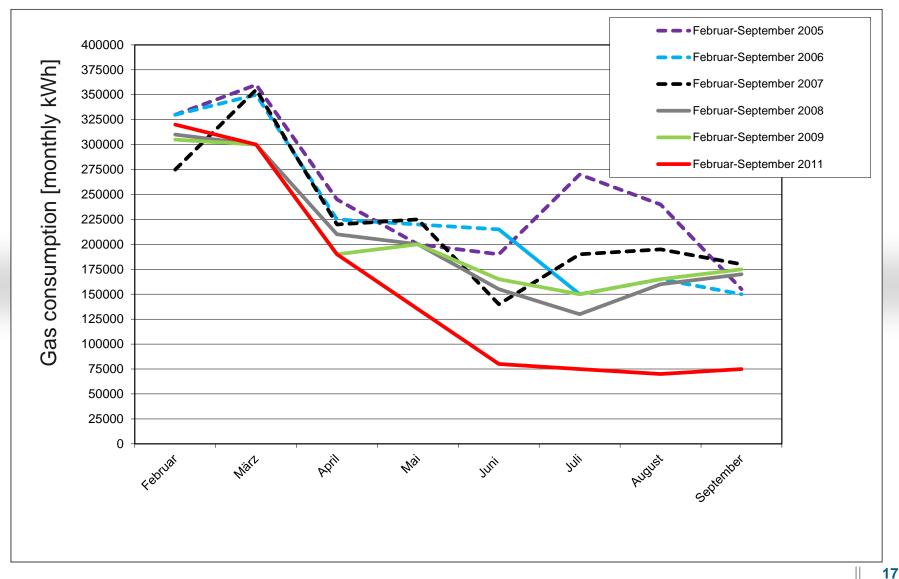


- 73% of the total heat requirement can be covered by WHR
- Sewer diameter DN 3000 mm; Q min = 80 l/s
- Heat exchanger extraction rate: 150 kW
- Thermal output of the heat pump: 200 kW
- Thermal output CHPU: 90 kW
- Peak load boiler

Practical experiences



Reduction in gas consumption



Site Nordwestbad Bochum CO₂ 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

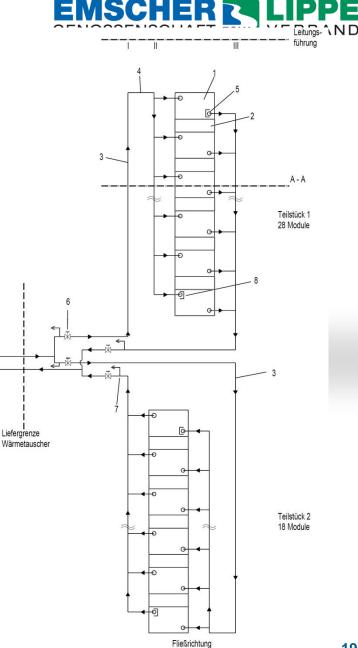
Section 1: 28 modules Section 2: 18 modules

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





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





Practical experiences - Installation of eqiupment





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

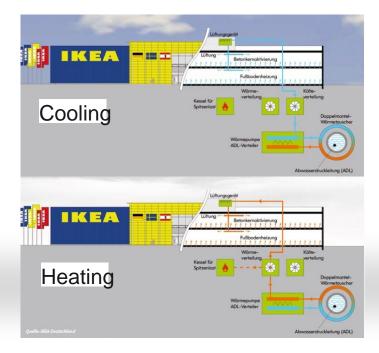
Electric power: Output power: 50 kW Thermal output: 82 kW

Combustion process: Gas Otto Engine

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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.

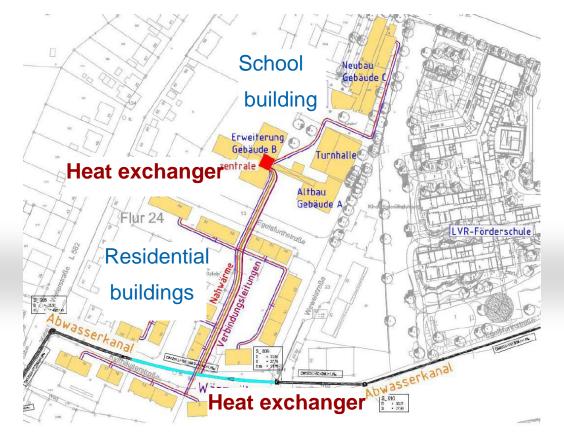
(Courtesy: Hamburg Wasser)



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



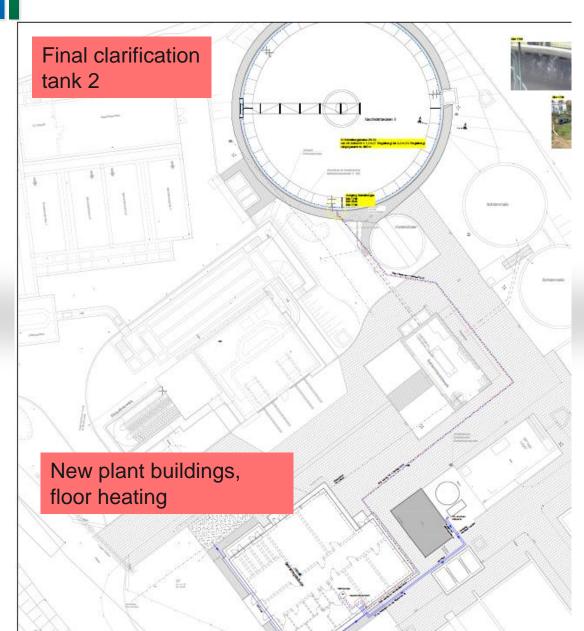
- Concept for local heat supply system for a school building and adjacent residential buildings in Oberhausen

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

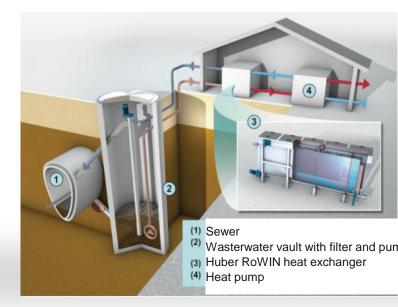
78% coverage from WHR

Costs: around € 24,000

Bypass solution School building in Duisburg









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



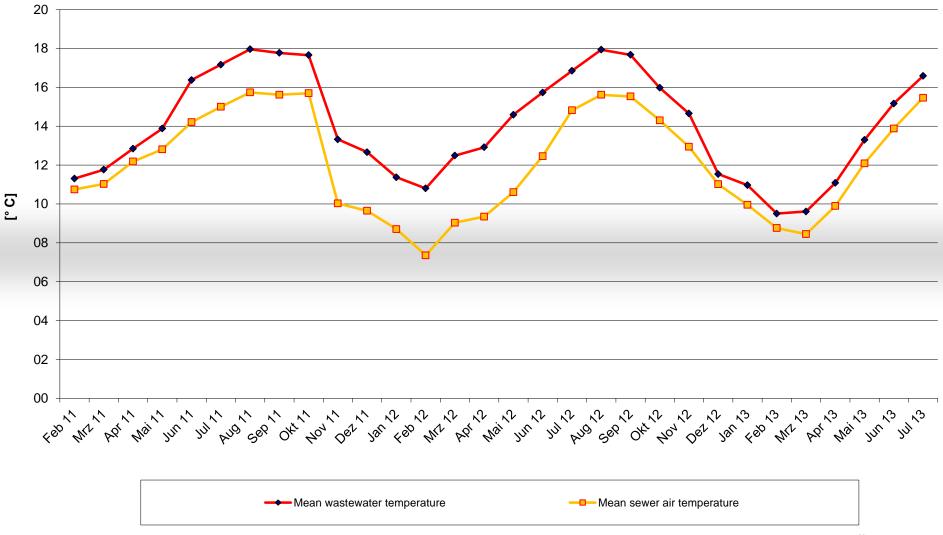
Main 'artery' in terms of waste water management in the new Emscher system



Outlook: Usage of sewer air heat



Comparison mean wastewater temperatures vs. sewer air temperature



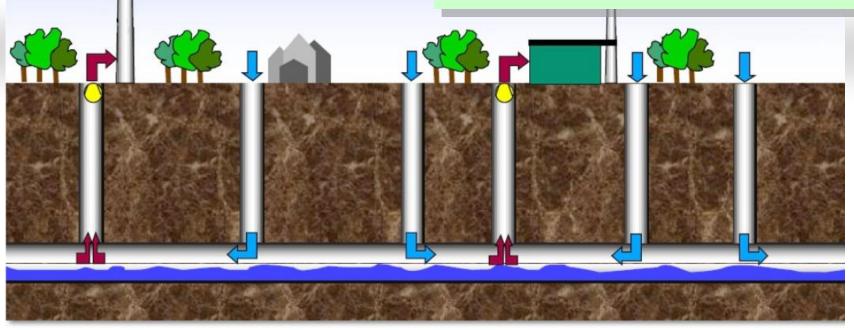
Outlook Use of sewer air from Emscher sewage canal



Ventilation of the Emscher sewage canal

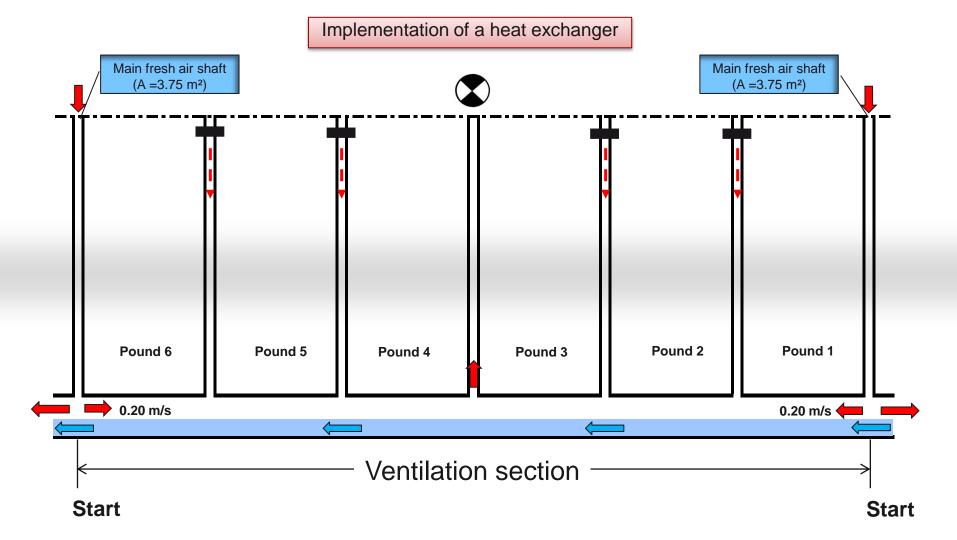
- 34 ventilation shafts
- Exhaust air volume flow up to 51,000 m³/h
- Extraction rates > 200 kW possible

•Energy input and ventilation equipment are available



Outlook Use of sewer air from Emscher sewage canal

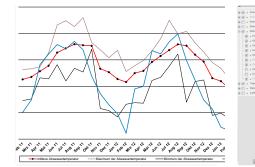








- Wastewater is a local, safe and renewable source of energy with long-term availability
- Wastewater heat recovery is not a potential substitute for energy sources exploited so far, but can be a sensible addition in certain cases
- Early participation of all parties because of the higher need for coordination
- 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

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