



Heat and water recovery from wastewater in a passive house

- SCALING UP FROM BUILDING TO DISTRICT LEVEL




ABG Frankfurt Holding



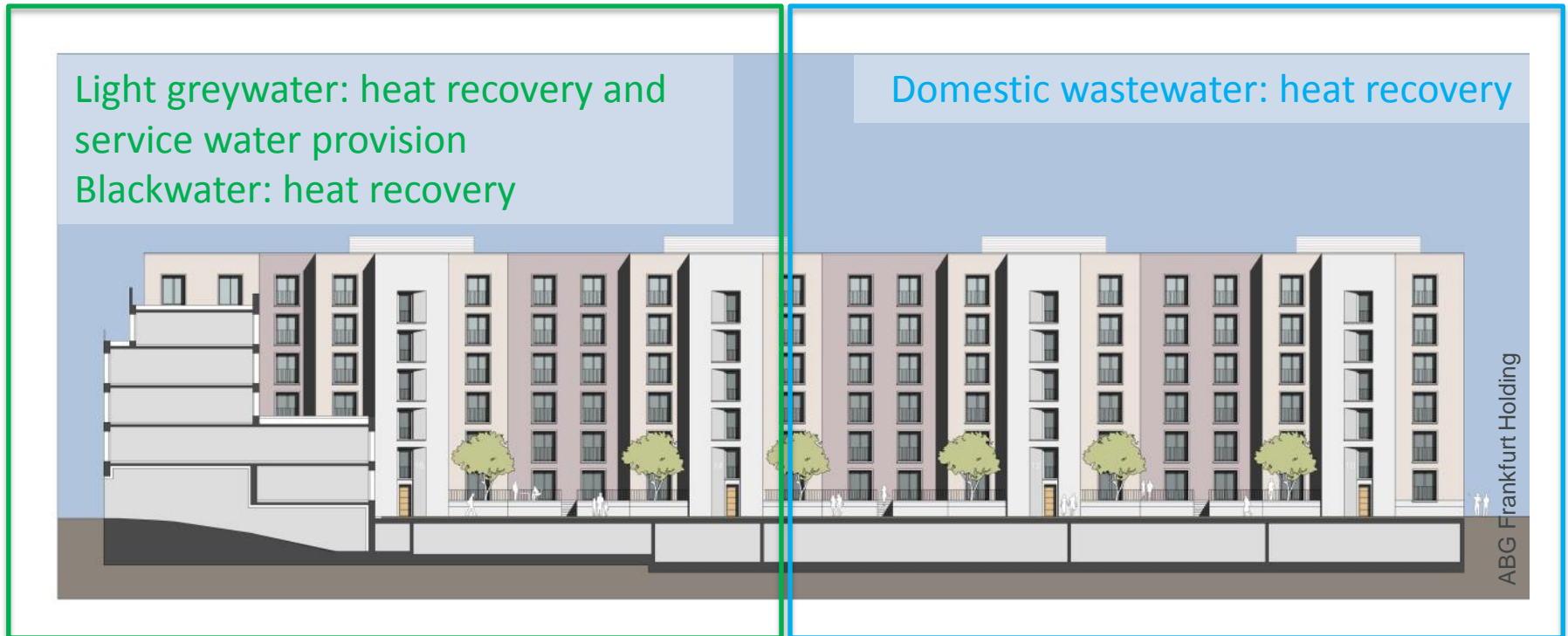
INTRODUCTION



- Rethinking the (waste)water system in Frankfurt/Main
 - Drivers for transformation:
 - Energy savings and higher energy efficiencies (Larsen et al., 2013)
 - Also attractive from an economic viewpoint (Felmeden et al, 2011)
 - Drivers for stakeholders:
 - Innovative/ economically attractive/ closing the “last gap” (building level)
 - Climate friendly city/ energy savings/ attractiveness (district level)
-  Investigation of a real case passive house under construction and its scaling up to district level

LOCAL SETTING

On building level:



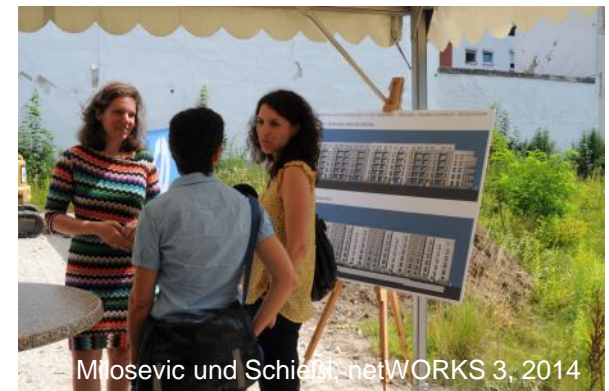
Approx. 145 persons & day-care centre for 70 children

GW = greywater (here: bathroom without toilet),

BW = blackwater, (here: toilet and kitchen), WW = domestic wastewater

MATERIAL AND METHODS

- Parameters of the calculation:
 - Specific heat energy demand: 15 kWh m⁻² a⁻¹
 - Specific demand for hot water generation: 20 kWh m⁻² a⁻¹
 - 90 l pers⁻¹ d⁻¹ WW due to water saving devices
 - 30 l pers⁻¹ d⁻¹ light GW, 60 l pers⁻¹ d⁻¹ of BW (Nolde, 2013)
 - day-care facility: 5 l pers⁻¹ d⁻¹ light GW, 10 l pers⁻¹ d⁻¹ BW
 - heat reduction: 5K (WW), 10K (GW), 2K (BW)
 - coefficient of performance of the heat pump (COP): 4.0
- Material flow analysis
- Stakeholder mapping, expert interviews, constellation analysis;
First stakeholder workshop



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FLOWS ON BUILDING LEVEL

- Heat requirements:
 - Overall: 235 MWh a⁻¹
 - Hot water generation: 131 MWh a⁻¹
- Hot water generation: about 30% of heat can be recovered from wastewater
- Overall heat recovery:
 - 17% from domestic wastewater
 - 9% from greywater and 4% from blackwater
 - Total basic heat load over the year: 19%



STAKEHOLDER CONSTELLATION ON BUILDING LEVEL



Local health authorities: control hygienic safety	Inhabitants: no behaviour changes expected
Craftsmen & plumbers key for acceptance	Fiscal policies: 7% tax for drinking water 19%VAT for service water
Key player: Real estate / House owner	Key personality: Plant operator

CONCLUSIONS: HOUSEHOLD LEVEL

- Separation of greywater / blackwater more attractive:
 - Energywise
 - Service water provision
- „Total“ rent including everything
- Key personality for acceptance: plant operator
- Key aspects (mainly for rented apartments):
 - Economically attractive
 - Maintenance requirements acceptable
 - Level of risks assessable (e.g. health and hygienic issues)

FLOWS ON DISTRICT LEVEL

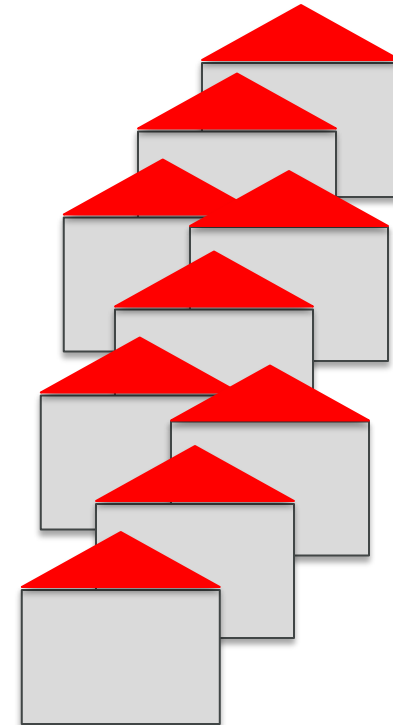
- Area with vacant office buildings:
 - Mixed usage patterns with varying building structure in age, types...
 - Existing separated sewer system
 - Local drainage of complete stormwater possible
 - Artificial feeding of small creek in the area
 - Energy and drinking water supply in place



STAKEHOLDER CONSTELLATION ON DISTRICT LEVEL



Municipality: coordinator	Utilities: new competitor in the field
Local health authorities: control hygienic safety	Inhabitants: no behaviour changes expected
Craftsmen & plumbers key for acceptance	Fiscal policies: 7% tax for drinking water 19%VAT for service water
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NEW BUSINESS MODELS

- Traditional model:
 - Municipal holding / multi-utility company, public-private partnership, or intermunicipal association
 - Centralised organisation and management model
- Changes by new system:
 - Water supply and wastewater services become closer
 - Wastewater services and energy supply merge
 - New services: De-/semicentral operation as well as accounting and billing
- Water companies might specialise in planning de-/semicentral systems (new branch)
- Heat can be commercialised to user/customer or local energy/heat supply company
- Selling of concessions to energy companies



CONCLUSIONS: DISTRICT LEVEL

- Attractive alternatives available, out of scope of usual planning (process)
- Conflict of interest between real estate/ house owners and district interests
- Legal-organisational setting of the municipal utilities or companies: field of competences
 - Entering the energy market could be forbidden
- New organisation models and structures need to be developed
- Upcoming solutions in Germany:
 - Hybrid companies
 - Private companies enlarge business activities





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Institute for
Social-Ecological
Research



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A PUBLICATION OF THE PROJECT NETWORKS 3:
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