Presentation from

2015 World Water Week in Stockholm

www.worldwaterweek.org

SEMI-DECENTRALIZED, MODULAR WASTEWATER TREATMENT CONCEPT FOR FAST GROWING CITIES

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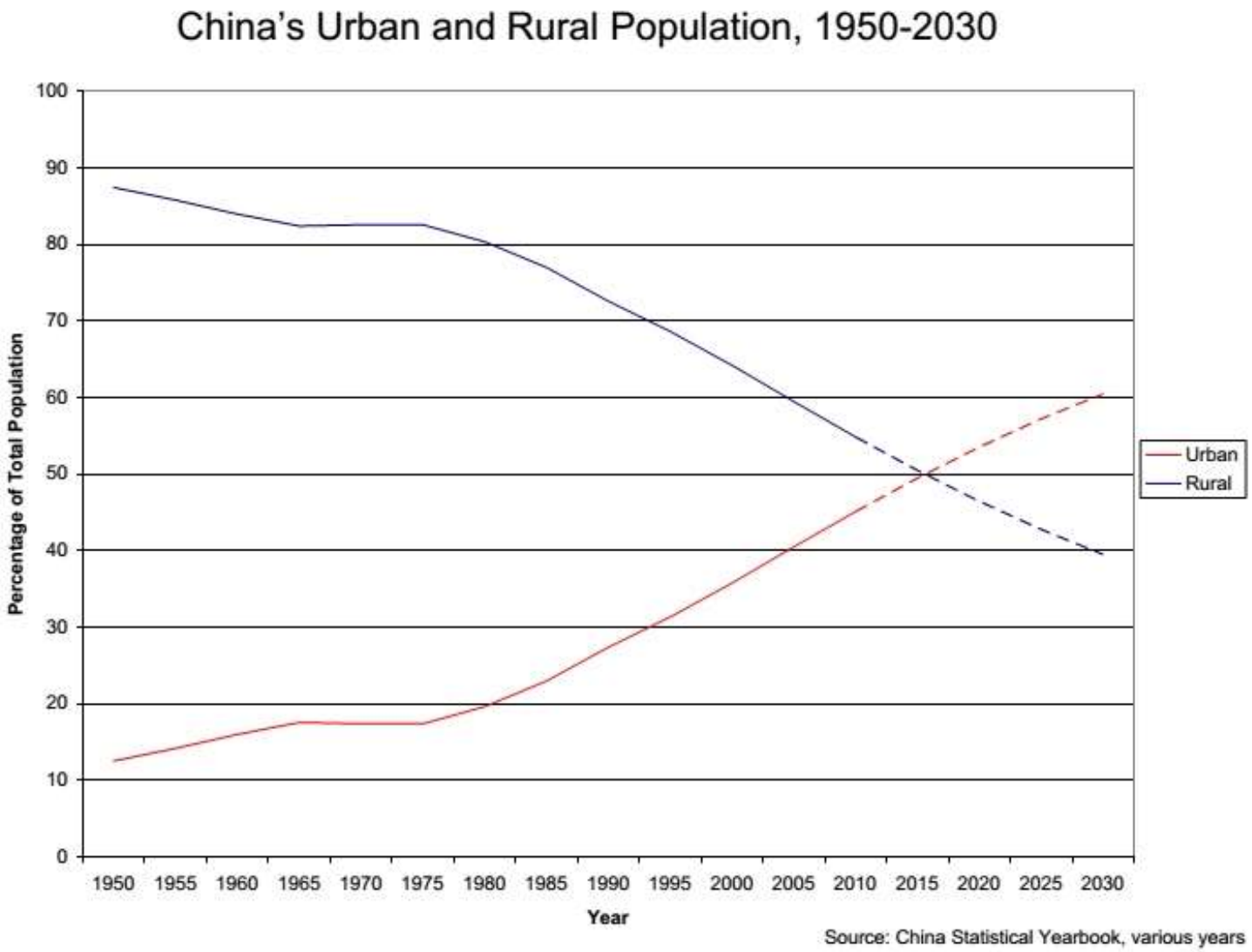
- Fraunhofer-Gesellschaft: **applied research** of direct utility to private and public enterprises - benefit to society
- Non-profit organization
- Largest organization for applied research in Europe
- International collaboration through representative offices in Europe, the US, Asia, and the Middle East

Urbanization in China



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Water management in China

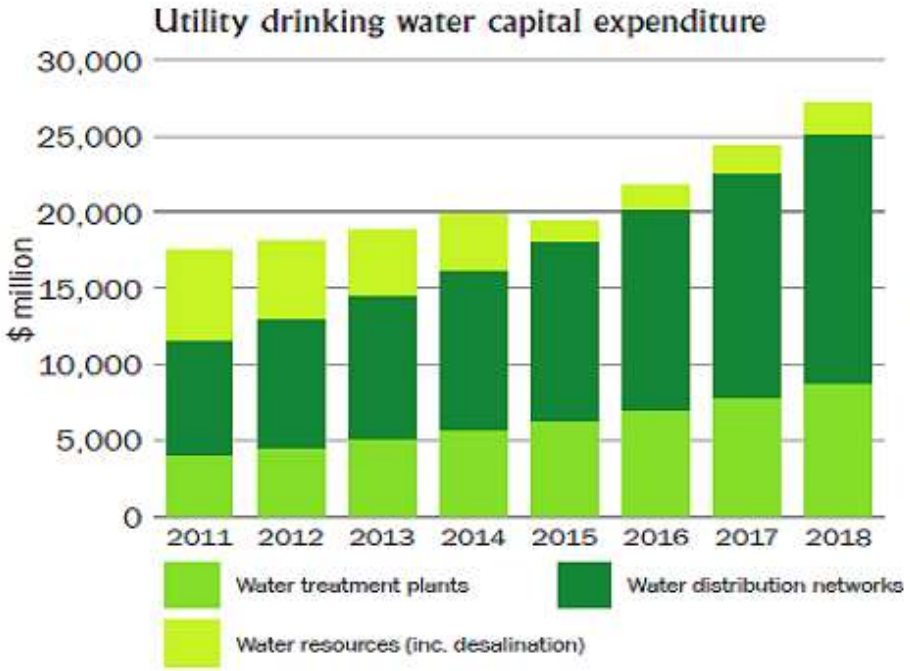
- Uneven distribution:
  - Northern China: About 20% of water resources for 46% of the population
  - Southern China: About 80% of water resources for 54% of the population, only 35% of China's total arable land
- 12th Five Year Plan (2011-2015)
  - At least 95% connected to water supply in urban areas
  - 85% of total wastewater generated in urban areas should be treated, and 20% of the treated wastewater should be reused
  - Increase sections with good water quality (grade I – III) for major rivers and lakes by 60%

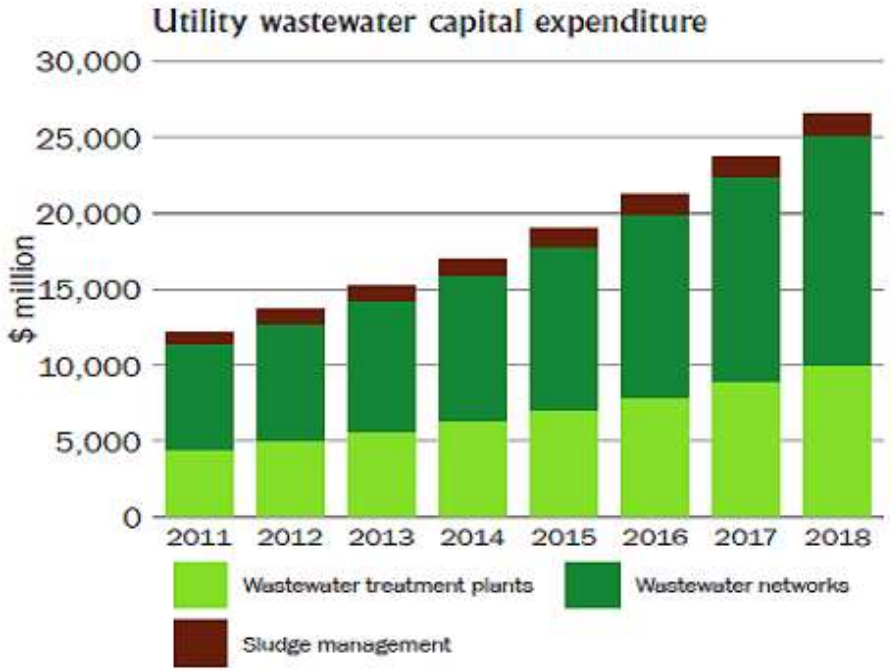
Water management in China

- Action Plan for Water Pollution Prevention (published by The State Council of the People's Republic of China on 2nd April 2015)
  - End of 2020: all urban wastewater treatment facilities reach discharge quality according to national discharge/ reuse standards
  - 2020: wastewater treatment ratio in counties and cities reaches 85% and 95% respectively, capitals should reach 100 % by 2017

Water management in China

- National Urban Water Supply and Wastewater Capital Expenditure 2011 to 2018 Forecast





Source: Global Water Intelligence (does not include the MWR and provincial water resources as well as the flood protection investment programme of EUR 40 billion per year)

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Examples from China

WWTP with a capacity of 10,000 m^3/d,
15 km from center of development area,
not operating

semi-decentralized WWTP with a capacity of 400 m^3/d, operating since 2013

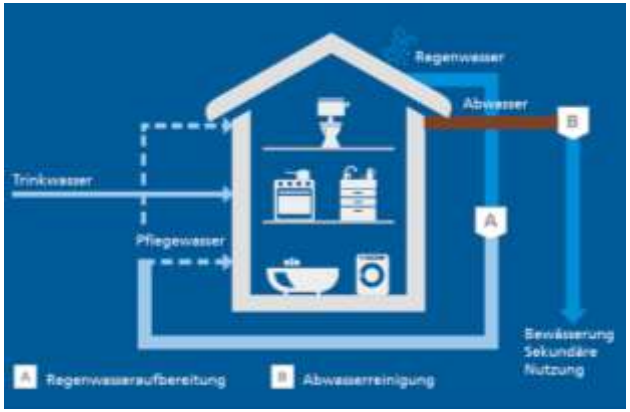
Transfer of solutions?

- Conventional “western” solutions not always adequate for Chinese conditions
- Recycling-oriented concepts have been developed, but hardly implemented in Europe
- Examples:
  - DEUS 21, demonstrated since 2006 in Knittlingen (Germany), 300 p.e.
  - Hamburg Water Cycle, Jenfelder Au, 2,000 p.e., under construction (www.hamburgwatercycle.de)
  - Semizentral, TU Darmstadt, implementation in Qingdao (China), designed for 12,000 p.e., in operation since 2014 (www.semizentral.de)

DEUS 21 – Decentralized urban water infrastructure systems

Saving water, utilizing resources

- Utilization of resources in wastewater: Water, energy, nutrients
- Rain water harvesting
- Intelligent collection of wastewater (vacuum sewer system)
- Anaerobic wastewater treatment
- Reuse of treated water and nutrients
- Development area in Knittlingen: 100 plots



Funding

- BMBF, period: 10/2003 – 05/2010

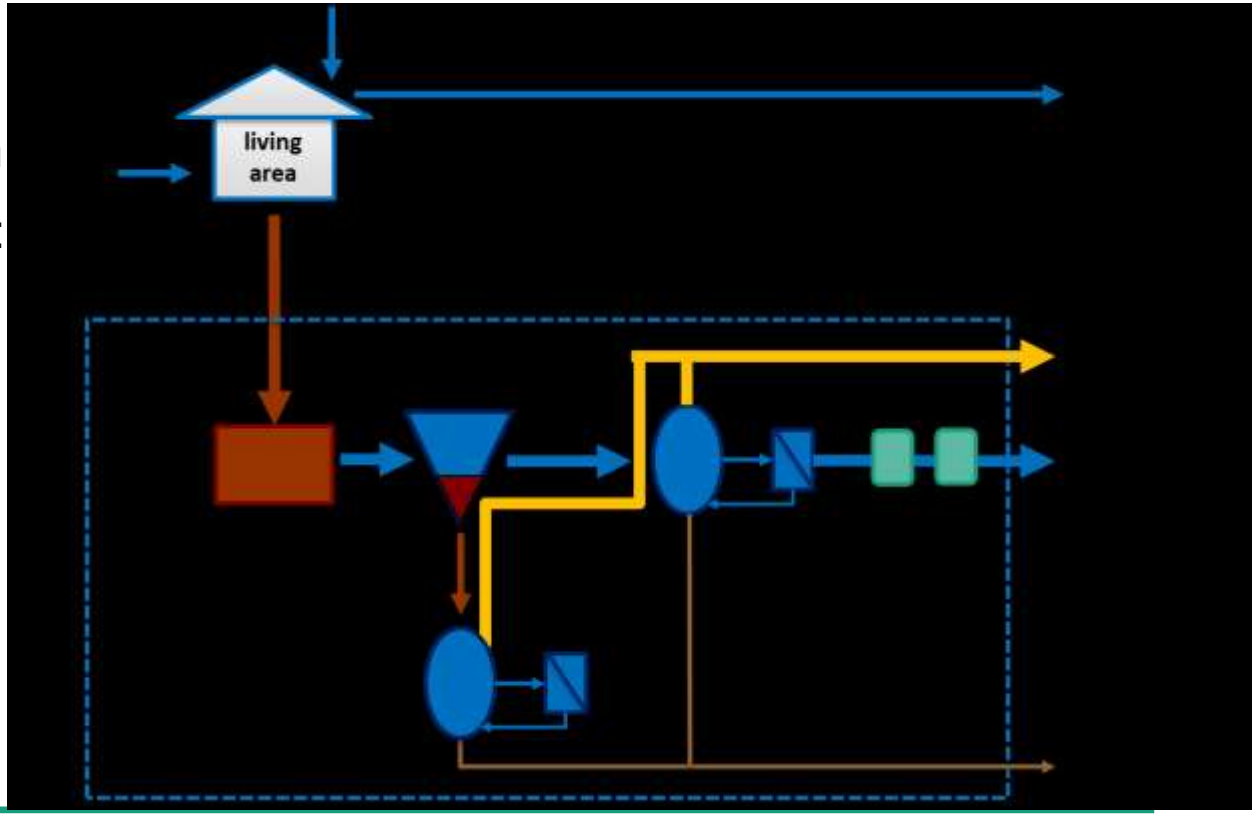
Partner: Fraunhofer ISI; EnBW Energie Baden-Württemberg AG, Eisenmann AG, GEMÜ Gebr. Müller Apparatebau GmbH & Co. KG, Gebr. Bellmer GmbH Maschinenfabrik, Kerafol GmbH, Roediger Vacuum GmbH, Stadt Knittlingen, ISA der RWTH Aachen (in first phase).

Decentral urban water infrastructure in Knittlingen

Demonstration project in development area: 105 plots

Innovations:

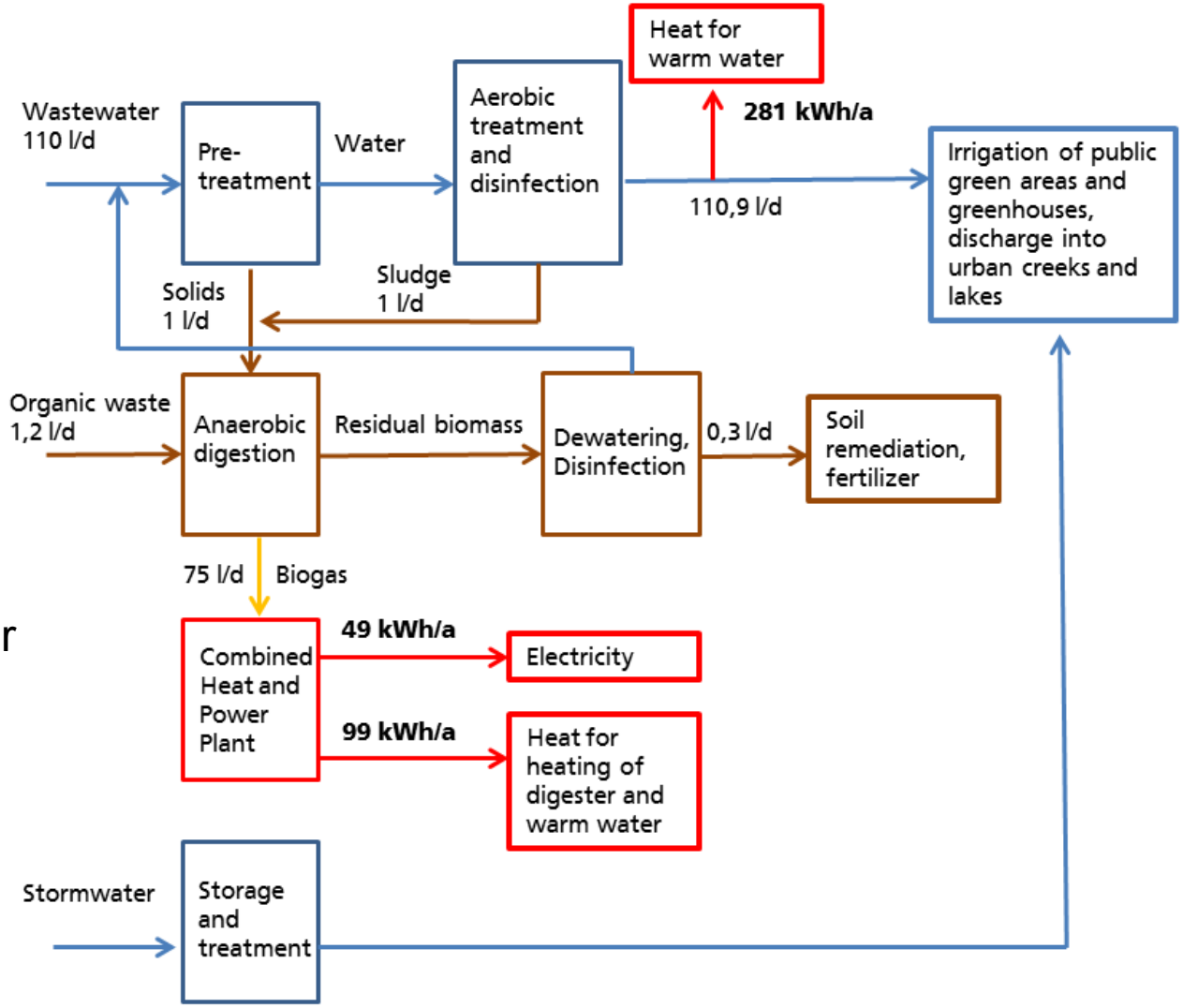
- Utilization of rainwater
- Vacuum sewer system
- Wastewater treatment: anaerobic membrane bioreactor



Transfer – framework conditions

- What is worth recycling (water, nutrients, energy)?
- Climate: water scarcity? Demand for heat or cold? Seasonal differences?
- Characteristics of development area, existing infrastructure, and economic parameters determine scale
- Legal situation: what substances have to be removed before recycling or discharge?
- Cultural issues: is reuse of wastewater accepted? For what purposes?
- Local partners are crucial

Concept A: Stormwater separated



Values per capita

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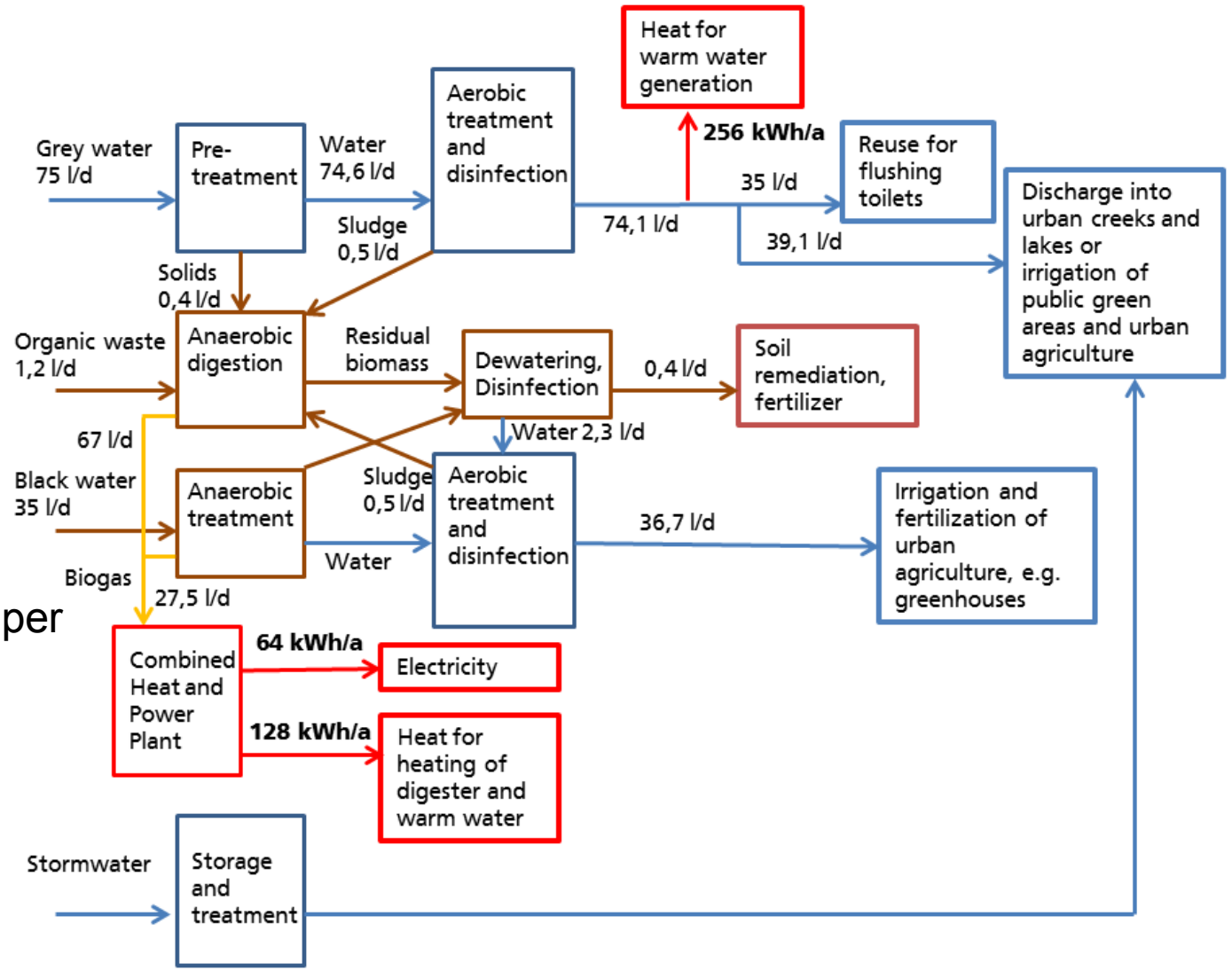
Concept B: Source separation in household



Values per capita

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Comparison

Concept A

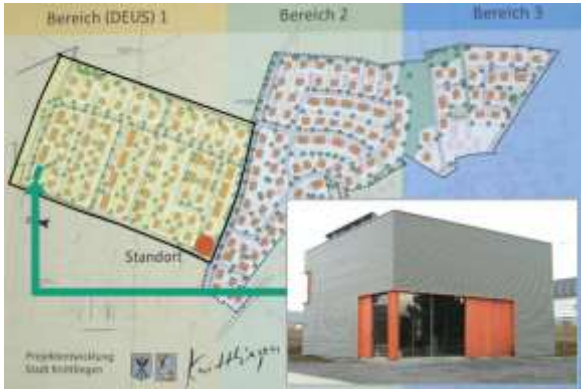
- Less complex, suitable for existing houses as well
- All nutrients are removed, treated water can be reused for irrigation or discharged
- Maximum heat recovery after biological treatment
- Combination of concepts possible, modular setup

Concept B

- Necessary volume for biological processes ca. 40% lower, if concentrated nutrients in treated blackwater can be used with water
- 20 % more biogas, as no denitrification of blackwater is necessary
- Greywater for flushing toilets, drinking water consumption reduced by 1/3
- Urine separation an option when suitable toilets are on the market

Summary and Outlook

- New solutions for rapidly growing cities needed
  - Modular fit-for-purpose concepts for integration of water, energy, and food production
  - Implementation based on demand
- Lighthouse projects for cities in developing countries as blueprints for sustainable development, cities as “real labs”
- Technology transfer and adaptation, e.g.: vacuum sewer system, disinfection of wastewater, efficient anaerobic processes, irrigation technologies
- How can this be organized efficiently?
- What can be the input from research organizations?
- How will these lighthouse projects be financed?



Thank you for your attention!
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