Conclusions

„Cities of the Future“ will differ from those of yesterday and today.

Water and Sanitation Infrastructures will be much more diverse and varying and adapted and flexible to changing conditions.

Wastewater is not a waste, but a resource
Why not „business as usual“?

- Are we no longer satisfied with „our wastewater treatment“?
- Why can’t we keep our system, which has been proven successful for more than 100 years?

**Counter questions**

- Did the requirements change during the last 100 years??
- Can we talk of a success model, if only 10% of the world population are connected to a wastewater treatment plant?

- Which challenges need to be overcome?
Challenge 1: World Population Growth

United Nations 2012: World Population Prospects
Challenge 2: Urbanization

Population Total: 2,532,229,000

Data: United Nations 2011, World Urbanization Prospect
Challenge 2: Urbanization

2000

Population Total: 6,122,770,000

Data: United Nations 2011, World Urbanization Prospect
Challenge 2: Urbanization

2025

Population Total: 8,002,978,000

Data: United Nations 2011, World Urbanization Prospect
Challenge 3: Dynamic of urban growth

Example of Shanghai: 67 C/h > 585,000 C/y

In total far more than 1 Million per week in cities

The Speed of Urban Change (Burdett & Rode 2007, modified with Data United Nations 2011, World Urbanization Prospects)
Growth rates e.g. Shanghai

Population growth
67 C/h → 585,000 C/y

Additional water (daily!)
132 L/(C·d) → 77,200 m³/d

Additional solid waste (daily!)
1 kg/(C·d) → 585 Mg/d
Challenge 4: Limited Resources

1. Water

2. Energy

3. Nutrients (P, N, ..)

Jialing/Chongqing 2006;
www.zeitenschrift.com/magazin/54-wasser.jpg 26.5.2013

http://www.hvv-mobility.com 26.5.2013

www.baecktrade.de 26.5.2013
Resource efficiency requires new infrastructure solutions

1. Water reuse fosters decentralization

2. Energy (heat) recovery fosters decentralization

3. Fulfilling high quality standards foster professional operation → rather partly- (semi)- centralized than de-centralized at household level

4. “smaller “ infrastructure is more flexible and reduces vulnerability (natural hazards, terrorism, …)

5. Energy self-sufficiency fosters combination of different sectors (water supply, wastewater treatment and waste treatment)

We know what is needed! Why don’t we start?
SEMIZENTRAL: Integrated treatment on district level

- adaptable to growth rate
- flexible
- adjusted
- integrated (water, wastewater, waste, energy)
- enclosed construction → low-emission

- „As small as possible, as large as necessary“
- Infrastructure on demand
SEMIZENTRAL
Mass flow in the RRC

SEMIZENTRAL
Resource Recovery Center

- Greywater
- Blackwater
- Foodwaste
- Non-potable Service water
- Energy
- Caloric heat
- Treated water “fit for purpose”
- Biosolids

Greywater treatment

Blackwater treatment

Sewage sludge and waste treatment
“SEMIZENTRAL“
Resource Recovery Center (RRC)

- Waste water as a resource for
  - Water
  - Energy
  - Nutrients

- Products instead of wastes
  - Non-potable service water
  - Irrigation water
  - Biogas/electricity
  - Biosolids (stabilized/rich in nutrients)

- Flexible and adaptable
Realization of the first RRC in Qingdao, P.R. China

Emerging metropolis at China’s east coast in ShanDong Province

Natural Water resources are deeply limited
(groundwater salination because of seawater intrusion, heavily pollution and/or grounding of surface waters)

- Available water resources not sufficient for higher demands
- Urban growth needs further water

⇒ The Qingdao solution: seawater desalination
⇒ Energy demand: 3 - 4 kWh/m³

⇒ The SEMIZENTRAL solution: Reuse for <1 kWh/m³
Semicentralized Resource Recovery Center (RRC) – a modular approach

Technical basics

Greywater treatment
- Non-potable service water production with MBR

Blackwater treatment
- Irrigation water with MBR

Foodwaste pre-treatment
- Mechanical pre-treatment

Energy-Center
- Anaerobic thermophilic treatment
- Electric energy by CHP station
Realization of the first RRC in Qingdao, P.R. China

implementation in context of the 2014 World Horticulture Exposition in Qingdao

catchment area: “ShiYuan-village plus”

- 3 Hotels
- Housing areas for staff and guests
- New developed housing areas
- Office buildings

- rd. 12,000 people to serve
Material flows within the semicentralized System Qingdao ShiYuan

**ShiYuan Village**
- Tap Water
- **33 L/(C·d)**

**Residential Area**
- **41 L/(C·d)**
- **68 L/(C·d)**
- Food Waste
- nearby area

**RESOURCE RECOVERY CENTER**
- Greywater Treatment
  - **sludge**
- Blackwater Treatment
  - **sludge**
- Waste and Sludge Treatment
  - Biosolids

**Service Water**

**Irrigation Water**

41 L/(C·d)

Food Waste

Blackwater

Greywater

Tap Water

Residential Area

Irrigation Water

discharge

Biosolids
Advantages of the system

On the water side

recycling rates between

40% (greywater only) and 100% (grey- and blackwater)

On the energy side

Energy self-sufficient operation possible
RRC in Qingdao ShiYuan
27 April 2014

- **Opening** of the worldwide first SEMIZENTRAL supply and treatment center by
  - State secretary Dr. Georg Schütte (BMBF) and deputy mayor of the city Qingdao WANG Jianxiang
  - with participation of the German and Chinese research partners and sponsors
Energy self-sufficient operation
comparison of current calculation with earlier estimations

max. electricity production
(RRC Qingdao Shiyuan)

electricity production
from biowaste/sludge treatment
(Bieker et al., 2010)

min. electricity production
(RRC Qingdao Shiyuan)

Electric energy [kWh/(C-a)]

- exhaust air purification
- food waste pre-treatment
- energy center
- blackwater treatment
- greywater treatment

electricity demand
RRC Qingdao Shiyuan

MBR

electricity demand
Bieker et al. (2010)

SBR

Tolksdorf et al., 2015 (submitted)
Conclusions

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Conclusions

The re-use of resources needs equivalent infrastructures

- District-related, co-growing (on demand), „semizentral“
- Water qualities „fit for purpose“
  → toilet flushing water doesn‘t need drinking water quality
- Integrated infrastructures
  (water, wastewater, biowaste, energy production)
- **Health protection** accounts for **professional operation**
  („as small as possible, as big as necessary“)
SEMIZENTRAL
Opening of the first semizentralized Resource Recovery Center (RRC) in Qingdao

Dresden Nexus Conference 2015
Urbanization - The Nexus Approach to Integrated Urban Water Management

25 – 27 March 2015

www.semizentral.de