European Water and Sanitation Services vs. Sustainable Development

Example Germany

ATHENS European Week, Autumn 2013
Paris, November 19th, 2013

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Structure

I. Water Infrastructure and their Challenges
II. Possible Starting Points of Transformation
III. Transition Management to Promote Sustainable Water Management (netWORKS 2)
IV. Assessment of potentials of new system solutions and implementation on the level of districts in Frankfurt/Main and Hamburg (netWORKS 3)
V. Research Initiative: „Intelligent and multifunctional Infrastructure Systems for Sustainable Water Provision and Waste Water Management (INIS)“
I: Water-Infrastructure and their Challenges

- Municipal water infrastructure is founded upon a central system of water supply and sewage disposal facilities and networks which emerged over a long period of time.
  - High product quality and security of supply
  - Large investments to improve environmental quality
  - High Path Dependency
  - Natural monopolies, regional monopolies, (2 disconnected units for water and waste water
  - Residential areas as flow-though Systems
  - Water solely is allocated in drinking water quality
  - All wastewater streams (domestically, industrial, rainwater) are collected in one pipe and treated together
  - Supply side provision of services

- Generally accepted rule: in areas with mid to high population densities, centralized and uniform systems held decisive technical and economical advantages over de- or semi-centralized systems.

- New Challenges
Demographic Change - Effects of Shrinking

- **Drinking Water Supply**
  - Strong reduction in flow rates can cause considerable problems for the functioning of water supply networks (stagnation zones, sedimentation areas (precipitation), long drinking water retention times in lines = risk of bacterial after growth).

- **Sewage Disposal**
  - Declining water consumption can in many places lead to a strong reduction in sewage volumes, falling below the required minimum flow rates.
  - Lower flow rates lead to sediment deposition in oversized sewers, especially in low gradient sections (flushing sewers frequently).
  - Anaerobic transformation processes due to deposits and long sewage retention times cause odour problems.
  - Degradation processes resulting from sedimentation furthers the corrosion of pipe material.
  - Decreasing amounts of effluent reduce the efficiency of existing, increasingly oversized sewage treatment plants and impair operation through surges of dirt after rain and rising proportions of extraneous water.
Implications of Climate Change for Infrastructure

- Impact of natural water quality in first and foremost in autumn and winter will lead to
  - Temperature induced processes
  - Growing overfall drainage
  - Growing elutriation
- During tropical days there will be more demand on water
- Impact on Urban Micro Climate
- Rain-Water
  - Less abundance in summer (garden watering)
  - More abundance in the winter half year with danger of water logging
  - Stronger rain peaks
Climate Adaption

- Local authorities have already made a considerable effort in the field of climate protection (mitigation), but have less experience with climate adaptation strategies.

- Sanitary Engineering based systems are energy consuming
  - Energy for pumps, conditioning
  - CO₂-balance necessarily has to be improved
  - CO₂-sink?

- In the waste water sector part of methane is emitted unused.

- Measures to increase the energy efficiency will become increasingly important in the years to come.

- Energy recovery is partially achievable in the domestic part of the infrastructure system.
Coping with uncertainty

- Adaptation measures should be preferred, that allow flexible reactions
  - Consequent addition of technology-based flood protection through rain water infiltration and other territorial measures
- Promotion of measures with synergy effects for several climate effects
- Attenuating impacts on extreme occasions, e.g. rising water backing in the area
  - Natural Replenishment
  - Dwindling of the runoff drainage

Adaptation of the Water Infrastructure

- Avoiding of
  - flooding the combined sewerage system
  - bottlenecks in supply during dry season
  - anaerobic transformation processes due to long sewage retention times or high temperatures in the pipes
- Consideration and when indicated adaptation of the existing infrastructure
- Joint consideration of climate impacts with impacts of other changing processes like the demographic change, urban renewal, changing land use etc.

Technological Change (1)

- Technological change offers windows of opportunity for transforming existing structures without exorbitant capital destruction.
- Where old structures reach the end of their useful life, opportunities for conversion are particularly favourable:
  - In the energy sector there is a trend toward decentralisation: photo voltaics instead of coal or nuclear power, bio-gas and bio-natural-gas, geothermal energy, solar heat, energy-efficiency, smart-metering.
  - But also in a comparatively decentralized system like waste water management, key indicators speak in favour of a shift towards materials minimisation, energy use, and nutrient recycling.
- Conventional technologies have system specific shortcomings (low flexibility and low adaptability).
Technological Change (2)

- New technologies (e.g. decentralized on-site treatment plants) can overcome these shortcomings and can have a more sustainable performance than conventional technologies.
- Intelligent system solutions are characterized by
  - material flow reductions (eco-efficiency),
  - greater flexibility and, in part, shorter pipelines;
  - in the long term, when compared to conventional system solutions (in terms of technological regulations), they exhibit increased economic efficiency (energy exploitation).
- These technologies can be complementary, mutually independent or competitive. They can in principle change the infrastructural system radically.
Technological Change (3)

- New types of technology should be considered and the benefits of alternative systems weighed against continuing operation of current facilities.
- It is important not to endanger the functionality of the system as a whole and to satisfy economic requirements.
- Pilot projects have clearly illustrated that, in principle, it is possible to differentiate between resources and innovatively combine wastewater and freshwater.
- Necessity to contemplate possible transformation of existing systems. In this context small units and self-sufficient systems may gain importance.
- How such alternative and supplementary technologies can be efficiently and cost-effectively integrated into existing systems is one of the greatest technical and organisational challenges facing infrastructure management today.
II: Water Infrastructure: Possible Starting Points of Transformation

- Differentiation of water use (drinking water, service water; rain water),
- disconnected collection and off-taking of separated component current (rain water, grey water and black water),
- De-central or semi-central linking of water supply and sewage disposal (e.g. use of rain water or conditioned grey water),
- separation and return of substances/materials for (re-)using,
- using of the energy potential of grey water streams and the biogen waste water substances as well as
- minimisation of energy use and of energy losses.
Spatial Differentiation

- Central: wastewater treatment and drinking water supply by central systems (sewer network, sewage treatment plant; water works, line network).
- Semi-central: wastewater treatment and drinking water supply for several houses/ apartments resp. bounded settlement areas, e.g. in the form of common installation.
- De-central: wastewater treatment and drinking water supply in the form of single installation for one residential building/ household.
Trends between Centrality and De-Centrality in Terms of Sustainable Water Infrastructure (1)

- Reduction of water abstractions to a degree that is essential and agreeable.
- Wastewater is increasingly considered as a resource for re-using as well as for recovering the dissolved matters (recyclable fraction, energy).
Sewer networks and drinking water lines are important cost-positions in public budgets.

Solutions that reduce the length of networks, downsize pipes or extend the life-time of the network offer advantages.

Those based upon parallel networks have to generate savings in maintenance, length of networks or bring other cost advantages.