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National Water Technology Platform

Energy-efficiency and adaptation to climate change in the R&D strategy of urban water management in Hungary

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Preambulum

"As a consequence of the global climate change, warming and drying of the climate and the increase of the frequency of extreme meteorological phenomena and of the resulting damages are expected to occure in Hungary. Concerning the climate and weather changes (droughts, raindtorms, inundations, flash-floods, internal waters, mud avalanches, hail-storms, snowdrifts, wind-storms, tornado-like phenomena, heat waves, forest fires etc.) it is important to prepare the society and the local population onto the prevention, the mitigation of risks, onto the restoration of the damages, in which the scientific preparation plays a paramount role." (Statement of the Presidency of the Hungarian Academy of Science (2009))

NATURAL CHANGES

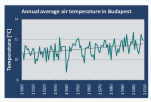

Fig. 1. Increasing air temperature in Budapest


Fig. 3. Low water level in Lake Balaton in 2003

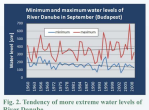

Fig. 2. Tendency of more extreme water levels of River Danube


Fig. 4. Severe floods in 2010 (North-Eastern Hungary)

Effects of the global hydro-climatic changes in Hungary

- Temperature increase (Fig. 1.) - seasonal and regional inhomogeneity
- Long-term warming of surface waters
- Increasing probability and frequency of extreme precipitation events
- Extreme water levels of rivers and lakes (Fig. 2-3.), increasing risk of droughts and flash floods (Fig. 4-5.)
- Decreasing water resources
- Deteriorating water quality due to longer dry periods (opposite to the experienced trend in the last decades – Fig. 6.)
- Decreasing annual average precipitation, change of temporal distribution (Fig. 7.)
- Increasing water stress (increasing water demand together with the reduction of availability of water resources)


Fig. 5. Flooding River Danube in Budapest, 2005

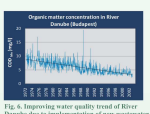

Fig. 6. Improving water quality trend of River Danube due to implementation of new wastewater treatment plants, more efficient treatment and decline of industrial discharges

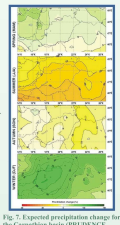
Fig. 7. Expected precipitation change for the Carpathian basin (PRUDENCE 2071-2100 - A2 scenario)

TECHNICAL RESPONSES

Hungarian National Climate Strategy 2008-2020

- **Mitigation**: decrease the emission of greenhouse gases
  - **Energy**
    - **Increase energy efficiency**
    - **Energy saving**
    - **Change in the present energy profile** (Fig. 8.)
    - CO_2 binding technologies
  - Industry
  - Transportation
  - Agriculture and forestry
  - Waste management and **wastewater treatment**
- **Adaptation**
  - Natural habitats
  - Human health
  - **Water management**
  - Agriculture and forestry
  - **Urban environment**
- **Research**
- **Education**

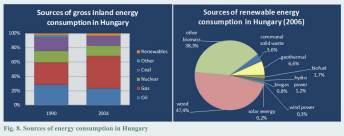

Fig. 8. Sources of energy consumption in Hungary

Challenges in urban water management in Hungary

- The deterioration of aged infrastructure (water distribution/collection networks)
- Urbanization parallel to decreasing population in rural settlements
- Extreme hydro-climatic events
- Increasing water stress and water utility cost

Challenges and tasks in urban water management due to climate change

Effects of climate change	Tasks
• Increasing peak water consumption: water shortage is forecasted in some regions	• Revision of safety plans in drinking water supply systems (water borne diseases, accidents, temporal water scarcity)
• Decreasing availability of surface, karstic and bank filtered drinking water resources	• Integrated management of safety and security
• Safety and security of water supply decreases	• Search for alternate water resources
• Secondary pollution in drinking water distribution networks	• Introduction of new technical standards
• Increasing water treatment costs (tariffs)	• Development of treatment technologies of new pollutants (drinking water, wastewater)
• Increasing importance of recycling/reuse	• Optimization of water distribution network operation
• Decreasing number of receiving waters with appropriate flow	
• Volume and composition of wastewater changes – disadvantageous biological processes; septicity, biocorrosion and odour problems, effects on technologies	
• Increasing risk of extreme precipitation events/rainwater drainage and management	
• Increasing probability of inundation due to floods	

Specific Hungarian conditions of urban water management

- Drinking water supply is primarily based on **good quality groundwater** (Fig. 9.).
- **Certain contaminants** (As, NH_4-N, B, Fe, Mn) **in drinking water exceed EU standards** in many areas (2.5 million inhabitants affected).
- **Postponing reconstruction of aged and oversized water distribution networks** results in service malfunctions and rising O&M costs.
- **Investment "tsunami" in water sector** to meet EU requirements for drinking water and wastewater effluent quality (4 billion € will be spent on implementing 150 new wastewater treatment plants within 3 years).
- **Decreasing water consumption** (Fig. 10.) has resulted in secondary pollution problems in water supply network, odor, corrosion and biological problems in sewer systems.
- **Treatment technologies and design principles used in the developed world cannot be straightforwardly transferred to Hungary** – raw wastewater composition, strength are all different (high N and relatively low C). Adaption to this clearly indicates **new R&D needs and necessary rethinking of investment strategy**.
- **Storm water management system is non-existent** (storm water drainage networks and reuse systems are missing).

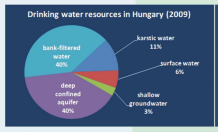

Fig. 9. Drinking water resources of Hungary

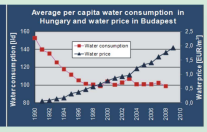

Fig. 10. Change in water consumption and price

R&D IN URBAN WATER MANAGEMENT

R&D tasks – Adaptation to hydro-climatic changes

Problem area	R&D priorities	Scheduling*
Climate change forecast	Development of mid-term, high accuracy weather forecast models.	S
	Research into the effects of climate change on surface and groundwater resources (water level changes, permanency of low water levels, maximum loadability of water bodies), development of regional hydrogeological models.	M
	Research of the climate sensitivity of urban water management technologies (climate effect matrix).	M
	Development of regional drought-forecast and monitoring systems.	L
Adaptation to the climate change	Revision of storm water management standards and establishment of rainwater reuse/recycle technologies.	M
	Refinement of water demand forecasts (seasonal differences, peak water demand) in consideration of expected effects of climate change.	S
	Technical solutions for the management of periodic water shortages (reserve water resources, recycling possibilities, etc.).	M
	Development and application of modern flow control and storage methods and technologies.	M
	Examination of the alternate water supply possibilities of plants constructed for the treatment of surface waters and bank-filtered waters and necessary technological modifications to respond changes in chemical and biological water quality.	M
	Risk management – mitigation of public health issues.	M

* S: short term; M: mid-term; L: long-terms

Hungarian National Water Technology Platform (NWTP) and its Strategic Research Agenda

The Hungarian National Water Technology Platform was established in 2008 with the aim of developing long-term R&D strategy in the field of urban water management. The Platform prepared a Strategic Research Agenda in 2009. SWOT analyses were conducted to diagnose the following areas: water, wastewater and sludge treatment technologies, public works (drinking water supply networks, storm water and wastewater collection systems), specific problems of small settlements (rural areas), hydro-climatic changes and water management, and financial/institutional/legislative framework of the water industry.

Based on SWOT analyses, prognosis was given for the development of the above thematic areas according to different scenarios. Priorities and R&D tasks were proposed considering the long term objectives of the integrated urban water management which are: (1) sustainability of water utility infrastructure, (2) safety and security of drinking water supply, (3) reduction of pollutant emissions, (4) **enhancing cost-efficiency and energy efficiency of water technologies**, (5) **adaptation to hydro-climatic changes**, and (6) social acceptance.

R&D tasks – Energy and material conservation

Problem area	R&D priorities	Scheduling *
Energy efficiency	Use of solar energy, wind and hydro power and geothermic energy in wastewater collection and treatment systems in small settlements.	M
	Development of low-energy, low-cost wastewater treatment technologies. Research for alternative reaction pathways/treatment technologies (MFC, ANAMMOX).	M
	Increase of energy efficiency in water supply networks, sewerage systems and water & wastewater treatment plants (benchmarking).	S
	Use of alternative renewable energy sources. New IT methods in energy management.	M
	Development of simple and cheap technologies for biogas production from wastewater for small settlements and households.	L
	Development of modern biogas technologies at low temperatures.	M
Closing of material cycles	Use of the nutrients of wastewater sludge (energy forest)	S
	Use of the urea, phosphorous contents and heat of wastewater.	M
	Direct industrial use of wastewater sludge as raw material.	M
	Decrease of greenhouse gas emission and ecological footprint of wastewater treatment technologies. Methodological development for the evaluation of virtual water consumption for LCA purposes and for establishing a national water strategy.	M

* S: short term; M: mid-term; L: long-term

Conclusions

- The highest cost in urban water management is related to the reconstruction of existing water utility (drinking water supply, wastewater drainage, storm water drainage) networks, and the further maintenance and surveillance of networks currently under construction in the future. This, particularly under the conditions of the present and elongated financial crisis represents a major challenge for the water sector.
- The presently open urban mass- and water cycles in sewerage and wastewater treatment plants are not sustainable in long-term. Paradigm change is needed at the level of households and municipalities as well.
- Long term adaptation to climate change requires the immediate launch of R&D projects in cooperation with countries of similar problems.
- Presidency of the European Union in the next year provides the NWTP an excellent opportunity to articulate and stress further the above outlined R&D priorities that are in accordance to international trends but also reflecting specific Hungarian conditions.

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