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GLOBAL CHALLENGES CONFRONTING DIRECT AND INDIRECT (I.E., UNPLANNED AND PLANNED) POTABLE WATER REUSE

KONFRONTACJA BEZPOŚREDNIEJ I POŚREDNIEJ (TJ. PLANOWANEJ I NIEPLANOWANEJ) ODNOWY WODY DO PICIA – WYZWANIA GLOBALNE

Water demand is driven by population growth and urbanization that forces water agencies to evaluate new water reuse systems and technologies while seriously considering alternative water resources options. The future demand for water cannot fully achieved by traditional hydrological cycle-dependent water resources, therefore purified wastewater has to be reclaimed. Effective ways of water recycling need to be developed and urgently implemented in many parts of the world. Reclaimed water is a resource available at the doorstep of the urban environmental world, where water is needed most and priced the highest. High microbiological quality of reclaimed water is essential for public health. Additional driving factors determining successful implementation of new potable reuse systems include public perception and economy.

Public perception and understanding of potable water reuse varies and depends on the awareness, general educations, self-education about water issue, and also access to multi-and-mass-media whose role in shaping public opinion and perception should not be underestimated. Mass media and multimedia usually do not advance objectively the reasons for potable water recycling and frequently; **a.** portray return flow as "treated sewage" rather than water; **b.** reinforce the understanding of the public that "sewage is a sewage until we lose track of it, and then it becomes water"; and **c.** support public aversion to reclaimed water.

Direct Potable Reuse is the most extreme case of water recycling, and is at present used only in water-critical situations. There are 4 issues related to direct reuse: **a.** public perception; **b.** health risk concerns; **c.** technological capacities; and **d.** cost considerations. The technology is technically and societally challenging as the effluent of a wastewater treatment plant is routed directly to the drinking water treatment plant; reclaimed water is supplied directly to the water supply system. Because of the relatively closed-loop cycle it is also called ``toilet-to-tap'' or "pipe-to-pipe". The wastewater requires extensive advanced physical and chemical treatment prior to re-introduction in the drinking water plant, and therefore is usually discharged to source water reser-

voirs. Direct potable reuse is associated with negative public perception related to use of wastewater for drinking purposes in the health and hygiene context. Any system that loops back a large quantity of wastewater without advanced physical and chemical treatment for drinking water production carries the risk of concentrating pollutants and contaminants over time, including those which are not on the monitoring list. While "toilet-to-tap" and "pipe-to-pipe" systems do work in theory, and some pilot plants are presently being monitored they are generally an option of last resort. There are some options in the system which include "time-lapse" in the "closed loop architecture" these may involve an open aerated tank or alternatively a pond with no water release from the tank or pond except to the drinking plants. In the US there is no imperative for use of reclaimed water for direct potable reuse; however, it is inevitable that potable reuse will occur. Direct Reuse relies on transportation of reclaimed water from WWTP for use without intervening discharge to water reservoirs, usually for agriculture or landscape irrigation. Direct recharge is a controlled saltwater intrusion or subsurface addition of reclaimed water directly to the ground water basin for subsequent aquifer storage and recovery or to replenish ground water via the injection wells recharging into the saturated zone.

Indirect Potable Reuse is a traditional system in which raw water is abstracted, treated, distributed to drinking water customers and after use the wastewater is collected, treated and discharged to a water reservoir which is usually the same one from which source water is abstracted. In this system, the reclaimed water is used to augment potable water supplies by mixing with natural water. Treated wastewater is discharged downstream of the raw water abstraction. Unplanned reuse generally occurs at the community level, when the treated wastewater discharged from an upstream community is abstracted for drinking water production purposes by another community at downstream locations, and source water quantity and quality is not controlled by the user. The abstracted fraction of wastewater volume for drinking water production can be high, sometimes reaching close to 50%. In planned reuse systems, treated wastewater is intentionally used to augment source water supplies. The treated wastewater is discharged at upstream water abstraction locations to mix with raw water prior to diversion to drinking water production. Reclaimed water is used directly or indirectly without loosing control of quantity and quality. Planned indirect potable reuse uses multiple safety measures and barriers to remove contaminants such as: **a.** wastewater treatment; **b.** dilution, **c.** mixing and natural cleansing in a wastewater-receiving reservoir, **d.** efficacious drinking water treatment; and **e.** effective source and finished drinking water monitoring. Other use of reclaimed water includes: **a.** agricultural and landscape irrigation; **b.** industrial reuse; **c.** groundwater recharge; **d.** recreational and environmental use; **e.** desertification control and snow generation; and **f.** non-potable urban uses (i.e., stabilization of building foundations, air-conditioning, and fire protection.