Policy and Institutional Framework as a means of enabling water recycling

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WATER & USES
RENEWABLE FRESH WATER

Total renewable water resources per capita (2013)
Total Water Demand in 2015 is about 4,000 km³. This represents 10% of available renewable water.

<table>
<thead>
<tr>
<th>Main Uses of Fresh Water</th>
<th>Percentage of Total Withdrawal - 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture (irrigation)</td>
<td>70%</td>
</tr>
<tr>
<td>Industry</td>
<td>18%</td>
</tr>
<tr>
<td>Municipalities (Domestic)</td>
<td>12%</td>
</tr>
</tbody>
</table>

GLOBAL WATER DEMAND 2000-2050

BRIICS (Brazil, Russia, India, Indonesia, China, South Africa); RoW (rest of the world).
DEMOGRAPHY
Population Growth and Urbanization

The Bigger change is happening and projected in **Asia, Africa, and Latin America**

![Urban Population Graph](image)
The largest population growth is awaited in urban centers in Africa.
By 2050 the world population will increase from 7 to 9 billions.

90% of increase located in developing countries

Almost 100% of increase will be located in urban areas.

Forecasted 70-90% of increase in demand for water.

By 2030, up to 70% of world population will be living in high water stress areas.

Needs in Water, Energy and Food will be concentrated in fast growing cities, requiring the use of resources coming from more and more remote areas.
CLIMATE CHANGE & VARIABILITY
Climate Change: challenge already visible to-day!

Abandoned ship in the former Aral Sea, near Aral, Kazakhstan
Temperature increase

Sea level rise,
Melting of snow and land ice
The increased frequency and intensity of heavy precipitation
The increased droughts and wildfires
Number of disasters per continent
Water reuse... Why?

*Drought is expected to increase in frequency and severity in the future*
Severe pathogen pollution affects around one-third of all river stretches in Latin America, Africa and Asia, putting the health of millions of people at risk.

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Source: UNEP (2016)
Mismatch between demand and availability:

Higher scarcity in several parts of the world during specific times of the year

The number of month per year in which blue water (surface and ground water) scarcity exceeds 1.0 at 30 x 30 arc min resolution (1996-2005), (Mekonnen & Hoekstra 2016)
Treated wastewater is a safe and reliable source of water that can be used to offset water scarcity.
Water reuse Application and Technologies

Comparison: Treatment efficiency, energy requirement, and cost of process

- Size: cost of Treatment process

- Ozone UV/H2O2
- NF/RO

- Chloramine
- Filtration
- PAC/GAC
- BAC
- ChlorineReservoirs
- Wetlands
- ASR
- SAT
- Riverbank Filtration

Treatments arranged based on:
- Energy Requirement: high to low
- Treatment efficiency: high to low

Legend:
- Chloramine
- Filtration
- PAC/GAC
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- Wetlands
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# Water reuse Application and Technologies

<table>
<thead>
<tr>
<th>Category of reuse</th>
<th>Description</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Un-planned</strong></td>
<td>The addition of treated or untreated wastewater to drinking water sources such as rivers, lakes, or groundwater aquifers or communities located in downstream draw water supplies from rivers that received discharges from upstream. Water from those rivers has been treated or untreated and supplied to downstream users.</td>
<td></td>
</tr>
<tr>
<td><strong>Landscape irrigation</strong></td>
<td>The use of reclaimed water for non-potable applications in municipal settings where public access is not restricted</td>
<td>Parks, playgrounds, cemeteries, golf courses, roadway rights-of-way, school grounds, greenbelts, residential and other lawns</td>
</tr>
<tr>
<td><strong>Agricultural irrigation</strong></td>
<td>The use of reclaimed water to irrigate food crops that are intended for human consumption</td>
<td>Food crops, fodder crops, fibre crops, seed crops, nurseries, sod farms, frost protection</td>
</tr>
<tr>
<td><strong>Processed food crops and non-food crops</strong></td>
<td>The use of reclaimed water to irrigate crops that are either processed before human consumption or not consumed by humans</td>
<td>Trees, turf, woodlots, flowers</td>
</tr>
<tr>
<td><strong>Urban reuse</strong></td>
<td>The use of reclaimed water for non-potable applications in municipal settings where public access is not restricted</td>
<td>Toilet and urinal flushing, fire protection, vehicle washing, street cleaning, decorative fountains and other water features</td>
</tr>
<tr>
<td><strong>Restricted</strong></td>
<td>The use of reclaimed water for non-potable applications in municipal institutional barriers or temporal access restriction</td>
<td></td>
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<tr>
<td><strong>Industrial reuse</strong></td>
<td>The use of reclaimed water in industrial applications and facilities power production, and extraction of fossil fuels</td>
<td>Cooling, boiler feed, stack scrubbing, process water, aggregate washing, concrete making, soil compaction, dust control, etc.</td>
</tr>
<tr>
<td><strong>Environmental reuse</strong></td>
<td>The use of reclaimed water to create, enhance, sustain, or augment water bodies.</td>
<td>Wetland, aquatic habitats(aquatic ecosystem restoration), streamflow(surface augmentation), aquifer recharge, artificial-snow production, etc.</td>
</tr>
<tr>
<td><strong>Impoundments</strong></td>
<td>The use of reclaimed water in an impoundment in which no limitations are imposed on body-contact water recreation activities (some states categorize snowmaking in this category)</td>
<td>Recreational impoundment: fishing, boating, wading, swimming</td>
</tr>
<tr>
<td><strong>Unrestricted</strong></td>
<td>The use of reclaimed water in an impoundment where body contact is restricted Environmental</td>
<td></td>
</tr>
<tr>
<td><strong>Groundwater recharge</strong></td>
<td>The use of reclaimed water to recharge aquifers that are not used as a potable water source</td>
<td>Saline intrusion control and delayed abstraction to increase water resources in quantity and quality</td>
</tr>
<tr>
<td><strong>Indirect reuse(IPR) Augmentation</strong></td>
<td>Augmentation of a drinking water source (surface or groundwater) with reclaimed water followed by an environmental buffer that precedes normal drinking water treatment</td>
<td></td>
</tr>
<tr>
<td><strong>Direct reuse(DPR)</strong></td>
<td>The introduction of reclaimed water (with or without retention in an engineered storage buffer) directly into a water treatment plant, either collocated or remote from the advanced wastewater treatment system</td>
<td></td>
</tr>
</tbody>
</table>
What makes it difficult?

**Inadequate Governance and Institutional capacity**
- Inconsistent governance
- Fractured responsibility
- Inadequate institutional capacity
- Too stringent quality standard

**Public Acceptance**
- Public hesitancy
- Misuse of different terms
- Absence of guidelines
- Insufficient education

**Unbalanced Financing**
- Costly than conventional method
- Difficult to make general statements
- Distortion of water price (even expect no price)

**Inefficient Technical approach**
- Under-performance
- Health and Environment risks
- Over-engineering
- Mistargeting (Fit-For-Purpose)
What are the opportunities

**Drivers**
- Geographical and temporal condition
- Weather variability
- Population growth
- Industrialization
- Energy inefficiency
- Conflicting demands

**Barriers**
- Inadequate institutional capacity
- Fractured governance
- Lack of Public acceptance
- Unbalanced financing
- Over-engineering
- Under performance

**Policy and Institutional Framework**
- Legal ground
- Information dissemination
- Incentives
- Regulation
- Research

- Consistent Governance
- Raise public recognition
- Pit-for-purpose
- Create a level playing field
- Health and environment risks management
- Improve expertise
- Economic efficiency
- Minimize trade barriers
- Build public trust
CREATING AN ENABLING ENVIRONMENT FOR CHANGE
At least 11 out of 22 Arab States have adopted legislation permitting the use of treated wastewater.

The costs of improved wastewater management are usually outweighed by benefits in terms of human health, socioeconomic development and environmental sustainability.
3. MINIMIZING RISKS to PEOPLE and the ENVIRONMENT

Exposure of vulnerable groups, especially women and children, to partially treated or untreated wastewater requires specific attention.

4. BUILDING CAPACITY and KNOWLEDGE

Capacity building, research and development aimed at improving wastewater management generate employment opportunities and promote green growth.

5. RAISING PUBLIC ACCEPTANCE and SOCIAL AWARENESS

Water reuse schemes can fail if planners do not account for the dynamics of social acceptance.
Take home messages

1. Wastewater increasing worldwide
2. Vast majority released without treatment
3. Affordable (‘low-cost’) treatment options are available
4. Reliable and sustainable source of water
5. Sustainable source of energy, nutrients and other recoverable by-products
6. In a circular economy, wastewater use and by-product recovery can generate new business opportunities while helping finance sanitation services
7. The costs of improved wastewater management are outweighed by benefits in terms of human health, socioeconomic development and environmental sustainability
8. Essential for achieving the 2030 Agenda for Sustainable Development
Policy and Institutional Framework

Legal ground

- Legislative Framework
- Competent authority
- Objectives
- Strategic Plans

Information Dissemination and Education

- Guidelines for water reuse
- Training courses
- Policy outreach

Incentives

- Financial incentives
- Regulatory incentives

Standardization

- Modify too stringent standard of quality
- Technical requirement
- Administrative requirement (monitoring & evaluation)
- Induce ‘Fit-For-Purpose’ concept

Research

- Risk management and pollutants
- Technology management
- (underperformance & overengineering)
- Feasibility and economic studies
Thank U
4 UR
@10Ti