Global Perspectives on Urban Water & Sanitation

Design and Implementing Affordable and Sustainable Citywide Sanitation for all

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KALA VAIRAVAMOORTHY, Executive Director, IWA
Global Network for Water Professionals spanning the continuum of research and practice, and covering all aspects of the water cycle

- 10,000 members in 140 countries
- 14 Journals
- 40 books/year
- Biennial Congress with over 9000 participants
- Over 30 conferences/year with over 50,000 participants
- Leading edge technologies and best practices

www.iwa-network.org
IWA can help bridge the chasm?

Universities, innovative technology providers  Bridging the chasm  Water Utilities

Innovators, (Technology Enthusiasts)  Early Adopters, (Visionaries)  Chasm  Early Majority (Pragmatists)  Late Majority (Conservatives)  Laggards (Skeptics)
the challenges
85% of wastewater is **NOT** treated
What happens when the pit is full?

FSM is a neglected issue with limited data

6.2.1 – safe managed sanitation
Next 20 years golden age for wastewater and sanitation - opportunities to “leapfrog”

• Models that optimize FSM solutions (combines process systems with financial optimization)
  – Strategic locates clustered septic tanks, transfer stations..
  – Route optimisation for septage collection
  – Optimization of scheduled desludging practices
  – Technology selection tools to identify optimal treatment and resource recovery and reuse.

• Economic and financial optimisation:
  – optimizes waste absorption/processing (social value);
  – optimizes sales/market saturation (green & financial value)
  – optimizes cost recovery (overall viability and sustainability)
City/town size and FS generation data as starting point

Collection scenarios depending on desludging rates

Available FS volume for processing

Selection of Business model and strategic partners

Exploring and securing year-round market demand

Treatment plant size and capacity

Investment climate (compost or waste to energy subsidies, etc.)

Optimizing logistics: inputs vs. outputs

Revenue and cost recovery optimization
Having treatment plants doesn't mean they work and do their job!

(Source: Murray & Drechsel, 2011)
Next 20 years golden age for wastewater and sanitation - opportunities to “leapfrog”

Innovations resulting in:

• Smaller plant footprint
• Energy savings (up-to 50%)
• Improved CAPEX and OPEX
• Improved effluent quality, resource recovery etc.

Granular Sludge  Anammox  Thermal Hydrolysis  Adv. Control
Opportunity to do things differently

status quo not an option
We require a level of leadership and innovation unprecedented in our history

- Complexity in transitioning to integrated one water solutions
- Deep uncertainty associated with global change pressures

We live in the ‘now’
Decisions need to be made today about our aging & outdated infrastructure
productive use of water
Changing our perspective creates opportunity to do things differently

1. Tertiary: Irrigation
2. 2nd+RO+MF: AAR
3. Nitrified: Cooling
4. RO: Refinery
5. RO(x2): Refinery

Indirect FO

Seawater

Concentrated Wastewater effluent

Post-treatment (concentrated WW)

Post-treatment (lower salinity)

Diluted seawater

Productive Use

Sewer mining

Changing our perspective creates opportunity to do things differently
We need to have a systems perspective of the water cycle

- Groundwater
- Stormwater/Rainwater
- Surface water
- Leakage management
- Desalination
- Black water
- Grey water
- Demand management
Modelling allows us to connect all flows for productive uses – digital ledgers help
Typical solutions - import more water to meet growing needs

- Unit costs of **US$ 0.36/m³**

<table>
<thead>
<tr>
<th></th>
<th>Demand (2010)</th>
<th>Demand (2035)</th>
</tr>
</thead>
<tbody>
<tr>
<td>New GW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New SW-1</td>
<td>637x10³ m³/d deficit</td>
<td></td>
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<tr>
<td>New SW-2</td>
<td></td>
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</tbody>
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Need to consider non-conventional resources – a portfolio of options

- Unit costs of **US$ 0.31/m³** (cf. to 0.36)
Need to consider non-conventional resources – a portfolio of options

- Unit costs of US$ 0.40/m³ (cf. to 0.36)

[Image: A graph showing water demand and unit costs.

Source: openknowledge.worldbank.org/handle/10986/11964]
Natural systems can help reduce the energy foot-print

- **Reservoir**
- **Dam**
- **Lake Bank Filtration**
- **River Bank Filtration**
  - $0.067/m^3$ (cf 0.28/m^3)
- **Water for Irrigation**
  - 0.012 - 0.024 $/m^3$ (cf 0.05-0.15 $/m^3$
- **Primary Treatment and/or Constructed Wetlands Stabilization Ponds**
- **Soil Aquifer Treatment Artificial Recharge Recovery**

**Low Energy – Water Efficient’ Closed Loop**
At watershed level also ‘**system of systems**’
waste as a resource
Changing our perspective creates opportunity to do things differently

Resource Recovery & Reuse (RRR)

Energy: electric (microturbines)

Energy: Biogas, bioelec, biofuels, MFC

Nutrients: P & N

Energy: Heat, electric (microturbines)

Nutrients: P & N

Changing our perspective creates opportunity to do things differently
Important to understand the business model

Key Partners
Key Activities
Value Proposition
Customer Relationships
Customer Segments
Key Resources
Channels
Cost Structure
Revenue Streams

Important to understand the business model.
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- **Capital purchase business model** or **treatment fee model**
We’re starting to talk about machines and factories

Productive Use

- Electric En.
- Heat En.
- Energy

- Surface Water
- Ground Water
- Rain Water
- Energy

Reclaimed non-potable
Potable Water
Industry Use

- Urine
- Brownwater
- Grey water
- Solid waste

Nutrients
Hygienized Sludge
Bioplastic
April 2014: Semizentralized Resource Recovery Center Qingdao Shiyuan

Energy-Center

Blackwater

Foodwaste

Greywater

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These perspectives lead to a more decentralized type of thinking?

Distributed systems well suited for:

- Energy recovery (heat recovered and used close to source)
- Minimizing energy consumption (for moving water)
- Source separation (to maximize nutrient recovery)
- Adjusted growth (to deal with rapid growing cities)
- Increased resiliency (dampens the propagation of failures)
Look for opportunities to create new paradigms (not extend old ones)

Outskirts
Demand met by informal systems

City Core
Formalised water & waste system

Expansion of existing system to growing areas

Distributed & Decentralized

Growth
Getting of the grid – disruptive

Hamburg Watercycle™

Battery Park City NY
10,000 people, Recycling, RWH, CHP

Siyuan Campus
18,000 students, Recycling, Comsump. down by 50%

Hammarby Sjöstad
12,000 people, Recycling, waste-to-energy
Principles for water wise cities
need to accelerate uptake of new ideas
Spreading innovation takes time


Source: Cambi
Myth - water sector slow moving & presents few opportunities to introduce major innovations

<table>
<thead>
<tr>
<th>Animal</th>
<th>Gestation Period (Average)</th>
<th>Average Lifespan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hare</td>
<td>35 - 50</td>
<td>7-8 yrs.</td>
</tr>
<tr>
<td>Cat</td>
<td>52-69 (63)</td>
<td>10-12 yrs.</td>
</tr>
<tr>
<td>Dog</td>
<td>53-71 (63)</td>
<td>10-12 yrs.</td>
</tr>
<tr>
<td>Monkey</td>
<td>139-270*</td>
<td>12-15 yrs.</td>
</tr>
<tr>
<td>Human</td>
<td>253-303</td>
<td>67 yrs.**</td>
</tr>
<tr>
<td>Horse</td>
<td>329-345 (336)</td>
<td>20-25 yrs.</td>
</tr>
<tr>
<td>Whale</td>
<td>365-547*</td>
<td>80+ yrs. *</td>
</tr>
<tr>
<td>Elephant</td>
<td>510-730 (624)*</td>
<td>30-40 yrs.</td>
</tr>
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Minimize carbon demand in side-stream deammonification system

Minimize carbon demand and increase capacity with mainstream deammonification

Maximize energy recovery in Cambi/MAD

Short-cut N removal: Nitrite shunt/mainstream deammonification

Maximize carbon capture in chemically enhanced primary treatment and high-rate activated sludge

DC Water’s Innovation Focus: Intensification and Resource Recovery
Need to think of horizontal technologies and then manage them appropriately.
Choices Before Us

Stay in Lane
Business as Usual

Try Harder
Spend More for Traditional Sys

Paradigm Shift
Truly Different Approach
Thank you!

Follow @IWAHQ on Twitter and share your urban water vision using #WaterWiseCities

IWA-Connect Group: Cities of the Future