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New Water or NEWater: Which is More Costly?

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Biodata of Singapore

Small Island State



High population density

High annual rainfall

Average water demand

5.3M population / 710 km² land area

1.73 million m³/d (380 mgd)

 100% of population served by potable water at the tap & 100% modern sanitation

2400 mm

Lack of aquifers and groundwater





Singapore in our early days

Typical Developing Country

"Singapore ... at the 170th position among a list of 190 countries in terms of freshwater availability."



- United Nations World Water Development Report

- Population Growth Population was1.65 million in 1960
- Rapid Economic Growth Per capital GDP from USD 428 in 1960
- Not all homes are sewered (bucket system)
 - Unaccounted for water is high
- Our disadvantage is a source of motivation
- Common understanding that water sustainability is core to our future as a nation

Water for All: Conserve, Value, Enjoy

Singapore's Water Resources Only conventional sources before 2002



Imported Water

- had 2 agreements with Malaysia
- only 1 left, expires in 2061



Reservoirs

• 14 reservoirs in 2002, from both protected and unprotected catchments



Singapore's Water Resources

NEWater introduced in 2002; Major Paradigm Shift



Singapore's Water Resources

A Systems Approach to Water Management

works with limitations and opportunities of Singapore's situation – limited land, little ground water, separate rainwater and used water system, abundant rainfall and abundant seawater



NEWater as an integral part of our Supply System

Can meet up to 30% of our water needs today



• Managing NEWater demand as a whole, increasing reliability of supply

Uses of NEWater

Mostly Direct Non-Potable Use (DNPU)



Is NEWater New?

Concept of Water recycling as a source of water is not new

- It has been practised in several parts of the United States as an indirect source for more than 20 years.
 - Orange County, South California (1976)
 - Upper Occoquan Sewage Authority, North Virginia (1978)
- Rivers a source of sewage treatment plant effluent and a source of potable water



Water for All: Conserve, Value, Enjoy

Merits of NEWater

Building a more Sustainable Water Supply

- Independent of rainfall fluctuations
- Enhances Singapore's resilience against prolonged periods of drought and climate change
- Frees up large amount of water for potable use
- Multiplier Effect of Water Recycling
 - If 50% of each water drop is recycled, the theoretical limit is doubling the water supply
- Cheaper than Desalination

But Needs ...

- Mindset change "Used water is a resource"
- Infrastructure in place to collect used water

The NEWater Technology

Multiple Barrier Process



Water for All: Conserve, Value, Enjoy

The NEWater Technology

Sampling and Monitoring Programme (SAMP) & Health Effects Study

- 295 water quality parameters, over and above the 100 specified by USEPA and 122 specified by WHO
- Surpasses USEPA and WHO standards
- Categories of parameters:
 - Physical, Inorganic, Organic etc..
- To date, more than 133,000 tests have been conducted on samples from treated used water and NEWater
- Health Effects Study carried out on mice and fish to test short and long term effects – no long term carcinogenic effect
- Internal Audit and External Audit Panels audit test results and operations



The NEWater Technology Comparison of Water Quality

Comparison of colour	mparison of colour Comparison of Suspended Particle					
WHO Standards		WHO Standards				
Rainwater		Rainwater				
Local Reservoir Water		Local Reservoir Water				
PUB Tap Water		PUB Tap Water				
NEWater		NEWater				
Comparison of level of org	anic substances	Comparison of bacteria c	Comparison of bacteria count			
WHO Standards	No Requirement	WHO Standards				
Rainwater		Rainwater	Not Detected			
Local Reservoir Water		Local Reservoir Water				
PUB Tap Water		PUB Tap Water	Not Detected			
NEWater		NEWater	Not Delected			
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The NEWater Technology

Comparison of Water Quality

Water Quality Parameters	Local Reservoir Water	PUB Tap water	NEWater	USEPA / WHO Standards
Turbidity [NTU]	0.5 - 11	< 0.1	< 0.1	5
Total Dissolved Solids [mg/l]	117 - 154	149.5	48.5	500
Lead [mg/l]	< 0.013	0.002	< 0.0005 to	0.01
			0.002	
Mercury [mg/l]	<0.00003	<0.00003	<0.00003	0.001
Hormones (Synthetic & Natural) [µg/l]	ND	ND	ND	Not Specified
PCBs [µg/l]	ND	ND	ND	0.5
Dioxin [pg/l]	ND	ND	ND	30
Total Organic Carbon [mg/l]	2.6 – 6.2	1.9 – 3.5	<0.1	Not Specified
Total Coliform [cfu/100 ml]	3 - 967	ND	ND	ND
Enterovirus	ND	ND	ND	ND
		ND Not Datastad		

ND – Not Detected

Water for All: Conserve, Value, Enjoy

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Gaining Public Acceptance

Communicating Effectively

Good Branding
"NEWater"



- Choice of words
 - "Used Water" vs "Wastewater";
 - "Water Reclamation" vs "Sewage Treatment"
- Engaging the Media
 - Briefings and visits to NEWater demo plant
 - Media familiarisation trip to USA
 - Documentary 'Thirsting for new sources' on national TV



Gaining Public Acceptance

Spreading the Message

• Political Leaders Lead by Example







• Endorsement by water experts

Branding and Providing Samples



Public Education





So NEWater or New Water?

- Cost-recovery principle
- Started at S\$1.30/m3 in 2003
 - Includes cost of production + transmission
- Important to consider relative cost, rather than just looking at absolute cost
 - Vs desalination
 - Vs tapping groundwater
 - Vs massive water diversion projects
- The option of PPP
- Looking forward, membranes will become more advanced, cost will come down



Concluding Remarks

Key Takeaways



"... the elixir of life and in this case, Singapore's own special brand: NEWater" – Ban Ki-Moon, United Nations Secretary-General

- NEWater as a concept is not new, and can be replicated
- NEWater is a safe, sustainable and viable source of water
- NEWater future-proofs Singapore's water needs
- NEWater's energy needs are less than that of desalination
- NEWater requires political leadership and public acceptance

Thank You



Bringing the world together to share and co-create innovative water solutions



Learn more about Water Recycling at SIWW! 1-5 June 2014

