

Public Health and Recycling

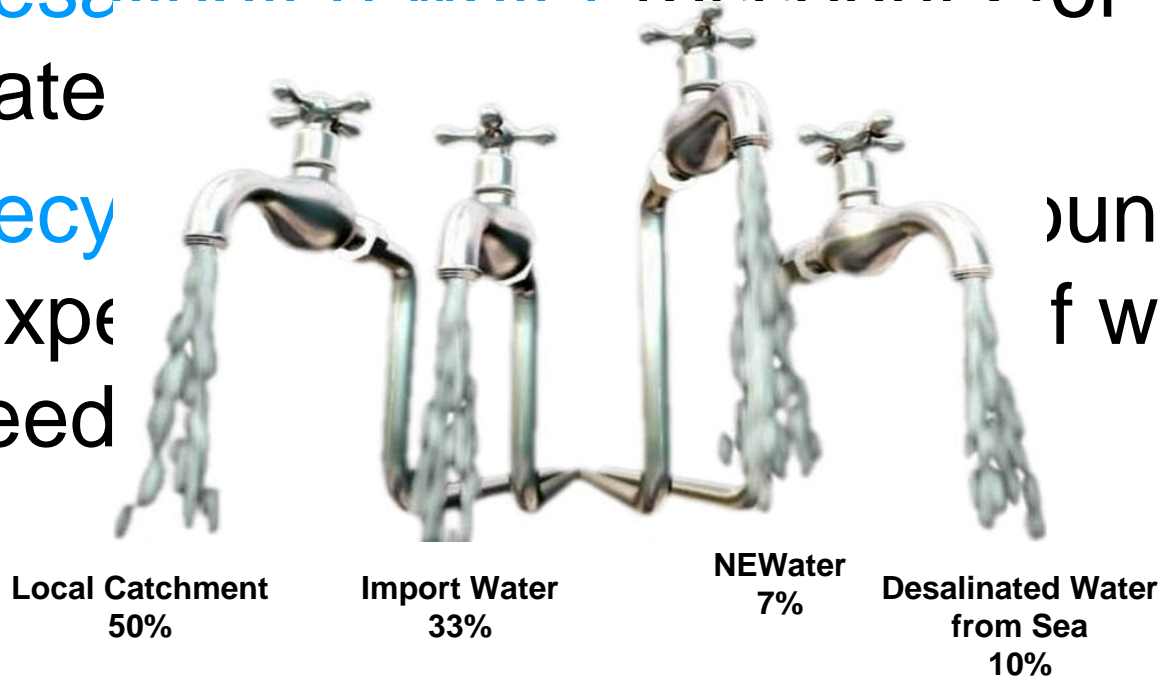
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The Tuas Desalination Process

- **Sea water intake**
- **Pre-treatment**
- **Reverse Osmosis** (including boron removal)
- **Potablisation**
- **Storage and Transfer**

Singapore – The Four National Taps

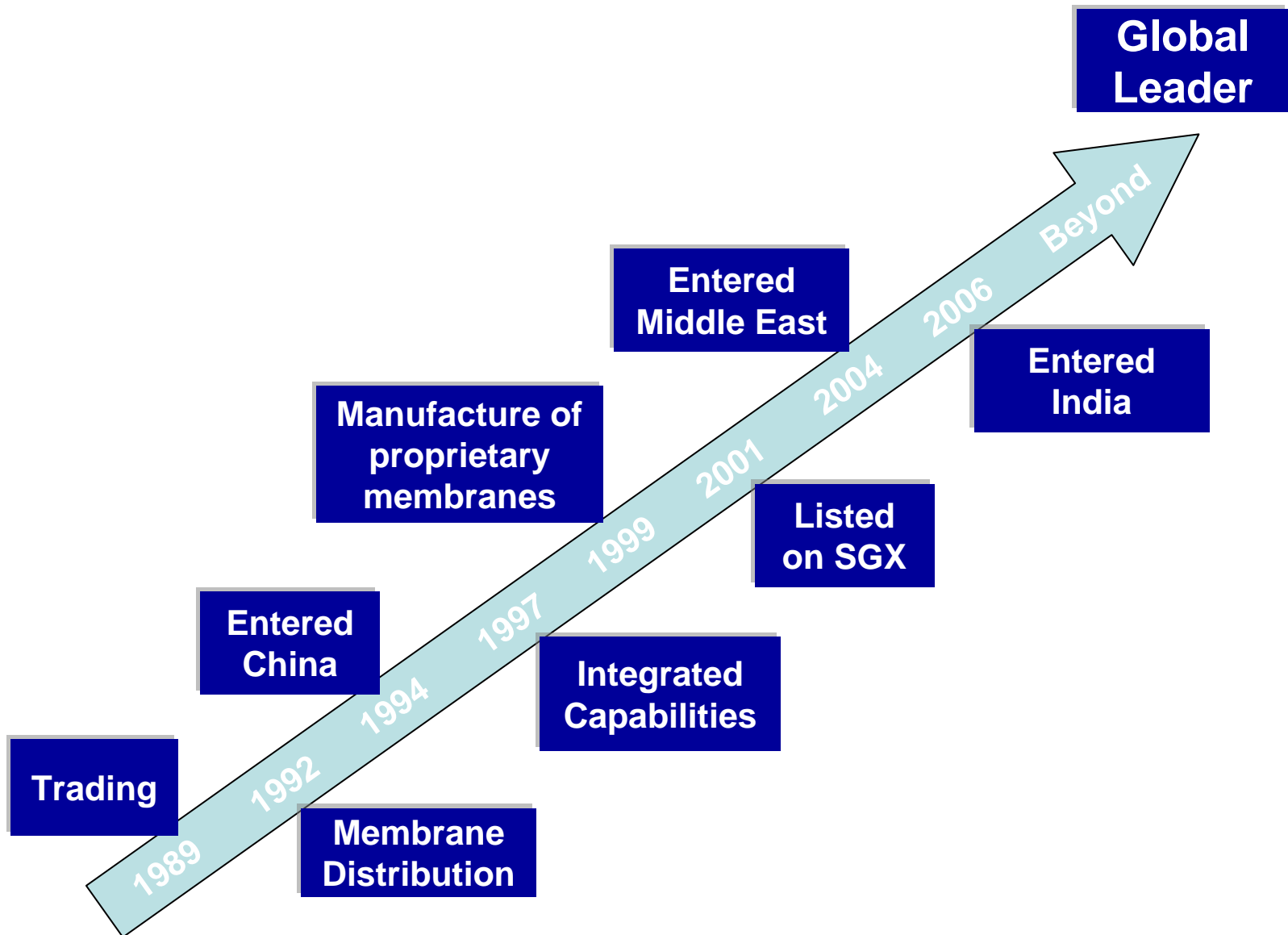
- **Local catchments** (Constitutes 50% of water needs)
- **Imported water** from Malaysia (Constitutes 33% of water needs)
- **Desalinated water** (accounts for 10% of water)
- **Recycled water** (accounts for 7% of water)



Hyflux – At a Glance

- **Hyflux has built several water treatment facilities worldwide producing over 300 million cubic metres of potable and industrial water per year.**
- **In water desalination, Hyflux is considered to be one of the top companies.**
- **Listed on Singapore Stock Exchange with current market capitalization of over US\$1 billion.**
- **Employs over 800 Staff in Singapore,**

Growth of Hyflux



Clean Water Alternatives

- Water Recycling

- Recycles treated wastewater for onward sale and distribution to end-users.

- Water Supply Treatment

- Treats raw water drawn from lakes and rivers for domestic or industrial consumption.

- Desalination

Tuas Desalination Plant

- In Singapore, Hyflux has built (and currently operates) Tuas, the largest seawater desalination plant in Asia.



Tuas Project – Success Story

- Provide alternative viable source of clean water for Singapore
- Value for Money
 - Lowest SWRO desalinated water price in the world.
 - Successful completion: on budget and ahead of schedule.
- Shift price & timing risk to private sector
 - Construction & operating cost over-runs borne by private sector.
- Improve local skill-set
 - First project financing for Hyflux and PUB.
 - First truly limited recourse financing by lenders in Singapore.
- Increase private sector involvement
 - Construction sub-contractors.
 - 20-year O&M contract.
- Encourage innovation
 - No restriction on technology employed.

Water Recycling in Singapore – “NEWater”

- NEWater is a **reliable source of water** that is not dependent on rainfall or climate
- The NEWater process **replicates the earth's natural hydrological cycle or water cycle**. However the demands of Singaporean's water use far out-strip the natural hydrological cycle that produces moisture. The **NEWater process helps speed up nature's water cycle** by reclaiming water quickly and safely
- NEWater is treated used water that has

Water Recycling in Singapore (cont'd)

- NEWater, a source of raw water to supplement Singapore's water supply, looks to provide a sustainable water supply for the future, helping to ensure that future generations are well taken care of.
- NEWater is used in industries for non-potable uses, freeing up large amounts of potable water for other uses.
- NEWater could be mixed and blended with reservoir water and then undergo conventional water treatment to produce drinking water (Planned Indirect Potable

Opportunities for Usage of Recycled Water

- High Grade industrial water users – reduced production cost for further treating NEWater
- Quality improvement programs within the industries for increasing the use of recycled water
- Indirect potable water usage – blending recycled water with rain water collected in reservoirs
- Industrial users for NEWater
 - Wafer Fabrication Industry
 - Electrical Industry

NEWater – Treatment Scheme



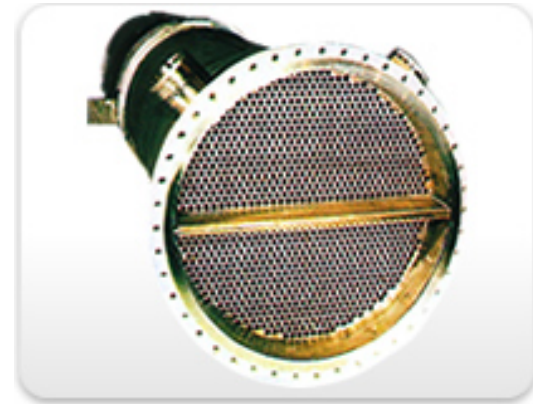
Membrane Products Used in Water Recycling

**Proprietary Hollow Fiber UF
membrane**



Pilot Plants for
our proprietary
Submerged Membrane

**Submerged
Membrane**



**Stainless Steel
Membrane**

NEWater Factories in Singapore

Location	Kranji	Bedok	Seletar	Ulu Pandan
Capacity (m ³ /day)	40,000	32,000	24,000	116,000
Operation	Jan 2003	Jan 2003	Jan 2004	End 2006
Contractor	US Filter	Hydrochem (Hyflux)	Hydrochem (Hyflux)	Keppel Integrated Engineering

Bedok NEWater Plant

- Singapore's first NEWater (High Grade Industrial Quality Water) Plant
- Feed Water: Secondary treated sewage water
- Product water: HGIW grade water
- 32,000 m³/day plant capacity
- Commissioned in Nov 2002
- System supplier: Hyflux

One of the tourist attractions of Singapore!!!



Seletar NEWater Factory

- Feed water: Secondary treated sewage water
- Product water: HGIW grade water
- 24,000 m³/day plant capacity



- Hyflux's *Kristal300™*



"The Seletar NEWater plant sets the standard for water recycling projects around the world?"
- Judges' verdict at the Global Water Awards 2005

- Commissioned in Dec 2003

Industrial Water Recycling Plant



Ultrafiltration System



UF / RO Feed Tank



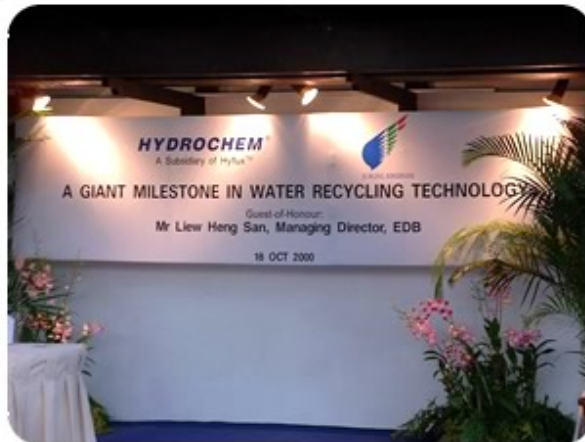
Treated Water for Penguins



Reverse Osmosis System



- One of Singapore's main tourist attractions - **Jurong Bird Park** uses recycled water.
- Treated Industrial Wastewater is recycled to a high-purity level for 'water-quality sensitive' fauna such as penguins.
- Plant opened in **October 2000**.



A Giant Milestone in Water Recycling Technology
Brought to you by Hydrochem (S) Pte Ltd
18 October 2000

Recycling Practices in Singapore

- Identify opportunities for usage of recycled water (NEWater)
- Social awareness through Government support & Publicity
- Investments in Research & Development
- Encourage use of recycled water
- Advanced and foolproof technologies
- Enforce strict trade effluent discharge standards
- Public Private Partnership approach

Social Awareness

- Form an **Expert Panel** - a panel of experts from all over the world to study all aspects of NEWater and certification of water quality by the panel over a period of 2 years.
 - *“NEWater is considered safe for potable use, based on the comprehensive physical, chemical and microbiological analysis of NEWater conducted over two years. The quality of NEWater consistently meets the latest requirements of the U.S Environmental Protection Agency’s National Primary and Secondary Drinking Water Standards and World Health Organization's Drinking Water Quality Guidelines.”* – extracted from Singapore Water Reclamation Study, Expert Panel Review & Findings, June 2002



Raising Social Awareness

- Use water wisely
 - educate the public.
 - price water to reflect its strategic importance and scarcity value.
 - make water-saving devices mandatory.
 - encourage water-efficient houses and buildings.
 - conduct water audits for large users.
 - encourage alternative sources such as NEWater, industrial water or seawater.
 - legislative measures to deter water wastage and unauthorized water usage.

For more information

- NEWater - http://www.pub.gov.sg/NEWater_files/index.html
- Hyflux - www.hyflux.com
- **Ministry of the Environment and Water Resources, Singapore -**
<http://app.mewr.gov.sg/home.asp?id=M1>
- **Singapore Water Reclamation Study Expert Panel Review And Findings –**
http://www.pub.gov.sg/NEWater_files/down