SSE1201/GES1017

BUILDING A DYNAMIC SINGAPORE – ROLE OF ENGINEERS

The Singapore Water Story

Division of Engineering & Technology Management
NUS Faculty of Engineering

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NUS National University of Singapore

The Vision :
Singapore Achieving Water Self-sufficiency

"I never believed it would be impossible forever; I thought sometime, some place, technology will be found that would make it nearly possible."

The Architect of Singapore's Water Story -

Mr Lee Kuan Yew, first Prime Minister of Singapore.

Four decades ago, Mr Lee issued a challenge to the country's engineers. "Suppose we could capture every drop of rain in Singapore, could we become self-sufficient?" Lee asked of the country's national water agency PUB.

Sessions on Singapore Water Story

Week 7 - 14 Sep The SG Water story

A/P Tan Kim Seng

Week 8 – 28 Sep The Marina Barrage – Engineering

A/P Vladan Babovic

Week 9 – 5 Oct Visit to Marina Barrage

A/P Tan Kim Seng

This Session

- Overview of Past and Present
- Engineering Leadership
- The 4 National Taps
- Closing the Water Loop
- Ground Breaking Projects
  - NEWater
  - Deep Tunnel Sewerage System
  - Marina Barrage
  - Desalination
- Marina Barrage Visit
- Individual Homework#3 Assignment

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Innovation in Water | SINGAPORE

- Singapore - a small island state - *"Singapore … at the **170th** position among a list of 190 countries in terms of **freshwater availability**." UN World Water Development Report 2002*
- shortage of land and water
- only 2 sources of water for more than four decades :
  local catchments and imported water
- major challenges :
  water shortages
  flooding
  pollution problems.
- inspired by these challenges to innovate and develop capabilities in water research and development, turning our vulnerability into a strength. https://www.youtube.com/watch?v=ZoPhFTLNY2Q

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Singapore's Water System in Review

- A delicate balancing act :

  1) maintain its **imported water supply** from Malaysia, while ceaselessly **exploring alternative sources** through technology and public mobilisation.

  2) balance **land requirements** for **water catchments** with competing needs for **housing and industry**. Demand is also calibrated.

- Water is **priced** to reflect not just the high cost of storage, processing and distribution, but also its strategic value. **Public education and community engagement** were also used to manage demand.
- Singapore achieved a paradigm shift in its water management by **using new technologies**, such as membranes and desalination, new drainage and flood control systems, as well as **innovations** such as building reservoirs in urban areas.

Overview of Past and Present National Water Supply

1960s

Local Catchments

Imported Water

Today

Local Catchments (45%)

Imported Water

NEWater (30%)

Desalination (25%)

Leadership – Mr Lee Kuan Yew

Contributions to the Singapore water story

1. Made water a top priority since Singapore's independence. *"Every other policy had to bend at the knees for our water survival."*
2. Ensured that the water agreements were legally written into Malaysia's constitution.
3. Water Planning unit in the PMO drafted Singapore's first *Water Master Plan* in 1972
4. Initiated the cleaning up of the Singapore River in the 70s-80s
5. Invested heavily and paved the way for high quality drinking water, NEWater
6. Envisioned the Marina Barrage in the 80s which became a reality in 2008

Engineering Leadership – Mr Lee Ek Tieng

"make fishing and other recreational activities possible along the Singapore River and Kallang Basin in 10 years' time."

Mr Lee Kuan Yew's public challenge to him and his team in 1977"

- A Former top civil servant and his team that made the Singapore River pristine
- A civil engineer by training, he commissioned a study in 1999 as PUB chairman that gave birth to NEWater, the high-quality recycled water that now meets 30 per cent of Singapore's total water demand.
- His' biggest worry then was : a) if PUB has sufficient political backing for eg. moving out the hawkers and squatters b) the full cooperation of other government agencies.

Engineering Leadership – Mr Tan Gee Paw

- Chairman of PUB since 2001, >40 years in public service
- B.Eng (Civil), M. Sc in Systems Engineering
- led teams that cleaned up the Kallang Basin, built reservoirs, and solved Singapore's sewage problem.
- On 16th Sep 2015, Mr Tan was awarded the President's Science and Technology Medal for his work in water sustainability. (IES) Lifetime Engineering Achievement Award recipient.
- drew up the master plan to clean the Singapore River, helped to diversify the country's water sources and oversaw the development of Newater, Singapore's brand of reclaimed water.
- "No engineer succeeds by working alone, so this award brings back memories of my five decades as an engineer working with some 300, 400 colleagues."
- A project close to his heart was the opening of the Bedok Newater plant in 2003. "It was the first time we were able to close the water loop. The technology was quite well-established, but putting the parts together was an engineering challenge.

Engineering Leadership – Mr Harry Seah, CTO, PUB

- One of the first two engineers sent to USA
- current Chief Technology Officer, PUB
- coordinates the research and development (R&D) initiatives, and support PUB's mission through technology, innovation, industry partnership, expertise development and introduction of best practices.
- Director of technology development, EWI to spearhead the development of the environment and water industry
- led the NEWater Programme in Singapore since 1998. pilot testing of three different Membrane Bioreactor systems in Singapore and the Variable Salinity Plant.

What PUB does

- our national water agency set up in May 1963
- responsible for the collection and management of raw water, production and supply/distribution of drinking water, and collection, treatment and reclamation of used water.

Environment and Water Industry Programme Office

- a multi-government agency set up in 2006 to spearhead the development of the environment and water industry
- transforms Singapore into a Global Hydrohub supporting a vibrant water eco-system.
- believes that technology is the key to continued growth in the water industry and paves the way
- offers a variety of avenues to support research and development in water technologies. These range from research funding and PhD scholarships, to offering facilities for companies to test-bed potential breakthrough technologies and solutions.

Four National Taps

The water supply comprises

(1) local catchment water, 17, 2/3 to 90% of land area in Sinapore by 2060, Variable Salinity

(2) imported water, 2 agreements with Malaysia : expired Aug 2011, expiring 2061

(3) highly-purified reclaimed water known as NEWater, commission in 2003 in Bedok and Kranji, 55%

(4) desalinated water – Sep 2005 Singspring, 25% by 2060

Singapore's Principles of Integrated Water Management

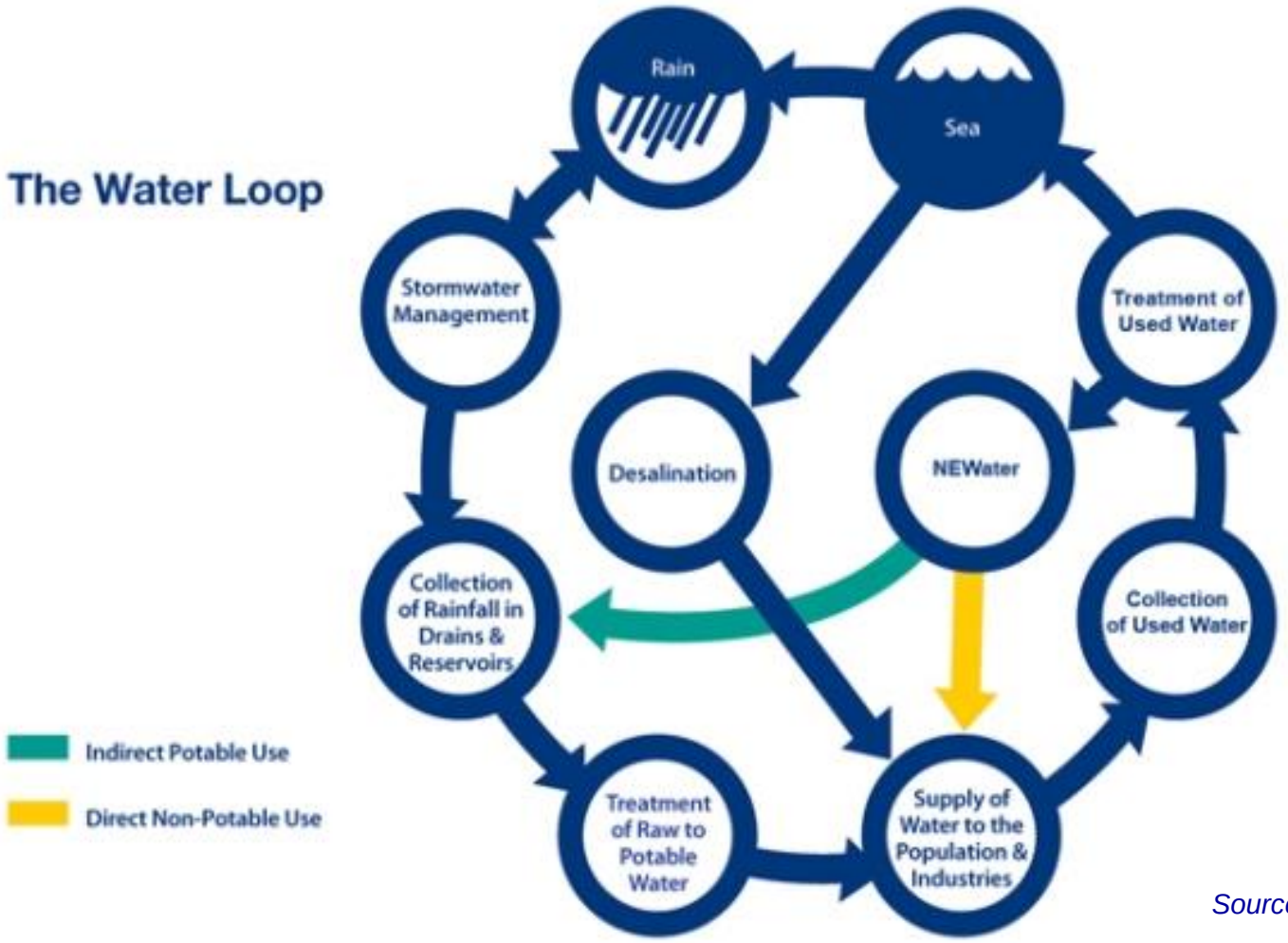
1) To capture every drop of rain that falls on Singapore
2) To collect every drop of used water
3) To recycle every drop of water more than once

1) from half to 2/3 and finally 90% catchment area & minimise runoff.

2) enables large scale water recycling to produce NEWater, DTSS, centralised superhighway for collection and treatment of used water

3) recycling creates multiplier effect as each drop used and reused many times over.

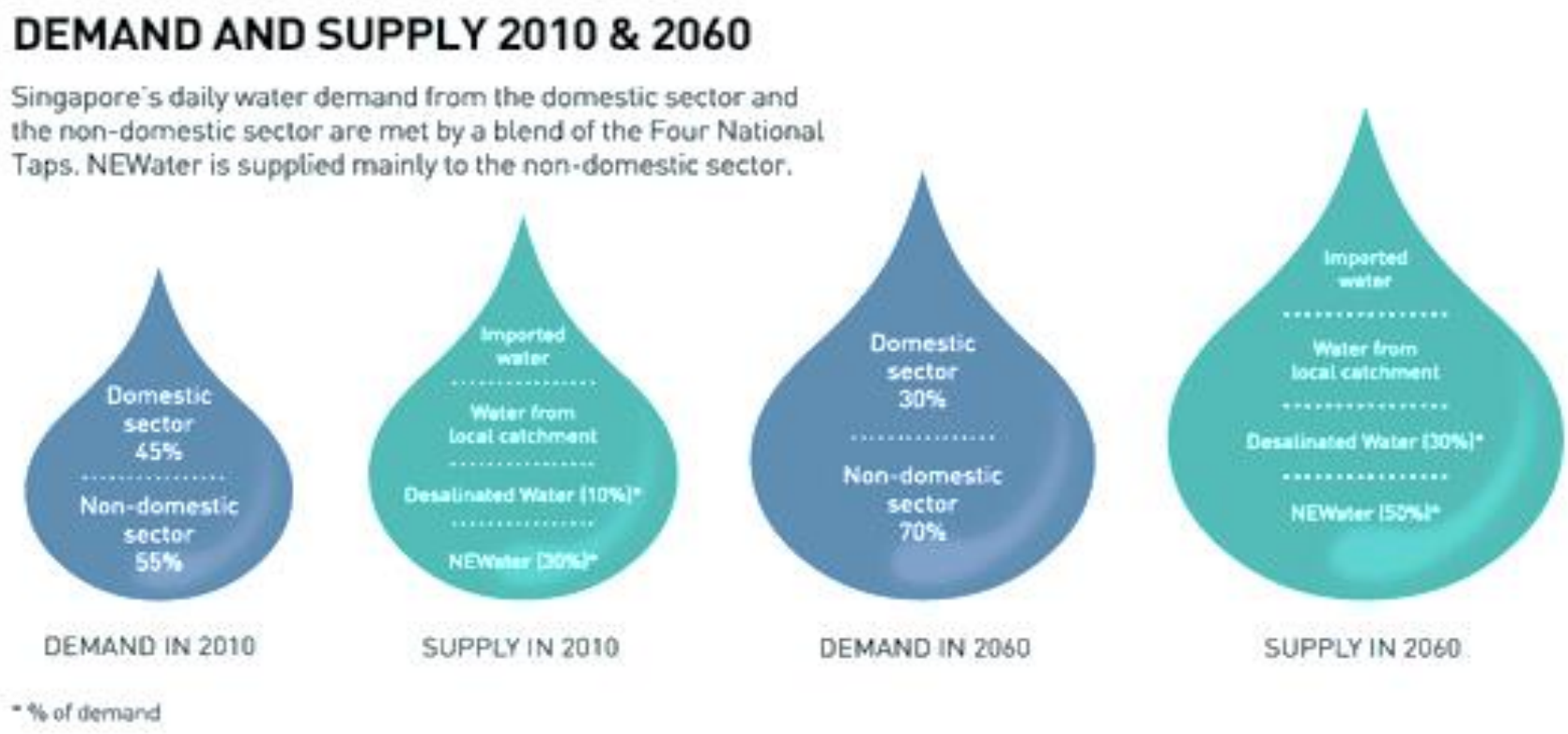
Closing the Water Loop



Source : PUB

Singapore's Water Strategy : Next 50 Years

The 4 National Taps& Beyond



Source : PUB

Major Milestones

Source : PUB

Engagement Programs and Platform

- Conserve, Value and Enjoy
- Engaging the Community – People, Public, Private)
- Singapore – Global Hydrohub, SIWW

Ground Breaking Projects

- NEWater
- Deep Tunnel Sewerage System
- Marina Barrage
- Desalination

Visit To Marina Barrage on 5th Oct 2016

Please assemble in front of Blk EA Lobby

At 12.50pm to board the bus which will take you to the Marina Barrage and back to NUS.

Duration : 1pm to 3 pm.

You are encouraged to ask questions relevant to the PUB and the Singapore Water Industry to prepare for your Homework 3.

As usual, we will be taking your attendance before boarding the bus.

Discussion

1. What were the challenges in the past and the success factors that led to the development of the 2 new national taps, namely, NEWater and Desalinated Water ?

Discussion

2. What was the role of engineers in fulfilling the objectives of NEWater project?

Discussion

3. How did PUB close the Water Loop and enable Integrated Water Resources Management in Singapore ?

Discussion

4. How did the government policy drive the innovation in water industry and ensure sustainability over the years?

Discussion

5. Can or should Singapore develop another national tap ? Why ?

Discussions (Bonus Questions)

1. What is your vision of Singapore Water Story in the next 50 years?
2. What are some essential non-engineering skills that engineers should develop for future challenges?
3. How does systems thinking help engineers in their discipline?

Homework 3 – Marina Barrage

To be uploaded to IVLE

Due on 16th October 2016 (Sunday)

After your visit to Marina Barrage on 5th Oct 2016

Homework 3 – Marina Barrage
Due on 16th October 2016 (Sunday)

1) Marina Lake is one of 17 man-made reservoirs in Singapore. These freshwater reservoirs form one of four national taps. What are the remaining 3 national taps? What are advantages and disadvantages associated with each of national taps?

2) Marina Barrage is a complex engineering structure which needs to fulfil several objectives simultaneously. What are the three most prominent benefits provided by the barrage

3) List three main ideas behind ABC (Active, Beautiful, Clean) Water programme?

Thank you