Climate Change & Managing Water Energy Carbon Nexus in Cities

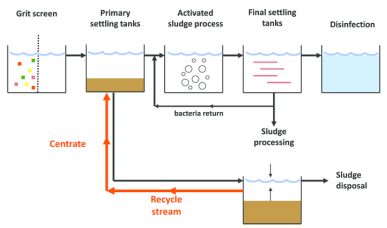
Panel Discussion
Seminar on "Sustainable Urban Development and Climate Change"
Asian Institute of Technology
28 January 2019

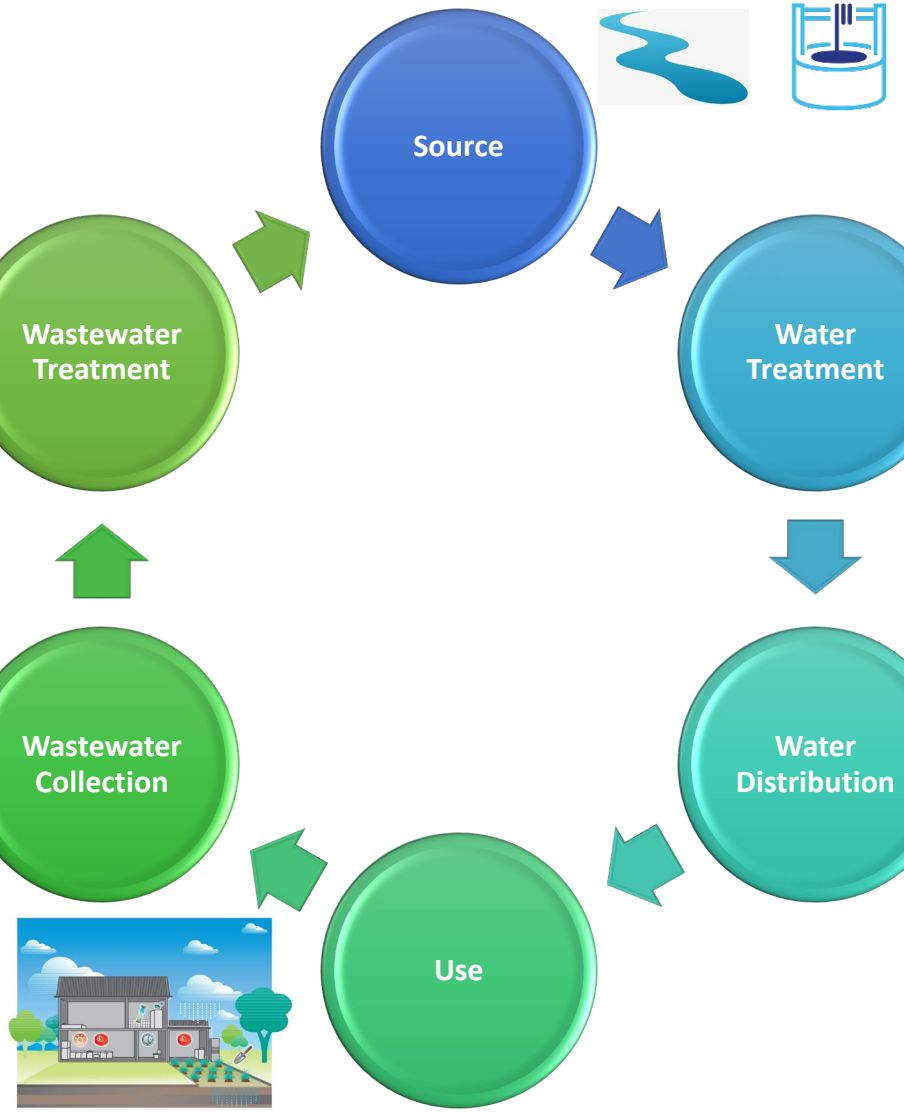
KOREA UNIVERSITY Graduate School of Energy and Environment

Department of Energy, Environment and Climate Change
School of Environment, Resources and Development

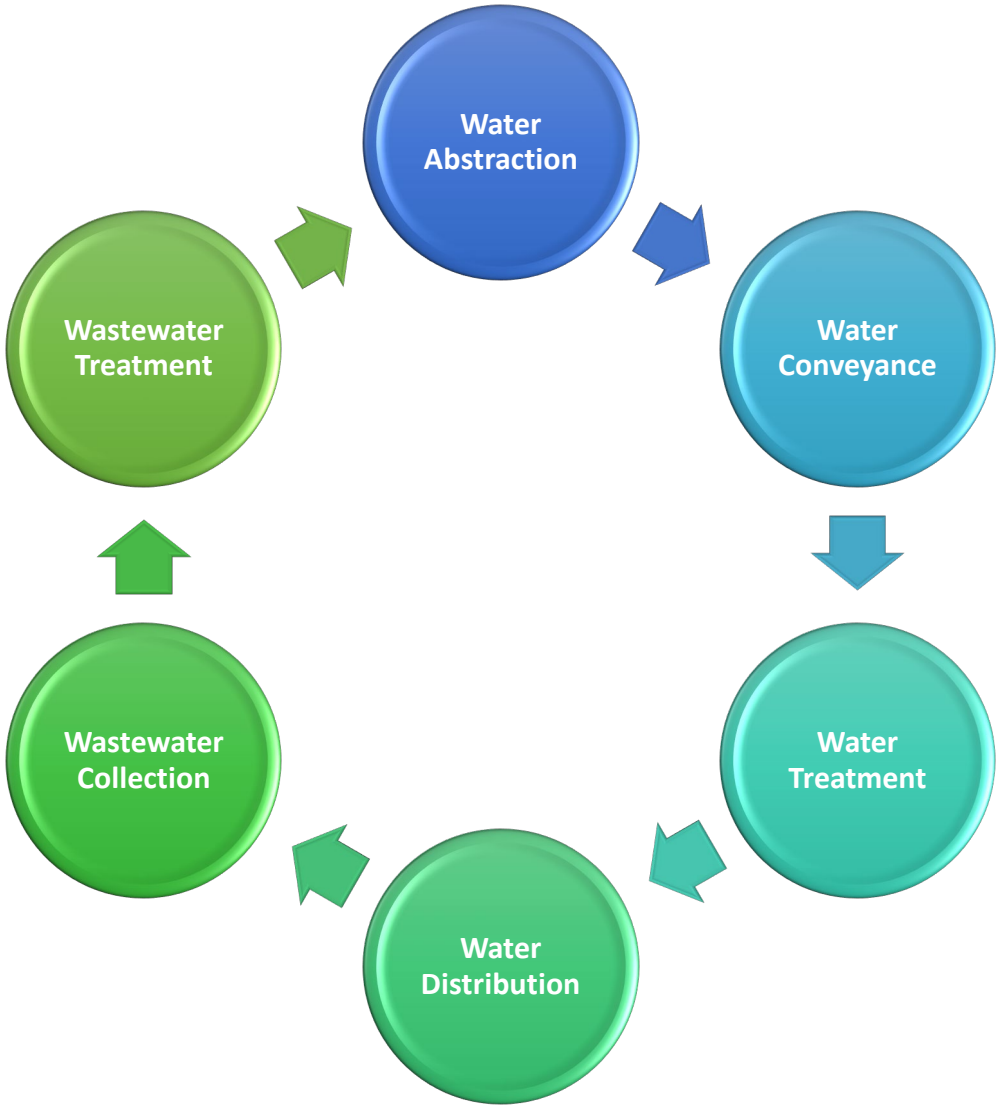
Sangam Shrestha
Associate Professor and Program Chair
Water Engineering and Management
Asian Institute of Technology

A Typical Urban Water System Cycle

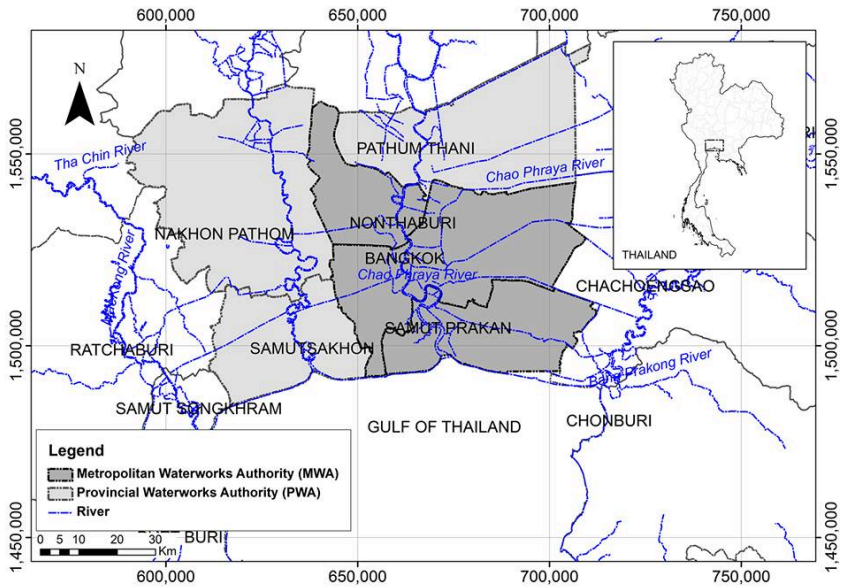




Energy Footprint (kWh/m^3) and Carbon Footprint (kg CO_2/m^3)



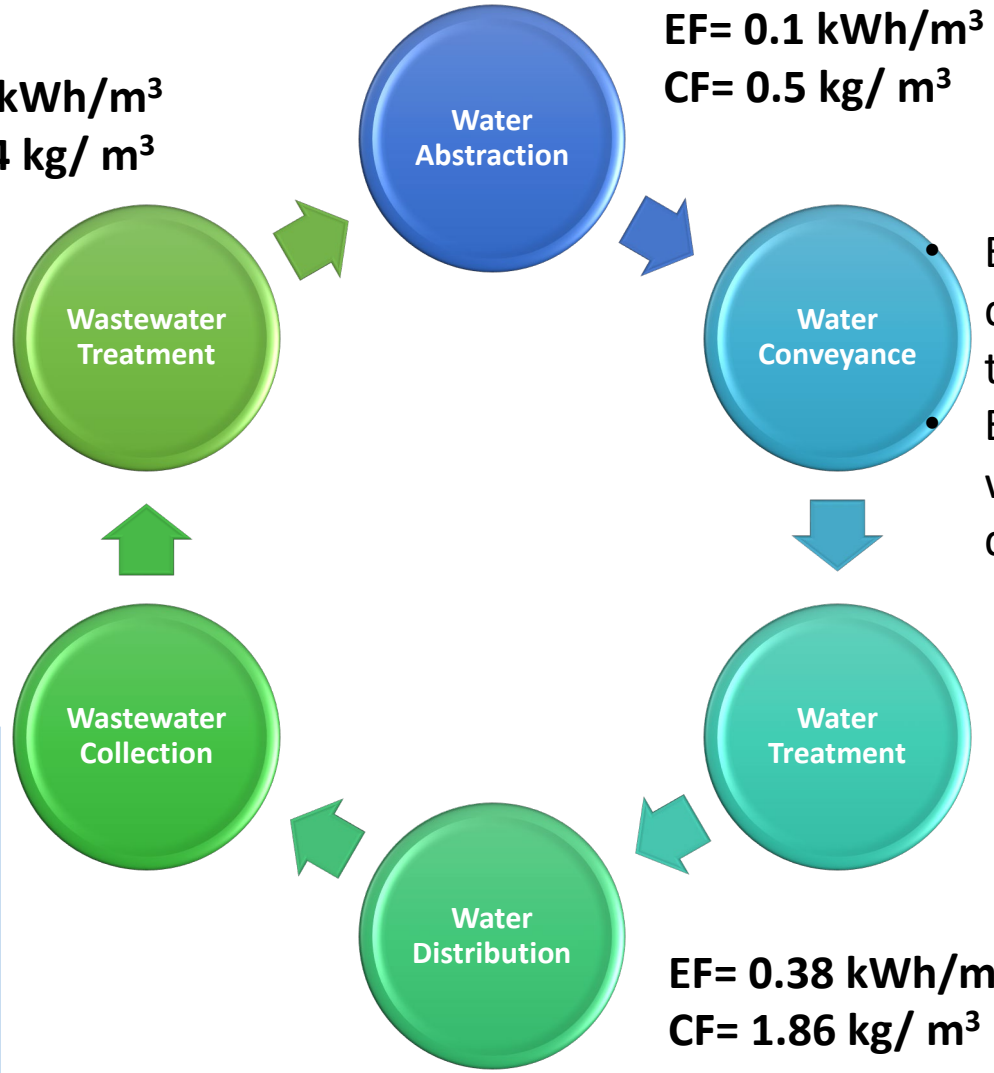
Energy Footprint (kWh/m^3) and Carbon Footprint (kg CO_2/m^3)



Bangkok Metropolitan Region, Thailand

- Cover total area of 7,761.50 km²
- Population: 10.5 million
- Management: Municipal Waterworks Authority (MWA) and Provincial Waterworks Authority (PWA)
- Piped systems established in 1909.

EF= 3.29 kWh/m^3
CF= 15.84 kg/ m^3



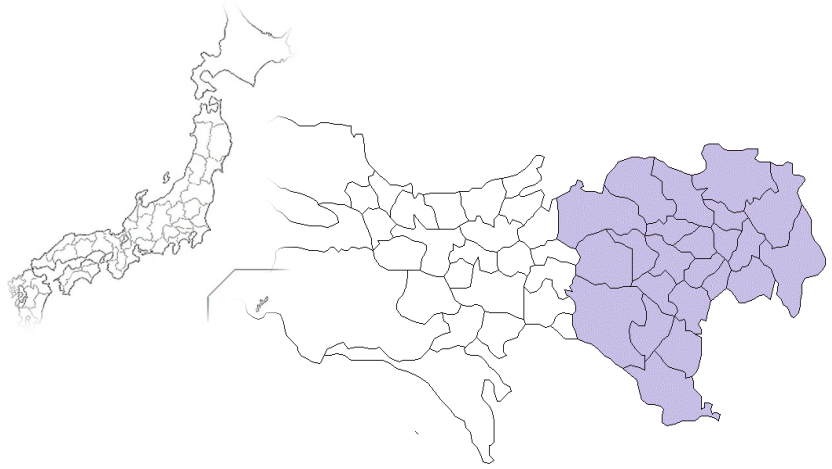
EF= 0.1 kWh/m^3
CF= 0.5 kg/ m^3

Energy use for drinking water treatment: 20%
Energy use for water transport & distribution: 80%

EF= 1.1 kWh/m^3
CF= 5.3 kg/ m^3

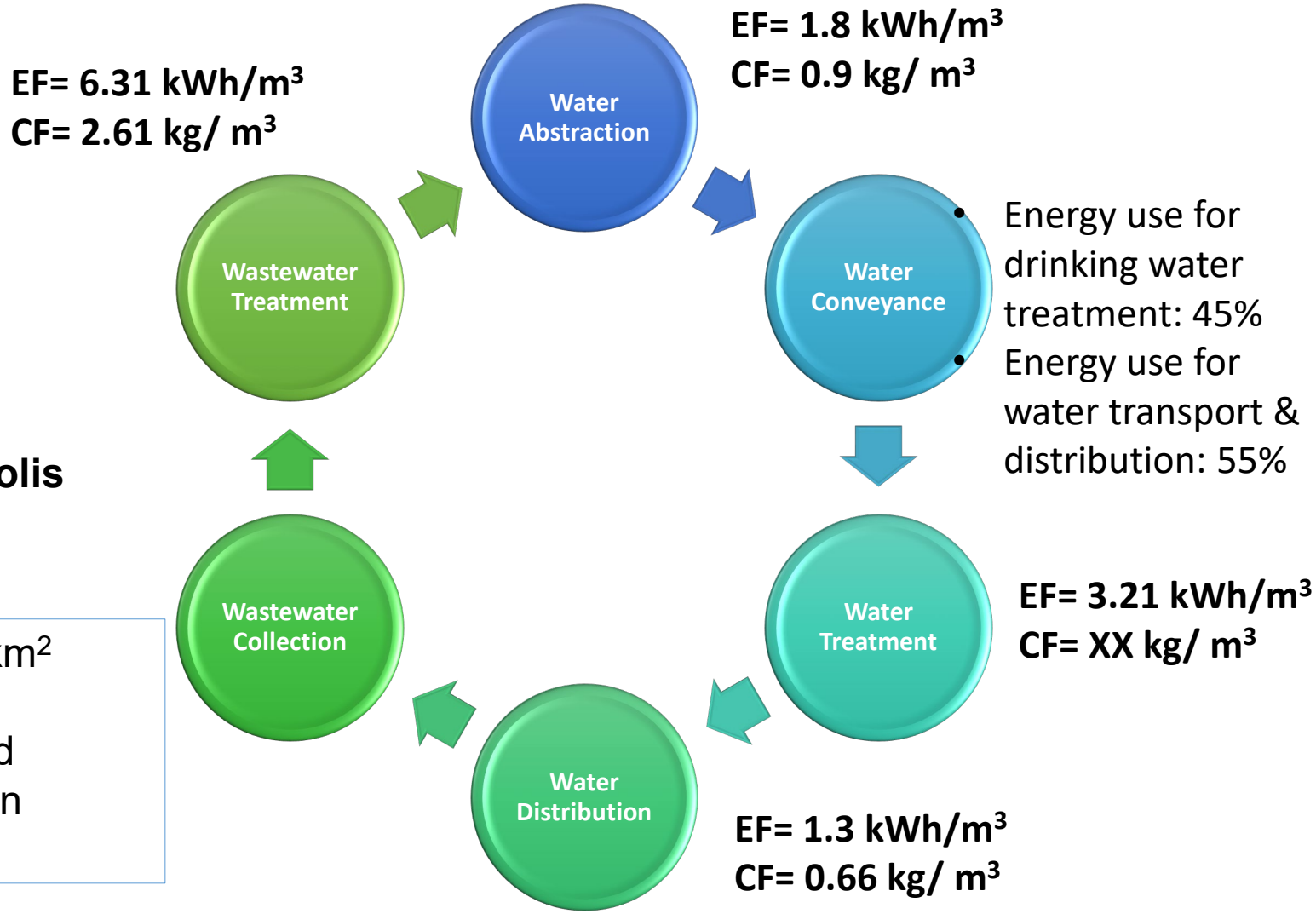
EF= 0.38 kWh/m^3
CF= 1.86 kg/ m^3

Energy Footprint (kWh/m^3) and Carbon Footprint (kg CO_2/m^3)



Greater Tokyo Area and Tokyo Metropolis (23 special wards)

- Cover total area of total area of 621.81 km^2
- Population: 13 million
- Management: Bureau of Waterworks and Bureau of Sewerage - Tokyo Metropolitan Government.



Bangkok vs Tokyo

	Bangkok	Tokyo	Bangkok	Tokyo
Water Abstraction			Surface water (Chao Phraya river and Mae Klong river)	Surface water (Edogawa, Tonegawa, Tamagawa, Sagamigawa)
Energy footprint (kWh/m^3)	0.1	1.8		
Carbon footprint (kg/m^3)	0.5	0.9		
Water Treatment			Rapid/Slow sand filtration, Advanced water treatment	Rapid/Slow sand filtration, Partially Advanced water treatment, Membrane filtration
Energy footprint (kWh/m^3)	1.1	3.21		
Carbon footprint (kg/m^3)	5.3	na		
Water Distribution			Piped network (NRW:24%)	Piped network (NRW:8%)
Energy footprint (kWh/m^3)	0.38	1.3		
Carbon footprint (kg/m^3)	1.86	0.66		
Wastewater Treatment			Activated Sludge System; No re-use	Activated Sludge System, semi advanced, advanced wastewater process ; Resource and energy are recovered
Energy footprint (kWh/m^3)	3.29	6.31		
Carbon footprint (kg/m^3)	15.84	2.61		

Conclusions & Recommendations

- The energy and carbon footprints of the urban water system depend on multiple characteristics, which include the nature of water sources, transportation distances, nature/extent of infrastructures, choice of technologies, water losses and management practices.

- Technological and policy interventions can reduce the energy and carbon footprints in urban water systems:
  - for e.g. In MWA Bangkok, if service pressure increased for 7.5m to 18m using Pressure Reducing Valves (PRVs) energy consumption is reduced by 32% (from 0.68 to 0.46 kWh/m^3) (Anusart, K. 2016)
  - Improving overall pump and motor efficiency up to 70% provides energy conservation 1-14%.

- City governments and water utilities should place emphasise on water demand management, leakage detection techniques, prompt repair of leakage and rehabilitation of old infrastructure.

Bibliography

- Dhakal, S., Shrestha, S., Shrestha, A., Kansal, A., and Kaneko, S. (2015). Towards a better water-energy-carbon nexus in cities (APN Global Change Perspectives Policy Brief No. LCD-01). Kobe: Asia-Pacific Network for Global Change Research. (Link: http://www.apn-gcr.org/2015/10/26/policy-brief-towards-a-better-water-energy-carbon-nexus-in-cities-lcd-01/)

- Shrestha, S., Dhakal, S., Shrestha, A., Kansal, A., & Kaneko, S. (2015). Water-Energy-Carbon Nexus in Cities: Cases from Bangkok, New Delhi, Tokyo. Presented at the Workshop on 'Water Energy Food Nexus: International Cooperation and Technology Transfer', 18 March 2015, Paris.

- Shrestha, A., Dhakal, S., Shrestha, S., Kansal, A., & Kaneko, S. (2014). Understanding and Quantifying the Water, Energy and Carbon Nexus for Low Carbon Development in Asian Cities. Presented at the APN's Low Carbon Initiative (LCI) session in 3rd Annual Meeting of Low Carbon Asia Research Network, 24-26 November 2014, Indonesia.

Thank you!

sangam@ait.ac.th