Annex A

Water Efficiency Awards 2017
Fact Sheet

Qualifying Criteria & Evaluation

The Water Efficiency Awards (WEA) recognises the most water efficient premises for each sector. This means their Water Efficiency Index (WEI) falls within the top 10th percentile value based on the range of WEI in the buildings sector (i.e. having the lowest WEI) or they have the highest recycling rates in the industries sector.

The WEI serves as the performance indicator for water efficiency, and refers to the amount of water used per business activity indicator (BAI).

$$WEI = Total\ amount\ of\ water\ consumed / business\ activity\ indicator$$

**Business activity indicator – A measure of business activity that takes into account the business operations of the water user*.

All qualifying award winners must be certified under Water Efficient Building Certification (Basic) programme, and are the best performers within their sectors.

(A) Commercial & Industries Sector

From the Water Efficiency Management Plan (WEMP) submissions (mandatory and voluntary), PUB selects the best water efficiency performers based on their Water Efficiency Index (WEI) for buildings and recycling rates for industries.

For office buildings, the WEI is computed using the annual water consumption of the office building divided by the gross floor area of the office building. It reflects the amount of water used for its operations for each gross floor area annually.

For hotels, the WEI is computed using the annual water consumption of the hotel divided by number of occupied guestrooms in the same year. It reflects the amount of water the hotel uses for its operations per occupied room daily.

For Retail, two WEIs are computed as follows:

a) the annual consumption (excluding toilets' consumption) divided by the gross floor area of the retail mall
b) the annual toilets' consumption of the retail mall divided by the number of shoppers and number of days in the same year.

This reflects the amount of water the retail mall uses for its operations for each gross floor area annually, and the amount of water used per shopper daily.

For wafer fabrication plants, recycling rate is computed using the total recycled water divided by the summation of the total supplied water and recycled water.

PUB also compares their performance with overseas examples, where data is available, and assesses them and their water efficiency by business sectors eg. office, hotel, etc.

Water Efficiency Index (WEI) / Recycling Rates			
Sector	**Classification**	**Best Performers (Top 10th percentile)**	**Average Performers (Median)**
Office	With cooling towers	0.80 m^3/m^2/year	1.13 m^3/m^2/year
	Without cooling tower	0.39 m^3/m^2/year	0.59 m^3/m^2/year
Hotels	With cooling towers	0.58 m^3/occupied guest room/day	0.88 m^3/occupied guest rooms/day
	Without cooling tower	0.54 m^3/occupied guest room/day .	0.78 m^3/occupied guest rooms/day
Retail		0.68 m^3/m^2/year	1.3 m^3/m^2/year
		1.6 L/person/day	3.05 L/person/day
Wafer Fabrication		60% recycling rate	45% recycling rate

(B) Schools and Estates

Based on schools' water consumption and school population provided by MOE in 2016, the WEI for schools are computed. The WEI is computed using the annual water consumption of the school divided by the population of people (teachers, students, etc) in the school and the number of days in the same year. It reflects the amount of water the school uses per person daily. The best water efficiency performers, capped at 5 schools, are recommended for the award.

Water Efficiency Index (WEI) - Litres/person/day		
Sector	**Best Performers (Top 10th percentile)**	**Average Performers (Median)**
Primary School	7.3 Litres/person/day	11.5 Litres/person/day
Secondary School	9.0 Litres/person/day	13.4 Litres/person/day
Junior College	9.1 Litres/person/day	18.3 Litres/person/day

Based on the water consumption and number of residential units in 2016, the WEI for the Town Councils are computed. The WEI is computed using the annual water consumption of the estate divided by the number of residential units in the estate and the number of months in the same year. It reflects the amount of water used for its estate operation per residential unit monthly. The best water efficiency performers are recommended.

Water Efficiency Index (WEI) - m^3 per residential unit per month		
Sector	**Best Performers (Top 10th percentile)**	**Average Performers (Median)**
Town Councils	0.9 m^3 per residential unit per month	1.1 m^3 per residential unit per month

Award Recipients

There are a total of 27 recipients from seven categories in this year's WEA.

1. Office
   - 1.1 Asia Square Tower 2
   - 1.2 AXA Tower
   - 1.3 OUE Downtown

2. Retail
   - 2.1 Big Box
   - 2.2 Compass One
   - 2.3 Junction 8 Shopping Centre
   - 2.4 Parkway Parade

3. Hotel
   - 3.1 Carlton City Hotel Singapore
   - 3.2 Grand Mercure Singapore Roxy
   - 3.3 Marina Mandarin Singapore
   - 3.4 The Elizabeth Hotel
   - 3.5 V Hotel Lavender

4. Wafer Fabrication
   - 4.1 United Microelectronics Corporation (Singapore Branch)

5. Refinery
   - 5.1 Singapore Refining Company Pte Ltd

6. School (Primary/Secondary/Junior College)
   - 6.1 Chung Cheng High School (Main)
   - 6.2 Clementi Primary School
   - 6.3 Fajar Secondary School
   - 6.4 Geylang Methodist School (Secondary)
   - 6.5 Greenview Secondary School
   - 6.6 Holy Innocents' Primary School
   - 6.7 Meridian Junior College
   - 6.8 Nan Hua Primary School
   - 6.9 Qifa Primary School
   - 6.10 Tampines Secondary School
   - 6.11 Yangzheng Primary School

7. Estate
   - 7.1 Jalan Besar Town Council
   - 7.2 Tangjong Pagar Town Council

Note

- The recipients are listed in alphabetical order.

Media visit award recipient profiles

Carlton City Hotel and the Singapore Refining Company (SRC) are amongst the 27 recipients who have been honoured with the Water Efficiency Award this year.

Carlton City Hotel Singapore --- Hospitable and Water Efficient

Located in the central business district, Carlton City Hotel Singapore is a 29-storey hotel with 386 guest rooms. In the last two years, Carlton City has seen a drop of about 4,233m^3 in water consumption. The hotel is certified Water Efficient Building (Basic) by PUB. The hotel also recovers condensate water from the Air Handling Units(AHUs) and reuses it for the cooling towers. Its remote monitoring system, coupled with a prompt maintenance regime, provides good preventive measures for possible water wastage. Guests are also encouraged to avoid frequent change of linens and towels thus saving water used for laundry. Currently, their WEI index at 0.45 m^3/occupied guest room/day is within the top 10^{th} percentile.

Mr Darren Ware, General Manager of Carlton City Hotel Singapore, affirmed, "As a Green Mark Platinum hotel, we strive to uphold environmentally friendly practices that will help conserve our limited precious water. We also encourage our guests to be part of our initiatives to help in water conservation."

Singapore Refining Company -- Onsite water recycling cuts water use

Located on Jurong Island, SRC operates a refinery that is capable of processing 290,000 barrels of crude oil daily. The refinery produces mainly fuel products which are distributed to domestic markets and overseas export markets.

Following a water audit that was carried out to identify streams for recycling, SRC decided to build an on-site effluent treatment recycling plant. The plant treats industrial used water from their processes that would typically be discharged to the sea, to NEWater standards through ceramic microfiltration and reverse osmosis, removing suspended solids, oil, grease and other contaminants from the treated used water. The recycled water is then reused in processes within SRC.

The plant currently operates at 2000m^3/day, and can meet approximately 20% of SRC's NEWater demand. SRC's recycling rate is at 40%.

Other water saving initiatives implemented by SRC include: maximizing the reuse of treated effluent water internally; maximizing the use of sea water and fin fan coolers for cooling; closed circulation cooling water or tempered cooler; steam trap surveillance and close monitoring of water consumption.

"Our water conservation solutions aim to reduce overall water consumption, identify streams for recycling and capitalize on existing facilities to improve operational efficiency. The Singapore Refining Company is pleased to be recognized for its water recycling efforts and are appreciative of PUB's ongoing support," Mr James Er, General Manager and CEO of Singapore Refining Company.

SRC will also be sharing on their efforts to improve water efficiency in their operations at the Industrial Water Solutions Forum.

Full list of 2017 award recipients and water conservation measures

Sector	Building / Plant Name	Water Conservation Measures
Office	Asia Square Tower 2	1. Certified Water Efficient Building by PUB. 2. Regular check to maintain flush volumes of the urinals and WCs. 3. Install Pressure Reducing Valve at necessary location of the water service installation to reduce the water pressure in order to minimise possibility of leaks and excessive flow rates. 4. Educate tenants by sharing knowledge and experience in water conservation. 5. Hosting event to recognise tenants' efforts in water conservation. 6. Regular monitoring of water usage patterns in order to identify abnormality or leaks.
	AXA Tower	1. Certified Water Efficient Building by PUB. 2. Monitoring of water usage by remote meter. 3. Collection of condensate water for toilet flushing. 4. Educate/Remind cleaners and users to promptly feedback if leaks and faulty water fittings are found.
	OUE Downtown	1. Certified Water Efficient Building by PUB. 2. Monitoring of water consumption by daily water meter reading. 3. Educate workers/employees on water conservation though pre-work briefings, talks, discussions, publicity materials, etc. 4. Encourage prompt feedback on leaks and faulty water fittings. 5. Mop the floor instead of washing with running water. 6. Use water efficient water fittings.
Retail	Big Box	1. Certified Water Efficient Building by PUB 2. Regularly remind employees about importance of water conservation 3. Regular maintenance of water service installations to avoid leaks and water wastage.
	Compass One	1. Certified Water Efficient Building by PUB. 2. Water taps, urinals and WCs installed are 3-ticks (excellent) rating.

Sector	Building / Plant Name	Water Conservation Measures
		3. Use Cooling Towers with high efficiency in-fills and drift eliminators that helps to reduce water loss.
	Junction 8 Shopping Centre	1. Certified Water Efficient Building by PUB. 2. Monitor water usage by remote meters at various locations. 3. Use water efficient water fittings. 4. Regular checks of water service installations to avoid leaks. 5.
	Parkway Parade	1. Certified Water Efficient Building by PUB. 2. Monitoring of water usage by regular meter reading. 3. Effective fault reporting system –information posted in toilets for users to call hotline when any leak/ defect is detected. 4. Water taps, urinals and WCs installed are 3-ticks (excellent) rating. 5. Rain water harvested for irrigation and flushing. 6. Organise water conservation events. 7. Display water conservation messages at common areas.
Hotel	Carlton City Hotel Singapore	1. Certified Water Efficient Building by PUB. 2. Encourage prompt feedback when leaks or faulty water fittings are found. 3. Regular inspection and maintenance of water service installations to avoid water wastage due to leaks. 4. Water taps, urinals and WCs installed in the hotel are 3-ticks (excellent) rating. 5. Remind guests and staff on importance of water conservation by means of displaying posters. 6. Encourage guests to avoid requesting for change of linens and towels thus saving in water used in laundry. 7. Recover AHU condensate water and reuse for cooling tower. 8. NEWater has been used for cooling towers.
	Grand Mercure Singapore Roxy	1. Certified Water Efficient Building by PUB 2. Use water efficient water fittings 3. Monitoring of water usage by water meters

Sector	Building / Plant Name	Water Conservation Measures
		4. Remind cleaners to avoid water wastage when carrying out their work
	Marina Mandarin Singapore	1. Certified Water Efficient Building by PUB. 2. Monitor daily water usage at various locations such as food and beverage area, and staff facilities. 3. Water taps, urinals and WCs installed in the hotel are 3-ticks (excellent) rating. 4. Remind employees of the importance of water conservation. 5. Highlight to staying guests, the importance of water conservation.
	The Elizabeth Hotel	1. Certified Water Efficient Building by PUB. 2. Monitor water usage by remote meters. 3. Installation of water efficient water fittings.
	V Hotel Lavender	1. Certified Water Efficient Building by PUB. 2. Water taps, urinals and WCs installed are 3-ticks (excellent) rating. 3. Use drip irrigation system. 4. Remind cleaners to avoid water wastage when carrying out their work.
Wafer Fabrication	United Microelectronics Corporation (Singapore Branch)	1. DI system RO/UF Regeneration Recycle 2. Certified Water Efficient Building by PUB 3. Process tools 1st Rinse Recycle 4. Process tools 2nd Rinse Recycle 5. Local Scrubber Recycle System 6. AHU/MAU Condense Water Recycle 7. DI system Regeneration Rinse Water Recycle
Refinery	Singapore Refining Company Pte Ltd	1. A water audit of the entire facility was first carried out to identify streams for recycling. This resulted in a decision to build an effluent treatment recycling plant to treat industrially used treated water from their processes (that would typically be discharged to the sea) to NEWater standards through ceramic microfiltration(MF) and reverse osmosis (RO) for reuse. 2. PUB worked with SRC on the design/ configuration/ process of the plant to meet their needs, and on plant optimisation. 3. Successful implementation of ceramic MF-RO technology enabled an onsite water

Sector	Building / Plant Name	Water Conservation Measures
		recycling plant for the petroleum refining sector (i.e. plant is located within the refinery's compound). 4. This reduces the amount of NEWater SRC requires from PUB. 5. The plant currently operates at 2000m3/day, and and can meet approximately 20% of SRC's NEWater demand. SRC's recycling rate is at 40%. 6. Certified Water Efficient Building by PUB
Schools	Chung Cheng High School (Main)	1. Certified Water Efficient Building by PUB. 2. Environment education programme to foster good water saving habits in students. 3. An effective fault reporting system for staff and students to report on water leakages and faulty water fittings. 4. Limit usage of high pressure jet for cleaning purposes. 5. Annual briefing to estate management staff and cleaners on their roles in water conservation. 6. Close monitoring on monthly water consumption
	Clementi Primary School	1. Certified Water Efficient Building by PUB. 2. Weekly monitoring and check water meters for sudden increase of water usage. 3. Installation of water saving devices at all taps. 4. Watering of plants is only done in the early morning once a day to minimize evaporation loss. 5. Limit the use of high pressure-jet washing.
	Fajar Secondary School	1. Educate students on importance of water conservation. 2. Certified Water Efficient Building by PUB. 3. Students propose solutions to reduce water wastage creating a water thimble using 3D printers. 4. Organise assembly programmes on World Water Day; Youth for the Environment Day etc to create awareness in water conservation. 5. Display publicity materials and posters on water conservation at common areas.

Sector	Building / Plant Name	Water Conservation Measures
		6. Monitor water usage and ensure that leaks are always promptly repaired.
	Geylang Methodist School (Secondary)	1. Certified Water Efficient Building by PUB 2. School staff are vigilant to ensure that there are no water leakages in the school. Repairs are carried out immediately on faulty taps and leaks. 3. Check on a regular basis to ensure that, the water flow rates at the taps in the canteen and toilets are not excessive. 4. Ensure that canteen stall operators avoid water wastage when carrying out their work.
	Greenview Secondary School	1. Certified Water Efficient Building by PUB. 2. Installation of water saving devices at water taps, shower heads. 3. Establish quick response team with managing agent to rectify problems such as leaks or faulty water fittings. 4. Regularly remind water users and cleaners in school to observe water conservation. 5. Encourage prompt feedback on leaks and faulty water fittings. 6. Class bonding fund tied to facility repair. The lesser facility repair needed, classes enjoy more class bonding fund.
	Holy Innocents' Primary School	1. The School promotes water conservation through raising awareness and discussions within the school community. 2. Certified Water Efficient Building by PUB. 3. Pupils imbibe the important messages through Assembly talks and the Science curriculum. 4. Pupils spread the message through ways such as hand drawn posters, which are displayed in the school premises. 5. Installation of water saving devices at taps. 6. Limit the use of pressure -jet to clean premises. 7. Monitoring of meter readings in order to avoid water wastage due to leaks.
	Meridian Junior College	1. Certified Water Efficient Building by PUB. 2. limit the use of automatic irrigation of college foliage areas.

Sector	Building / Plant Name	Water Conservation Measures
		3. Limit pressure-jet washing of drains, outdoor, courts and open areas. 4. Mopping of toilets floors by contract cleaners instead of spray washing. 5. Water supply is to faulty fittings is always isolated immediately upon discovered. 6. Water usage is monitored daily through the water meter readings. 7. Ensure publicity of water conservation messages to the College population
	Nan Hua Primary School	1. Certified Water Efficient Building by PUB. 2. Regular checks to ensure that the flush volumes of the WCs and urinals are not excessive. 3. Regularly ensure that faulty water fittings are repaired/replaced promptly. 4. Regularly remind users and canteen stall operators to avoid water wastage. 5. Effort in educating and creating greater awareness among our students have been put in. An assembly talk about World Water Day was held on 22 March 2017. Lessons on learning to read utility bills and tracking water consumption at home were conducted. Students were rewarded with a token if their home water consumption over 3 months showed a decrease or is below national average.
	Qifa Primary School	1. Certified Water Efficient Building by PUB 2. Pupils' awareness of water conservation is enhanced through explicit teaching in Science and Social studies lessons, and assembly talks. 3. Encourage prompt feedback upon discovering faulty water fittings or leaks. 4. Always ensure that repairs on leaks are done within one day. 5. Replaces liquid soap with foam soap as less water is required to wash off the foam compared to liquid soap.
	Tampines Secondary School	1. Certified Water Efficient Building by PUB. 2. Use water-efficient fittings. 3. Water usage is monitored monthly to identify and review unusual usage.

Sector	Building / Plant Name	Water Conservation Measures
		4. Prompt measures to ensure that leaks and faulty fittings are remedied immediately. 5. The school also reinforces the above with the educational approach and constantly emphasizes the importance of water conservation to staff and students.
	Yangzheng Primary School	1. Certified Water Efficient Building by PUB. 2. Monitor and review water usage monthly. 3. Installation of water saving devices at taps 4. Encourage prompt feedback upon discovering faulty water fittings or leaks. 5. Carry out daily inspection at water service installations. 6. Always ensure that repairs on leaks are done within one day.
Estates	Jalan Besar Town Council	1. Ensure that the taps at common areas are always locked. 2. Regularly remind contractors to be mindful of water conservation when washing work is being carried out. 3. Publicise water conservation in newsletters distributed to the residents.
	Tangjong Pagar Town Council	1. Operations Command Centre (OCC) monitors water consumption on a monthly basis. Any variation in the consumption amount is flagged and quickly addressed. 2. Contractors are regularly reminded by the Town Council officers to avoid water wastage and OCC monitors the water consumption closely.

Annex B

Best Practice Guide in Water Efficiency - Buildings

Currently, Singapore's water consumption stands at 430 million gallons a day, with water consumption in the domestic sector accounting for 45% of total water use, and the remaining 55% coming from the nondomestic sector. By 2060, Singapore's water consumption is expected to more than double, with non-domestic consumption estimated to make up 70% of total water use. Companies therefore have an important role to play in Singapore's effort to conserve water.

Since 2015, PUB has mandated Water Efficiency Management Practices for large water users. Under this programme, all large water users - those consuming at least 60,000 m^3 of water per year - are required to submit their Water Efficiency Management Plans to PUB on an annual basis. These companies are also required to monitor the breakdown of their water usage via the installation of private water meters. With this information, businesses can study their water usage patterns and target their water intensive operations to improve water efficiency and save on their water bills.

The data collected has also provided useful insights for PUB. PUB has compiled the best water efficiency practices and developed recommended water efficiency benchmarks for Office, Retail and Hotel buildings into a Best Practice Guide for Water Efficiency – Buildings.

It aims to provide professional engineers, developers, building owners, facilities managers and managing agents involved in water management, with the basic knowledge of designing, maintaining and operating a water-efficient building, to help them in sustainable commercial water use.

PUB is seeking comments on the guide from the industry so that it will be a resource developed with the industry, for the industry. The final version of the publication will be ready by early 2018.

Interested parties who wish to view the guide and share comments can visit the PUB website at www.pub.gov.sg.

Technical Reference for Water Conservation in Cooling Towers

It is estimated that more than 30mgd (million gallons per day) of water is used by evaporative cooling towers in Singapore. Reducing that water demand — and saving energy in the process — is a matter of PUB's interest to stem further water losses to the atmosphere and instil water conservation among users.

The aim of this technical guide is to provide cooling tower users, developers, building owners and managing agents with basic knowledge of cooling tower management, and proper operation and maintenance of these equipment in their premises.

By adopting this set of guidelines, PUB hopes to instil discipline and equip users on the technical knowhow for the management of these devises to maximise water

savings i.e. optimise the cycles of concentration, while still meeting cooling demands for buildings or industrial processes. The topics covered seek to address concerns on the existing requirements for control of scale, corrosion, deposition and biological fouling associated with the operation of a cooling tower water system.

This technical guide should be read in conjunction with the relevant codes of practice and guidelines issued by the National Environment Agency, and the Environmental Public Health (Cooling Towers and Water Fountains) Regulations.

Interested parties can visit PUB website at www.pub.gov.sg to view the publication.