Ministry of Sustainability and the Environment
SINGAPORE

PUB SINGAPORE'S NATIONAL WATER AGENCY

MEDIA FACTSHEET

TO BE REPORTED ONLY IF CONTENT IS DELIVERED AT COS 2023 DEBATE AND TO BE EMBARGOED UNTIL AFTER DELIVERY

PUB'S DECARBONISATION STRATEGY

Singapore's water demand is projected to almost double by 2065. As the supply sources of importation and local reservoir will remain constant, the increase in demand will be met by more energy intensive sources such as NEWater and desalinated water. PUB's carbon footprint will correspondingly more than triple, from the current 279 kilotonne carbon dioxide equivalent (kt CO_2-eq) to about 1000 kt CO_2-eq.

2 Having closed the water loop by recycling used water to produce NEWater nearly two decades ago, PUB is now aiming to close the carbon loop. In line with the public sector's overall target, PUB targets to achieve net-zero emissions by 2045 by building a **Green and Resilient Water System** for Singapore.

Commitment towards Decarbonisation

3 PUB's decarbonisation strategy is based on a three-pronged 3Rs approach to **Replace**, **Reduce** and **Remove** carbon emissions from our water operations.

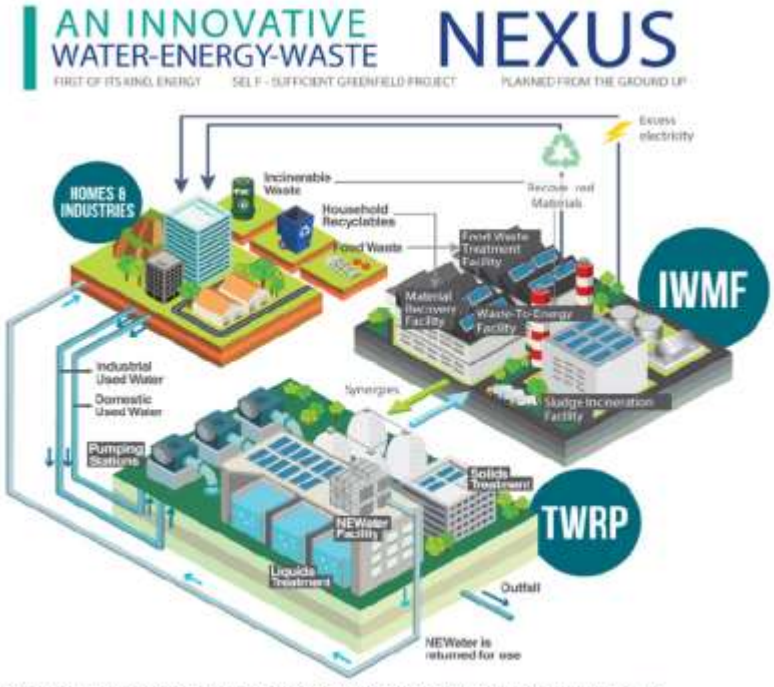
i. **Replace**: PUB has been replacing fossil energy sources with renewable solar energy. To date, PUB has deployed solar photovoltaic (PV) systems on our facility rooftops and reservoirs, generating a total of 68 megawatt-peak (MWp) of electricity. This has enabled us to offset 10% of our annual energy needs. Opened in July 2021, the 60 MWp solar farm at Tengeh Reservoir is capable of powering all our local water treatment plants, allowing us to produce clean water from clean energy. Two smaller 1.5 MWp floating solar PVs at Bedok and Lower Seletar Reservoirs have also commenced operations in August 2021.

   Extensive environmental studies and continuous monitoring show that the floating solar panels have minimal impact on our reservoirs' water quality and biodiversity. PUB will be calling a tender in 2023 to deploy at least 44 MWp floating solar farm at Pandan Reservoir. When completed, it is expected to generate enough power to support approximately 11,000 four-room HDB flats annually.

From left: Floating Solar farms at Lower Seletar and Tengeh Reservoirs, Solar panels on rooftop of Choa Chu Kang Waterworks

ii. **Reduce** – PUB invests in research and development to improve energy efficiency and reduce the energy required for water treatment processes. We leverage on our experience in water and used water treatment as well as our network of research partners, to source for technologies that can be integrated with PUB's operations. For instance, PUB is aiming to validate and scale up its blue energy[1] research. This is the energy harnessed from the salinity difference between NEWater reverse osmosis (RO) brine and seawater RO brine, both of which are waste streams. With the potential to offset 0.5 kWh/m^3, or 14% of the total energy consumption for desalination, the technology will be piloted at the Changi Water Reclamation Plant in 1Q 2023. Concurrently, PUB is scaling up the development of ultra-permeable membranes, such as biomimetic membranes that mimic the way plants and animals extract freshwater from seawater. The biomimetic membranes have the potential to lower the energy required for NEWater and seawater desalination processes by 0.2 kWh/m^3 and 0.4 kWh/m^3 respectively. Through the scale up and validation of technologies, including the above mentioned and ceramic membranes and Closed Circuit Reverse Osmosis[2], PUB aims to reduce the energy consumption of desalination from 3.5kWh/m^3 to less than 2kWh/m^3 by 2025.

PUB is also constructing Singapore's first energy self-sufficient water reclamation plant (WRP), that is co-located with NEA's Integrated Waste Management Facility (IWMF) to form Tuas Nexus. Tuas WRP can effectively harness process synergies from used water and solid waste treatment to maximise energy and resource recovery. For instance, the completed Tuas WRP will utilise the rich organic content in used water sludge to produce more biogas for electricity generation.



Tuas Nexus, Singapore's first Integrated Water and Solid Waste Treatment Facility.

[1] Blue energy is the osmotic energy to be harnessed from the salinity gradient of two waste brine streams.
[2] Closed Circuit Reverse Osmosis (CCRO) is a semi-batch reverse osmosis (RO) process that works by re-circulating pressurized feed water until the set recovery or pressure is achieved while the brine is replaced with fresh feed, without stopping permeate production. Compared to conventional RO systems which operate at single seawater feed pressure, CCRO conserves water, reduces brine waste and overall energy consumption to produce every drop of water.

iii. **Remove** – PUB is actively sourcing for solutions on innovative Carbon Capture, Utilisation and Removal that can be integrated with PUB's operations, such as through the "Carbon Zero Grand Challenge" held in 2021. PUB is also working with A*STAR's Institute of Sustainability for Chemicals, Energy and Environment (ISCE^2) and the University of California, Los Angeles (UCLA) to advance our work in this area.

With UCLA, we are exploring the use of electrolysis technology to capture carbon dioxide in seawater and produce hydrogen, and a stream of pre-treated seawater that can be desalinated at lower energy. A pilot plant with removal capacity of up to 100kg of CO_2 per day is expected to be commissioned in end March 2023.

We are also following the research of ISCE^2 closely to explore the feasibility of removing carbon dioxide from biogas and carbonising it with waste materials (e.g. incinerated ash) to produce aggregates or alternative sand which can potentially be used in the building construction industry or land reclamation applications.

Another project with CO2Tech, the commercial arm of Australian decarbonisation research organisation CO2CRC, will explore capturing carbon dioxide via solvent absorption and membrane separation, and mineralising it with brine from our desalination plants[3]. If these carbon capture projects are successful, large quantities of carbon by-products will be produced. In PUB's third edition of the Global Innovation Challenge (GIC), one of the challenge statements[4] aims to seek useful industrial applications for these carbon by-products to achieve permanent carbon removal.

***

For media queries, please contact:

Ms Hasnita Abdul Majid
3P Network Department, PUB
Tel: 9457 7114
Email: hasnita_abdul_majid@pub.gov.sg

Ms Ng Yun Shuen
3P Network Department, PUB
Tel: 9830 0938
Email: NG_Yun_Shuen@pub.gov.sg

[3] For more information on PUB's project with CO2Tech, visit: https://co2tech.com.au/carbon_zero_grand_challenge/

[4]The GIC was launched in 2020 as part of PUB's constant pursuit of great ideas, as we seek to accelerate the discovery and adoption of smart solutions and new technologies to overcome technical challenges, improve operational excellence and meet future water needs. We commit to providing funding support that will help cover the costs of development and test-bedding. To date, around $3 million in funding has been awarded. If the pilot proves successful, PUB will also help to scale-up the product, which will facilitate its commercialisation. For more information, visit PUB's GIC webpage: https://www.pub.gov.sg/innovationchallenge.