



A floating solar farm in Bedok Reservoir. While solar farming can lower reliance on fossil fuels, Singapore's small size limits the amount of solar power that can be generated. What this means is that the country has to look to other ways, such as improved technology, to cut carbon emissions, say the writers. PHOTO: PUB

S'pore's water challenge: More on tap at lower carbon costs

From solar farms to carbon capture, PUB is looking at all ways and means to meet rising demand for water while keeping down carbon emissions.

Asit K. Biswas and Pang Chee Meng

For The Straits Times

How "green" is the glass of water you drink?

The question captures in essence the challenge Singapore faces – it needs to ensure long-term water security while keeping a lid on the cost to the environment in terms of carbon emissions.

In practical terms, consider the fact that while Newater and desalinated water have made Singapore less reliant on rain for its water supply, they are also more energy intensive to produce.

As the national water agency, PUB has to take into account Singapore's broader and

longer-term climate change goals in managing the water supply. Specifically, it has to meet its target of peak carbon emissions by 2025 and strive to achieve net-zero carbon emissions by or around mid-century.

Currently, PUB emits about 460 kilotonnes of carbon dioxide equivalent per year (ktCO₂e/yr). But with Singapore's water demand projected to double from now to year 2060, emissions are also expected to rise steadily to the one megatonne mark. About 200 ktCO₂e/yr of this will come from direct emissions from the treatment of used water. Electricity used to power PUB's installations, such as waterworks, desalination plants, water reclamation plants and Newater factories, contributes to emissions indirectly.

To meet its net-zero carbon goals, PUB has formulated a three-pronged strategy to replace carbon, reduce carbon and remove carbon. It plans to use more renewable energy in place of fossil fuels ("replace"), cut energy consumption from all parts of its operation ("reduce"), and develop new technologies to capture carbon dioxide from the environment ("remove").

ALTERNATIVE POWER SOURCES

Singapore is disadvantaged in terms of renewable energy. There is insufficient strong wind to support the use of wind power. Its relatively narrow tidal range and calm seas also limit opportunities for tidal power generation.

However, with ample sunshine all year round, solar power is a most promising source of renewable energy.

Since 2005, PUB has been installing solar photovoltaic (PV) panels on the rooftops of its installations to harness solar power. In 2016, the first floating solar PV array was test-bedded at Tengeh Reservoir to assess the feasibility of deploying floating solar PV systems on Singapore's freshwater reservoirs. Studies showed no observable change in the reservoir's water quality and no significant impact to surrounding wildlife. Floating PV systems also performed 5 per cent to 15 per cent better than conventional rooftop systems due to the cooler reservoir environment, as well as added light reflected off the water's surface. Reservoirs can thus serve a dual purpose of water storage

and desalination. Water treatment processes for seawater desalination are most energy intensive to run. For every cubic metre of water desalinated, 1.4kg of CO₂ is emitted. Next year, a testing facility will be commissioned to try out potential technologies for use in future desalination plants.

Meanwhile, Tuas Nexus is being built. This will be an energy-neutral facility made possible by exploiting the synergies of co-locating a food waste facility and a waste management facility. What happens is that food waste slurry and wastewater sludge are used to produce biogas. Burning the gas generates electricity to run Tuas Nexus. The proximity of the two plants reduces the carbon footprint of running them.

An often-overlooked aspect is how greater water conservation in households and industries can lead to significant energy and carbon reductions. PUB has initiated a large-scale trial for advanced metering infrastructure (AMI) to install some 300,000 smart water meters across seven districts in Singapore. A previous AMI pilot with 800 households has shown that water savings of about 5 per cent can be achieved through behavioural changes arising from real-time information of water consumption patterns and early leak detection. Islandwide roll-out of AMI offers another important means of reducing both water consumption and carbon emissions.

CARBON CAPTURE AND UTILISATION

The ongoing projects for producing renewable energy and reducing emissions will abate about 60 per cent of PUB's total emissions by mid-century. Removing carbon that has been released into the environment will be the next big task for PUB to achieve its net-zero carbon ambitions.

Carbon capture and utilisation is an emerging area of science that PUB plans to harness to develop technologies that can be integrated with its operations. One example is a research and development project with the Agency for Science, Technology and Research's Institute of Sustainability for Chemicals, Energy and Environment to remove carbon dioxide in biogas and carbonise it with waste materials (such as incineration ash) to produce aggregates which can potentially be used by the construction industry or for land reclamation.

Sustainability has always been central to PUB's mission as it seeks out new sources and technologies to secure Singapore's water supply. Climate change and the imperative to cut global carbon emissions have added a new dimension to what it means to be truly sustainable. The doubling of the challenges may seem daunting but it is also a spur to inventions and innovations – a focus of the gathering of experts in Singapore to examine new ways in shaping the future of water.

stopinion@sph.com.sg

• Asit K. Biswas is distinguished visiting professor at the University of Glasgow and director of Water Management International, Singapore. Dr Pang Chee Meng is chief engineering and technology officer of PUB, organiser of the Singapore International Water Week (April 17 to 21).