

Sustainability Report 2023

Building Our Water Future



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ABOUT THIS REPORT

With the publication of this Sustainability Report, PUB acknowledges the role we play as Singapore's National Water Agency by managing our activities and impacts in a sustainable and responsible manner. This report covers PUB's sustainability approach, initiatives and performance for our key environmental, social and governance ("ESG") topics.

For a more comprehensive view of PUB's business and performance, we recommend that this report be read together with PUB's Annual Report 2022/2023.

For any questions or feedback on the report, please email [TIN Jing Jie@pub.gov.sg](mailto:TIN_Jing_Jie@pub.gov.sg)

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REPORTING SCOPE AND PERIOD

The report covers our performance from 1 April 2022 to 31 March 2023 ("FY2022") unless otherwise stated. Where available, the prior year ("FY2021") data has been included for comparison. The reporting scope of the Sustainability Report is aligned with PUB's GreenGov.SG reporting submissions.

REPORTING STANDARDS

This report has been prepared in accordance with the GRI Sustainability Reporting Standards ("GRI Standards").

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About PUB: Our Vital Role

Our Mission

Supply good water. Reclaim used water. Tame stormwater. Resist rising seas.

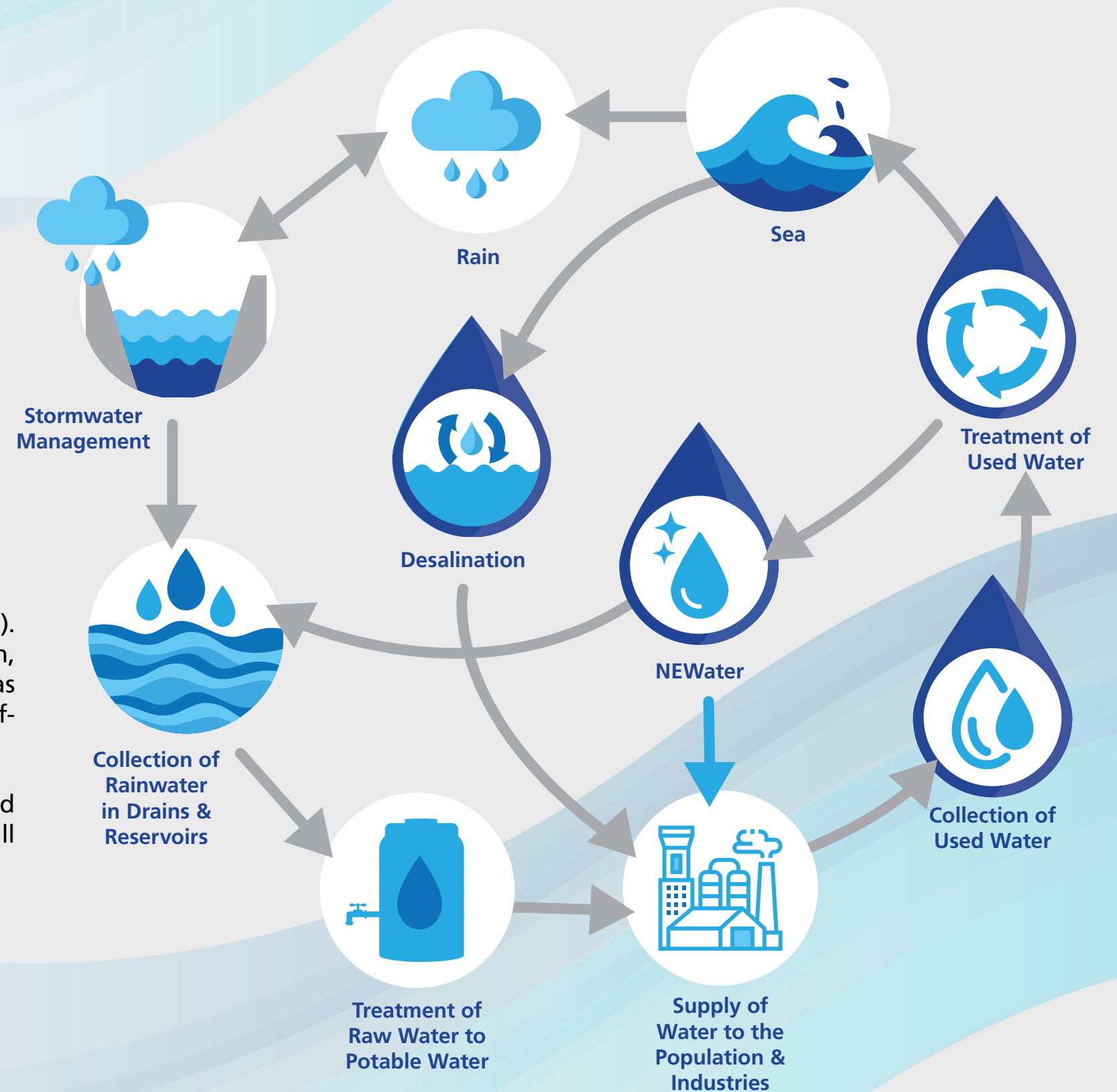
Our Vision

Water for Everyone. Everyone for Water.

Singapore's National Water Agency

PUB is a statutory board under the Ministry of Sustainability and the Environment (MSE). As Singapore's National Water Agency, PUB is responsible for the collection, production, distribution and reclamation of water in an integrated manner. In April 2020, PUB was appointed the national Coastal Protection Agency to lead and coordinate Whole-of-Nation efforts to protect Singapore's coastline.

PUB calls on everyone to use water wisely, save water, keep our waterways clean and care for Singapore's precious water resources. Together, we can ensure that there will always be enough water for a vibrant, thriving Singapore.



GRI [2-6] [2-22]

Chairman's Message

Today, Singapore is internationally recognised as a model city for integrated water management. Having built up our Four National Taps, the water loop has been closed. This was done through decades of sustained investments in research and technology to supply, treat and recycle water. For a small island nation with limited land and natural resources, water is our lifeblood, an economic asset and environmental treasure to be safeguarded for current and future generations.

Even as PUB strives to deliver a sustainable water supply, climate change will impact every part of PUB's operations and mission success. The need for energy sustainability and decarbonisation would require us to rethink and transform our operations, including energy-intensive operations like water reclamation and desalination. PUB has also been entrusted with the national mandate of protecting Singapore's coastlines against the rising seas. To provide strategic guidance to our long-term sustainability focus, PUB has formed a new Board Sustainability Committee. The key focus will be on research and development, energy usage and consumption, and carbon capture techniques.

Every drop of water is precious. This holds true even more so going forward as the El Niño phenomenon we are currently experiencing can exacerbate water stress. While PUB expands our infrastructure to meet future demand, water conservation remains key to a sustainable water supply. Each drop of water conserved translates to energy and emissions savings as less water needs to be treated and produced. We not only have to make extra efforts to reduce water consumption at the domestic household level, but also at the non-domestic level. Our industry is a huge consumer of water and growth in water demand will mainly be driven by the non-domestic sector. PUB has recently introduced mandatory recycling requirements for water-intensive industries from 2024. PUB has also enhanced our Water Efficiency Fund to incentivise large water users to reduce demand, and has revamped our Water Efficiency Awards to profile businesses who are role models for water conservation. These efforts are projected to contribute water savings of nine million gallons of water per day from 2035 onwards. All these efforts will help PUB in its pursuit of net zero emissions around 2045.



Chiang Chie Foo

Chairman

PUB, Singapore's National Water Agency

PUB contributes to a more resilient Singapore by protecting our coastlines from sea level rise. We are progressively carrying out site-specific studies to formulate coastal protection measures for different segments of the coastline, starting with City-East Coast in 2021 followed by Northwestern Coast (Coastal Reservoirs) and Jurong Island in 2022. PUB also launched a \$125 million coastal protection and flood management research programme funded by the National Research Foundation. This brings together local and overseas multi-disciplinary experts to advance our understanding of coastal science and develop coastal protection solutions. We have also involved members of the public from diverse backgrounds to provide ideas and suggestions through Our Coastal Conversations to source for inputs to our planning process for coastal protection measures. Together, we will keep out the rising seas.

Through forward planning, sustained investment in research and technology and most importantly, with the dedication of the men and women at PUB who are committed to delivering our mission as well as a supportive public, I am confident that we can build a sustainable water future for all.

GRI [2-6] [2-22]

Chief Executive's Message

Building our Sustainable Water Future

This year marks PUB's 60th Anniversary. Over the past decades, Our Water Story has been one of overcoming challenges to enhance water security for Singapore, turning vulnerability to strength. From the early days of water rationing and dependence on imported water, we have built up our Four National Taps – namely water from local catchment, imported water, NEWater and desalinated water – to support Singapore's population and economic growth. Today, we have a high-quality and reliable water system to meet our water demand, that has grown six times since independence.

Looking ahead, we expect water demand to double by 2065. To ensure water security for future generations, PUB must again overcome new challenges. Climate change can bring prolonged droughts and threaten our water resources. To meet growing demand and remain resilient against climate change, we will increasingly rely on weather resilient water sources like NEWater and desalination, which are more costly and energy intensive to produce. If PUB continues to operate in a business-as-usual manner, our energy consumption and carbon emissions will increase significantly. To build a sustainable water future, PUB has to take firm actions to be more sustainable in our operations, invest in our water system, and also in managing demand growth.

Sustainable Operations

PUB has embarked on a 3R strategy to achieve sustainability in energy consumption and decarbonisation from our operations – Reduce energy consumption, Replace with renewable energy and Remove carbon from our operations. Through this, we seek to achieve net zero around 2045.

Reduce – The bulk of PUB's emissions stem from electricity consumption. Our focus is therefore to improve energy efficiency of our operations, through process optimisation and R&D. Key projects are already ongoing to reduce energy needs in NEWater production and desalination, and to recover more energy in our used water treatment processes. These long-term efforts will reshape our future operating landscape.



Goh Si Hou

Chief Executive
PUB, Singapore's National Water Agency

Replace – PUB aims to replace our energy needs with green energy by expanding solar deployment at our installations and on our reservoirs. By 2030, PUB aims to triple our floating solar capacity with the deployment of 44MWp and 100MWp floating solar farms at Pandan and Lower Seletar Reservoirs. These deployments will allow more of PUB's operations to be fuelled by renewable energy.

Remove – PUB is actively pursuing carbon removal technologies that have synergies with our operations. For instance, PUB is exploring ocean carbon dioxide removal (CDR) technologies, and has commissioned a \$2.5 million pilot system in May 2023 to test its viability.

Sustainable Water System

To ensure water security for Singapore, an important thrust is to grow our weather-resilient sources of water. Under PUB's Water Masterplan, we charted long-term infrastructure plans to significantly expand our water reclamation and NEWater capacity. At its heart, we are completing the development of our 3-node Deep Tunnel Sewerage

System (DTSS), with expanded water reclamation and NEWater capacity in Changi, Tuas and Kranji. By closing the water loop and reusing every drop of water endlessly, we will provide a sustainable source of water for Singapore in the long term.

PUB is also committed to developing our water system in an environmentally responsible manner. We work closely with partner agencies and nature group stakeholders to conduct environmental impact studies for our infrastructure projects and implement mitigation measures. We also aspire to develop water infrastructure that meet internationally recognised green standards through solar energy deployment and introducing best-in-class technologies. To support our green transition, we have also established PUB's Green Financing Framework. For instance, we have earmarked \$800 million of our inaugural green bonds raised in August 2022 for Tuas Water Reclamation Plant and Tuas NEWater Factory.

Sustainable Demand Growth

A sustainable water future for Singapore also requires us to manage long-term demand growth. In the past year, we have sharpened our focus to advance water conservation in the non-domestic sector, which could account for two-third of water demand by 2065. From 2024, PUB will introduce mandatory water recycling requirements for new projects in water-intensive industries. We have also enhanced the Water Efficiency Fund, to provide greater support for businesses to implement water-efficient practices and embark on water recycling projects. Finally, we have launched the revamped Singapore Watermark Awards, to recognise and promote best practices in water conservation, and draw a stronger link to the renewed emphasis on ESG practices in the corporate world.

Strengthening Climate Resilience

PUB's second mission focus is to keep Singapore resilient against climate change. As a low-lying island, rising sea levels can pose an existential threat to Singapore. At the same time, more intense rainfall can overwhelm our drainage system and impact critical infrastructures, causing large-scale disruption to life in Singapore.

In the past year, PUB has advanced our new mandate as the national coastal protection agency, setting out policies and plans to lay the foundation for long term coastal

protection work. Our site-specific studies for the different stretches of our coastline are progressing. Internally, we have brought together coastal protection and flood management as an integrated mission, building on the synergy in planning, flood-risk modelling and implementation. Notably, we established the new Coastal Protection and Flood Management Research Programme, to build up local capabilities and talent as we develop innovative solutions for Singapore. In land-scarce Singapore, PUB has also adopted a multi-functional approach towards managing flood risks. For instance, the upcoming Alkaff Lake, which will be completed in November 2023, serves as a retention pond that holds stormwater runoff during heavy storms, while providing recreational spaces. We will extend this multi-functional approach to redesign our coastlines and waterways, to bring greater benefits to the community.

Our People

We cannot achieve a sustainable water system or strengthen climate resilience for Singapore, without the commitment of our people in PUB. A key building block is hence to equip our people with the awareness and knowledge to contribute to a sustainable future. As such, PUB has recently embarked on the Environmental Sustainability E-Learning programme to build up this new core competency for all our staff. To complement this broad-based programme, we intend to build and anchor deep expertise in related sustainability domains as part of our professional development framework, to enable PUB's transformation in the long term.

Our Sustainability Journey

I hope that this 3rd Sustainability Report will give you a better understanding of PUB's sustainability strategies, key initiatives, and performance. We recognise that our sustainability journey will be a long-term endeavour. It will require the partnership and collaboration of many stakeholders across community, industry, and the research ecosystem. But we take heart and confidence from Our Water Story, that we can rise to the new challenges as we embark on this next lap. Let us work together to secure a Sustainable Water Future for Singapore.

Key Performance Snapshot for FY 2022

LEGEND

Sustainable Water System

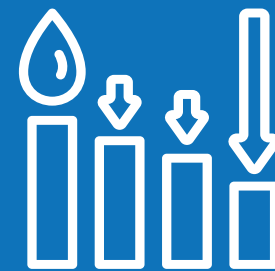
Decarbonisation

Resource Circularity

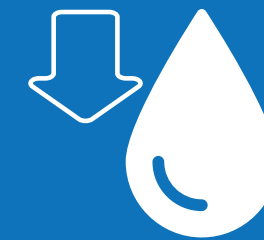
Coastal Protection and Flood Resilience



Maintained 100% of water-quality tests meeting WHO drinking water guidelines¹



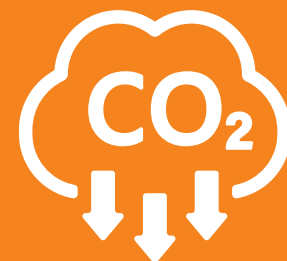
0.7 percentage points reduction in % distribution losses to **7.5%**¹



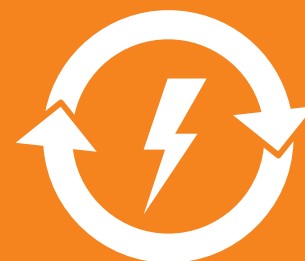
6% reduction in per capita per day of household water consumption to **149L**¹



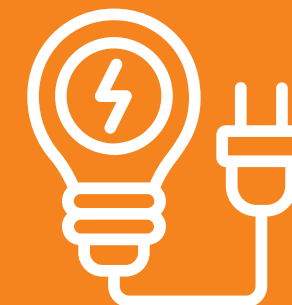
1% reduction in waste generated to **190,861 tonnes**



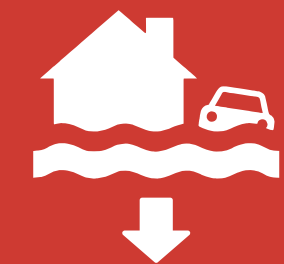
11% reduction in CO2-eq of Scope 1 and 2 emissions to **247 ktCO2e**



26% increase in renewable energy generated to **177.2 GWh**



11% reduction in grid electricity consumption to **590 GWh**



1ha of flood-prone areas reduced from 2021¹

¹ Data reported is for CY2022 and benchmarked against CY2021 performance. All other data reported is for FY2022 and benchmarked against FY2021 performance.

Highlights

Pillar 1: Water and Sustainable Management

Redevelopment of Kranji Water Reclamation Plant (WRP)

Three-node Deep Tunnel Sewerage System (DTSS) for water reclamation.

To meet the projected increase in used water, PUB will be redeveloping Kranji WRP and Kranji NEWater Factory. Together, the facilities will bolster NEWater production, augment water supply and strengthen Singapore's water resilience against growing water demand and climate change. Refer to Page 22 of PUB's Annual Report 2023 for details.



Singapore's three-node used water system.

Pilot Desalination-integrated Ocean CDR Facility

At the frontiers of science.

A pilot system was commissioned in May 2023 to test the viability of desalination-integrated ocean carbon dioxide removal (CDR) technologies that could allow us to extract and capture atmospheric carbon through seawater. In partnership with Equatic, PUB is making strides towards our net zero 2045 target². Refer to page 28 for more details.



PUB/Equatic's Pilot desalination-integrated ocean CDR plant at Tuas R&D Facility.

Alkaff Lake

An integrated and multifunctional approach to enhancing flood resilience.

A first-of-its-kind retention pond integrated within Bidadari Park, Alkaff Lake helps channel, filter and hold stormwater runoff during heavy rain, while providing green community spaces for recreation. Alkaff Lake is slated for completion in November 2023. Refer to page 39 for more details.



Artist's Impression of Alkaff Lake.

² PUB's Net Zero 2045 target pertains to Scope 1 and 2 Emissions.

Highlights

Pillar 2: People and Partnerships

Singapore World Water Day 2023

Community-wide efforts to communicate the value of water.

This is an annual flagship event held in March 2023, where PUB engaged widely with schools, businesses, community, grassroots, non-governmental organisations and public agencies to reinforce the message of water conservation, through a wide range of ground-up activities, along with a celebration event at Marina Barrage. Refer to page 48 - 49 for more details.



DPM Lawrence Wong joined more than 2,000 participants during the Singapore World Water Day 2023 celebration event at Marina Barrage.

Pillar 3: Business Excellence

Green Financing of Tuas Water Reclamation Plant (WRP) and Tuas NEWater Factory 1 (TNF 1)

Green financing for a sustainable future.

The Tuas WRP and NEWater Factory, due for completion in 2026, will receive \$800 million of green bond proceeds — representing a significant investment in advanced used water treatment technologies and resource circularity. Refer to page 57 and PUB's inaugural Green Bond Report 2023 for more details.



Artist's impression of TWRP and TNF 1.

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Overview of Sustainability Governance

Sustainability is at the core of PUB

Pressing sustainability issues, such as our carbon footprint, coastal protection and flood resilience, affect every aspect of PUB's operations. Collective management and governance of these issues across PUB is critical for our mission success.



PUB's new Board Sustainability Committee

Charting our course with expert guidance

Formed on 1 April 2023, PUB's Board Sustainability Committee brings together technical experts with specialised knowledge to guide PUB in the following areas:

- Energy sustainability and decarbonisation plans,
- Planning and implementation of coastal protection programmes, and
- Capability building in coastal protection and flood resilience, energy sustainability and decarbonisation.



Chief Executive

- Oversees management of sustainability strategies and performance.
- Reviews and approves ESG material topics.



PUB Sustainability Committee

- Develops and drives PUB's sustainability strategies.
- Assesses and manages specific climate-related risks and issues.
- Chaired by the Deputy Chief Executives with department directors as committee members.



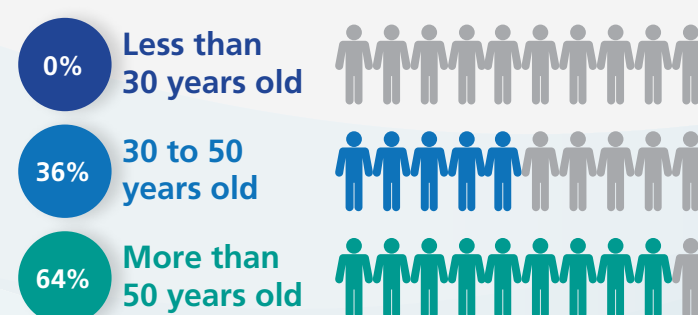
Sustainability Working Group

- Coordinates, implements and tracks performance of sustainability initiatives with support from PUB departments.
- Chaired by the Chief Sustainability Officer (Director Level), with department representatives as committee members.

Our Board Members³

Breakdown by Age Group

FY2023
(Total: 14)



Breakdown by Gender

FY2023
(Total: 14)



³ Please refer to Pages 7 and 8 of PUB's Annual Report 2023 for more details of our Board Members. PUB has increased the diversity of members (age and gender) on the Board, with a larger proportion of Board members who are lower in age (10% in FY2022 to 36% in FY2023) as well as females (20% in FY2022 to 36% in FY2023). The total number of Board members as of end FY22 was 10.

PUB's Climate Risks

A changing climate exacerbates water challenges

Water — its availability, predictability, and sustainable management — will be affected profoundly by climate change. PUB has identified the following climate risks that will significantly impact our ability to achieve mission success. Please refer to pages 17 - 39 on Water and Sustainable Management for more information on PUB's mitigation actions to address our climate risks.

Rising Sea Levels and More Intense Rainfall

As a low-lying island, Singapore is particularly vulnerable to rising sea levels.

By 2100, sea levels are expected to rise by up to 1 metre in Singapore due to climate change. Coupled with storm surges, high tides and land subsidence, sea levels could increase up to 4-5 metres transiently. Intense rainfall could also overwhelm our drainage system.

Without timely action to protect our coastlines and enhance flood resilience:

- Potential flooding of low-lying areas.
- Potential disruption to lives and damages to infrastructure.

Rising Temperatures

A looming threat: More frequent dry spells, coupled with El Niño conditions forecasted to develop in the second half of 2023 that could decrease precipitation by up to 45% below average⁴, could exacerbate water stress.

Warmer temperatures could result in changes to reservoir and seawater water quality, which will have to be handled by our treatment processes.

⁴ "High Likelihood of El Nino Conditions in Second Half of 2023 will increase risk of transboundary haze affecting Singapore", NEA, dated 30 May 2023.

Increased energy consumption and carbon tax

- Increasing water demand.
- Increasing reliance on climate-resilient water sources.
- Carbon tax from power generators.

Increased grid-based energy consumption and higher operating costs, which could impact financial sustainability.

GRI [3-1] [3-2]

PUB's Sustainability Approach

Materiality Assessment

PUB conducted a materiality assessment in 2020–2021 to identify our key ESG focus areas and material topics. A materiality review was subsequently conducted in 2023 to reprioritise our sustainability focus.



Identify 1

In 2020–2021, PUB identified a list of ESG topics based on:

- Megatrends
- Peer benchmarking
- Sustainability risks in our Enterprise Risk Management (ERM) framework



Prioritise 2

Internal and external stakeholder groups (e.g. employees, businesses and industry groups) were surveyed to rank PUB's material topics, based on their impact on PUB's success and stakeholders.

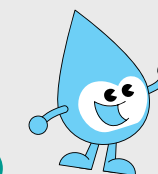
3



Validate and Approve

List of material topics were endorsed by senior management.

4



Review

The ongoing energy crisis and accelerating national sustainability efforts have placed an increased emphasis on energy, carbon footprint and resource circularity management.

These material topics and climate adaptation efforts were prioritised in an internal materiality review conducted in 2023, through which PUB updated our sustainability framework to incorporate three key sustainability focus areas and eight material topics.



PUB's Material Topics and Sustainability Framework

PUB's revised Material Topics and Sustainability Framework are described as follows. PUB also reaffirms our support for the United Nations Sustainable Development Goals (SDGs), and we have highlighted specific SDGs that are most relevant to our Material Topics⁵.

Delivering PUB's mission responsibly			
<div></div> <div>Pillar 1: Water and Sustainable Management (UNSDGs 6, 7, 9, 11, 12, 13)</div>		<div><div><div>6 CLEAN WATER AND SANITATION</div></div><div>7 AFFORDABLE AND CLEAN ENERGY</div></div> <div>9 INDUSTRY, INNOVATION AND INFRASTRUCTURE</div>  <div>11 SUSTAINABLE CITIES AND COMMUNITIES</div>  <div>12 RESPONSIBLE CONSUMPTION AND PRODUCTION</div>  <div>13 CLIMATE ACTION</div> 	
<div> Sustainable Water System</div>	<div> Decarbonisation</div>	<div> Resource Circularity</div>	<div> Coastal Protection and Flood Resilience</div>
<p><u>PUB's key mission:</u> Water security and resilience.</p>	<p><u>Reducing our environmental footprint:</u> Climate change and rising water demand will increase reliance on energy-intensive water sources. We must manage our energy, waste, and carbon footprint for sustainable development.</p>		<p><u>Protecting lives and livelihoods:</u> Coastal protection and flood resilience can help us adapt to climate change-induced sea level rise and more frequent and intense storms for mission success.</p>
<div></div> <div>Pillar 2: People and Partnerships (UNSDGs 4, 8, 10, 12)</div>		<div><div><div>4 QUALITY EDUCATION</div></div><div>8 DECENT WORK AND ECONOMIC GROWTH</div></div> <div>10 REDUCED INEQUALITIES</div>  <div>12 RESPONSIBLE CONSUMPTION AND PRODUCTION</div> 	
<div> Our People: Healthy, Safe, Competent</div>		<div> Customers and Community</div>	
<p><u>Valuing our people:</u> A healthy, safe and future-ready workforce sustains and drives all aspects of PUB's operations.</p>		<p><u>Meeting our goals together:</u> Customer and community engagement fosters critical support for PUB's initiatives.</p>	
<div></div> <div>Pillar 3: Business Excellence (UNSDG 6, 16, 17)</div>		<div><div><div>6 CLEAN WATER AND SANITATION</div></div><div>16 PEACE, JUSTICE AND STRONG INSTITUTIONS</div></div> <div>17 PARTNERSHIPS FOR THE GOALS</div> 	
<div> Risk Management</div>	<div> Financial Sustainability</div>		
<p><u>Strengthening our business fundamentals:</u></p> <ul style="list-style-type: none">• Risk management helps us identify and manage complex threats to our business• Green financing of upcoming infrastructure contributes to our long-term financial and sustainability goals.			

⁵ Reference has been made to guidance documents including the SDG Compass Inventory of Business Indicators, linking the SDGs and the GRI Standards published by the GRI, Singapore Statistics by the Department of Statistics Singapore, and peer reports.





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Stakeholder Engagement

Fostering a community of stewards and advocates

At PUB, we recognise the importance of working with a range of stakeholders and organisations towards common sustainability goals. We identify stakeholder groups based on how our activities impact them and how they affect ours. This allows us to build relationships to understand our stakeholders’ concerns and co-create solutions together.

Who we engage	How we engage	When we engage
 Public-sector agencies and ministries	Facilitate and enable Whole-of-Government approach in the public service: inter-agency meetings and workgroups	Workstream-dependent
	Celebrate and support Singapore World Water Day: partnerships with agencies	Major event in March
 Business and community research partners	Encourage professionals to share industry practices and challenges: dialogue sessions with trade associations, e.g. Association of Consulting Engineers Singapore (ACES) and Singapore Institute of Architects (SIA)	At least once a year
	Knowledge sharing and support to encourage water conservation and safeguard water recycling: regular site visits to industry premises, annual dialogue sessions with companies and trade associations to share best practices in managing trade effluent quality, distribution of educational materials and joint circulars with other government agencies, sharing by companies who have been successful at water recycling at industry forums	Several times a year
	Spark collaboration: grant calls, sharing sessions with industries on the Technology Roadmap and Focus Areas	Several times a year
	Collaborations with corporates: events to promote the importance of water conservation, e.g. Singapore World Water Day	Regularly, with major event in March
	Recognise corporates for their achievements in water efficiency and conservation efforts	Biennial
 Non-governmental organisations (NGOs) and nature groups	Collaborations with NGOs: events to promote the importance of water conservation, e.g. Singapore World Water Day	Regularly, with major event in March
	Specific project engagements: solicit feedback from experts on measures to mitigate the environmental impact on PUB’s projects	Project-dependent
 Public and the community	Specific project engagements: keep stakeholders informed about PUB projects, solicit feedback, source for partnership opportunities	Project-dependent
	Provide flash flood alerts, monsoon advisories and precautionary tips via various platforms such as Telegram and myENV mobile app	Throughout the year
	Community connections: events and initiatives to celebrate water and promote water conservation, e.g. Singapore World Water Day, surveys to understand public knowledge and behaviour on water management and conservation	Annually in March
	Collaborations with grassroots leaders: events to promote the importance of water, e.g. grassroots events, Singapore World Water Day	Regularly, with major event in March

Stakeholder Engagement

Who we engage	How we engage	When we engage
 Schools	Collaborations with schools and student groups to promote the importance of water, e.g. Water Wednesdays and Water Rationing exercises as part of the Singapore World Water Day celebrations	Regularly, with major event in March
	Student learning journeys: facilitating self-guided Active, Beautiful, Clean Waters (ABC Waters) Learning Trails, self-led Geographical Investigation field studies at selected waterways / water catchments, visits to Marina Barrage and NEWater Visitor Centre	Throughout the year, based on schools' availability
	Incorporating water topics into the curriculum: working with Ministry of Education (MOE) curriculum planners to design subject-specific and age-appropriate material	Based on MOE's curriculum planning cycle
	Deepen youth engagement with ideation and participation: PUB Splash Lab, a collaboration with Institutes of Higher Learning (IHLs) focusing on water sustainability	Based on IHL's academic cycle
 Media	Working with the media to increase engagement and knowledge: media lunches, media briefings, site visits, information and demonstration sessions to give journalists insights into specific topics, e.g. coastal protection, flood management, green efforts in water treatment, and SMART PUB initiatives	Bi-monthly
 Our employees and workers	Ongoing communications to engage our people and facilitate feedback: surveys, dialogue sessions, fireside chats with management, roadshows, department townhalls, virtual and physical staff engagement sessions, whistleblowing channels	Varies from monthly to annually
	Nurture growth, facilitate knowledge retention and sharing: equal opportunities for employees to be considered for competency-based training, technical knowledge webinars on Intranet portal and mobile application	Varies from monthly to annually
	Information and awareness about latest initiatives in PUB and the public service: regular emails and updates on Intranet portal and Workplace by Facebook, messages from senior management	Several times a month



Water and Sustainable Management

Our lives and industries run on water. As Singapore's National Water Agency, PUB's mission is to provide a robust and **sustainable water supply** to meet the needs of our growing nation. However, we must continue to **mitigate** our growing energy, waste and carbon footprint as we increasingly rely on weather-resilient water sources, while contributing to national efforts to **adapt** to climate change through coastal protection and flood resilience measures.

1-1 Sustainable Water System

1-2 Decarbonisation

1-3 Resource Circularity

1-4 Coastal Protection and Flood Resilience

"Sustainability is everything that PUB does. Even as PUB continues to supply safe, clean water 24/7 from diversified and climate-resilient sources with a turn of the tap, the large energy and carbon footprint of these climate-resilient water sources poses a great barrier to their sustainable use. Just as we have closed the water loop, we must work towards closing the carbon and waste loop for a sustainable water system while adapting to the impacts of climate change through coastal protection and flood resilience."

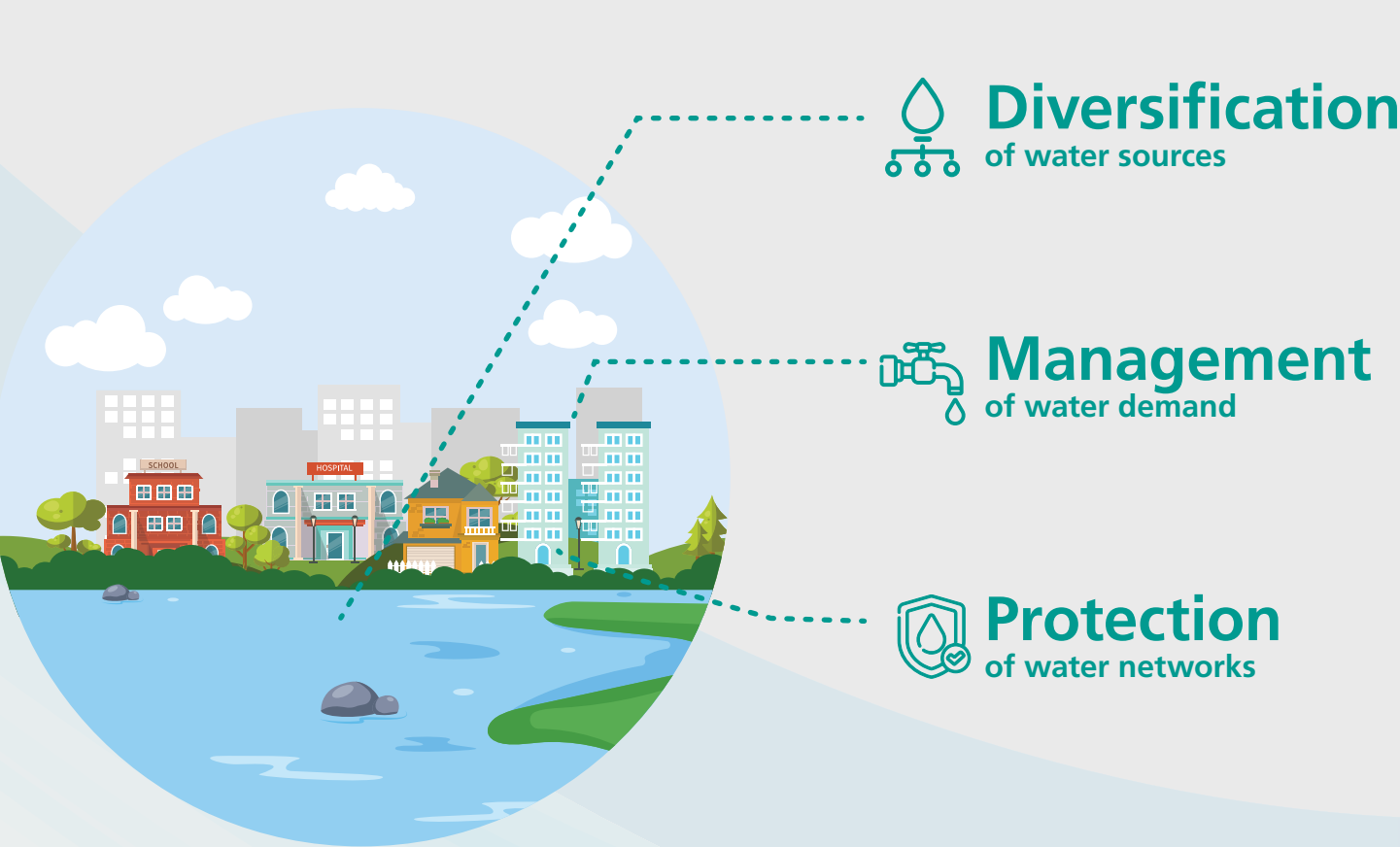
Mr. Ridzuan Ismail
Chief Sustainability Officer, PUB

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Sustainable Water System – Snapshot






Securing our future with water

Water is a fundamental natural resource. Access to safe and clean drinking water and sanitation is a basic human need. Water security is paramount and even as we face new climate challenges, PUB is committed to building a sustainable water system for all. This is founded on three strategies.






Targets and Commitments



-  Ensure that there will always be **enough water for all**
-  Achieve **household water consumption of 130 litres per person per day (LPCD) by 2030**
-  **Improve Water Efficiency Index (WEI) by 10% by 2030**, from average of 2018 – 2020 levels (Litres/pax/day)*
-  Ensure that **PUB's water consumption is managed (m³)**
-  Ensure that **our water is not lost nor contaminated**

* Note: Applicable to PUB's Standard Buildings only.

Metric	Perfomance	% Year-on-year improvement																				
 Percentage of population served by tapped water supply and modern sanitation.	CY22 100%	Maintained																				
 Litres per person per day (LPCD)	CY20 <div><div></div></div> 154 CY21 <div><div></div></div> 158 CY22 <div><div></div></div> 149	6% reduction																				
 Water Sales (mil m³)	<table><tr><th>Water Sales (mil m³)</th><th>CY20</th><th>CY21</th><th>CY22</th></tr><tr><td>Potable Water in Singapore (Domestic)</td><td>320.7</td><td>316.5</td><td>305.9</td></tr><tr><td>Potable Water in Singapore (Non-Domestic)</td><td>180.5</td><td>184.9</td><td>200.8</td></tr><tr><td>NEWater</td><td>141.1</td><td>148.9</td><td>148.2</td></tr><tr><td>Industrial Water</td><td>13.0</td><td>11.4</td><td>12.0</td></tr></table>	Water Sales (mil m³)	CY20	CY21	CY22	Potable Water in Singapore (Domestic)	320.7	316.5	305.9	Potable Water in Singapore (Non-Domestic)	180.5	184.9	200.8	NEWater	141.1	148.9	148.2	Industrial Water	13.0	11.4	12.0	
Water Sales (mil m³)	CY20	CY21	CY22																			
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NEWater	141.1	148.9	148.2																			
Industrial Water	13.0	11.4	12.0																			
 Water Efficiency Index (WEI) (Litres/pax/day)	CY18 – 20 <div><div></div></div> Baseline 49.08 CY21 <div><div></div></div> 66.87 CY22 <div><div></div></div> 42.52	36% reduction ⁶																				
 PUB Water Consumption (m³)	FY20 <div><div></div></div> 219,700 FY21 <div><div></div></div> 199,773 FY22 <div><div></div></div> 230,649	15% increase ⁷																				
 % Distribution Loss	CY20 <div><div></div></div> 8.0% CY21 <div><div></div></div> 8.2% CY22 <div><div></div></div> 7.5%	0.7% reduction																				
 Percentage of water-quality tests meeting WHO guidelines for drinking water quality.	CY22 100%	Maintained																				

⁶ CY22’s WEI is comparable to CY19’s pre-pandemic WEI. This suggests that water consumption patterns in the office might have returned to what was observed pre-pandemic. However, more data is required to support this hypothesis.

⁷ Increase in water consumption was mainly due to testing and commissioning of new infrastructure, to ensure that equipment, facilities and processes meet design requirements and technical specifications.

Sustainable Water System: Diversification of Water Sources

Four National Taps to meet Singapore's water needs, now and tomorrow

Singapore is one of the most water-stressed countries in the world and cannot achieve water security in a conventional way due to a lack of land to capture and store rainfall. Over the years, PUB has built a diversified, resilient and sustainable water supply through our Four National Taps to meet Singapore's long term water needs. The expected completion of Changi NEWater Factory 3 and Tuas NEWater Factory 1 in 2026 will enhance our NEWater capacities for a more resilient water system.

Our Four National Taps



Water from Local catchment

17 reservoirs. 7 local waterworks.

Through an extensive network of drains, canals, rivers, stormwater collection ponds and reservoirs, we aim to capture and convey every last drop of rainwater for treatment into potable water at our local waterworks.



Imported Water

Drawing up to 250 million gallons of water per day.

The 1962 Water Agreement allows Singapore to draw water from the Johor River for treatment and import into Singapore.



NEWater

Closing the water loop.

Through microfiltration, reverse osmosis and UV disinfection, Singapore's treated used water is recycled into ultra-clean, high-grade, weather-resilient NEWater. NEWater is used in industries and to replenish reservoirs during periods of low rainfall.



Desalinated Water

Harnessing the seas' potential.

Desalination increases the resilience of our water supply against the potential impacts of climate change, such as prolonged drought. Investing in research and development is key to reducing the energy requirements of desalination, as it is currently the most energy-intensive and expensive method of producing water.

Sustainable Water System: Diversification of Water Sources

Story

Reconstructing Choa Chu Kang Waterworks in an environmentally responsible manner

Choa Chu Kang Waterworks (CCKWW) is Singapore's second largest waterworks and the only one located in Western Singapore. Constructed between 1975 and 1981, it is a critical water treatment infrastructure that supplies drinking water to towns in the western part of Singapore. These include Jurong East, Jurong West, Tuas, Penjur, Boon Lay, West Coast and the Nanyang Technological University (NTU).

As part of PUB's long-term planning and timely renewal of water infrastructure to safeguard Singapore's water security, CCKWW's aged infrastructure such as the raw water chamber, clear water tanks, and treated water pumping stations will be reconstructed. The reconstruction works also include upgrading the CCKWW plant with new water treatment technologies and equipment such as high-rate clarifiers and advanced membrane filtration systems, among others.

PUB has taken steps to minimise the environmental impact of the reconstruction project, which will be carried out within the Western Catchment Area.



1. Adjusting project footprint

PUB adjusted the original project footprint to preserve a part of a freshwater stream which is home to aquatic species of conservation significance.



2. Engaging in conversations

PUB worked actively with nature groups to enhance mitigation measures proposed in the Environmental Impact Assessment (EIA) report. Members of the public shared concerns over the loss of green spaces while acknowledging the importance of Singapore's water security.



3. Reducing impact on wildlife

Flora species of conservation significance will be transplanted to suitable habitats, while wildlife shepherding and animal relocation will be conducted prior to land clearing.



Some of the threatened species found on the project site include the puff-faced water snake and straw-headed bulbul.



Choa Chu Kang Waterworks in 2019.

Sustainable Water System: Management of Water Demand

Partnering consumers and industry to conserve precious water.

Singapore's total water demand is expected to almost double by 2065. Critical to our long-term water security is a collective effort to ensure that we are using water in a responsible and sustainable way, even as PUB continues to develop and improve our water supply.



Smart Water Meters

300,000 smart water meters will be installed in households by the second half of 2024. These will help individuals and families keep an eye on household water consumption and take small but valuable steps towards water conservation.

Three strategies to manage water demand



Putting a price on scarcity



In Singapore, water is priced to reflect the scarcity value of water and to recover the full costs of its supply and production. The price of water also incorporates the higher cost of producing water from unconventional sources, specifically NEWater and desalinated water.

Targeted regulation



PUB sets and reviews the water efficiency standards to ensure efficient water use. Under the Mandatory Water Efficiency Labelling Scheme (MWELS), suppliers and retailers must display WELS labels or label information of their WELS products, to allow consumers to make informed choices and do their part to reduce their water use.

Engaging people and businesses



We encourage everyone to play a part in water conservation programmes and initiatives for households, partners, industries, and community to make every drop count. More details on PUB's outreach activities can be found on Page 47 - 50.

Managing water demand in PUB

Under GreenGov.SG, the public sector's sustainability movement, all standard government infrastructure are required to reduce our Water Efficiency Index by 10% by 2030. PUB has conducted internal water audits of the existing water systems and identified areas for improvement to further reduce our water consumption in our standard building premises.

Sustainable Water System: Management of Water Demand

Mandatory recycling to boost non-domestic water efficiencies

Why does water recycling matter?

As projected water demand growth is expected to be driven by the non-domestic sector, non-domestic water efficiencies must be improved through measures such as recycling water on-site for reuse to conserve our scarce water resources.

Mandatory Recycling Requirements for water-intensive industries

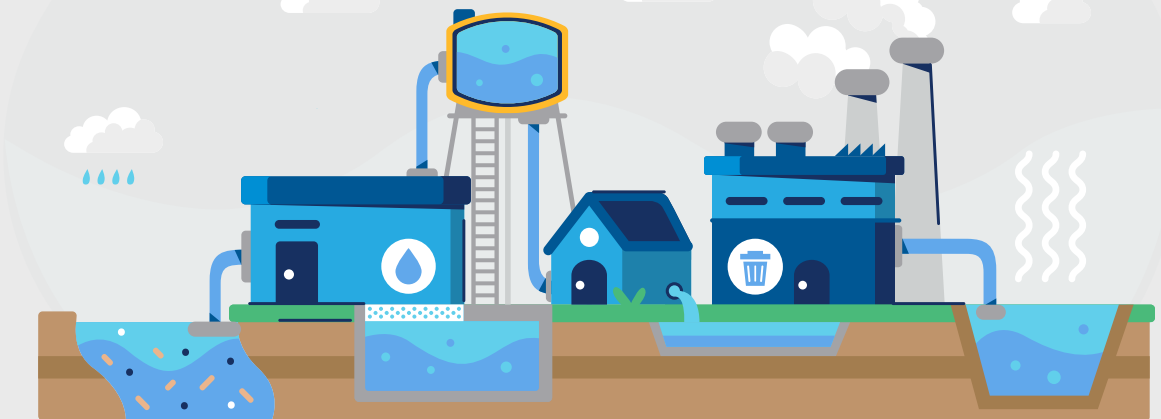
The wafer fabrication, electronics, and biomedical industries are amongst the largest water users in Singapore, accounting for more than 17% of non-domestic water demand. They are projected to be the main contributors to non-domestic water demand, and are expected to make up two-thirds of total water demand in the future.

There is high potential for water recycling in these industries, as their fairly clean waste streams can be segregated at source and effectively recycled with minimal treatment. From 1 January 2024, PUB will be mandating the following water recycling requirements on new projects that consume at least 60,000m³ of water per annum:

- minimum 50% recycling rate for wafer fabrication plants involved in front-end semiconductor manufacturing; and
- recycling of specified waste streams for electronics and biomedical plants.

With the new recycling requirements in place, companies will be able to lower their water bills, build long-term competitiveness, and contribute to Singapore's resource resilience with total projected water savings of nine million gallons of water per day from 2035 onwards.

Story



Support for companies

Companies engaged in PUB's industry consultation reflected support for the more efficient use of water, and agreed that the new recycling requirements are achievable for new projects. Companies can tap into PUB's Water Efficiency Fund (WEF) and the Industrial Water Solutions Demonstration Fund (IWSDF) until the end of 2025 to defray the costs of their water recycling initiatives to meet this new requirement.

To support these initiatives, the project funding caps for WEF and IWSDF have been raised to \$5 million from July 2023. With the support from the companies complemented with PUB's funding and technical assistance, we can collectively make a significant reduction on national water demand, paving the way for a more sustainable future.

"If the world faces a crisis it will not be due to physical scarcities of water, but... it will be due to sheer mismanagement of water."



Professor Asit K. Biswas,
Winner of the Stockholm Water Prize in 2006

Sustainable Water System: Protection of Water Networks

Strengthening our networks to minimise water loss and contamination

As water flows across Singapore through our extensive network, we have put systems in place to reduce leaks, prevent contamination, and ensure that used water is collected, recycled or discharged with minimal environmental impact. PUB implements various measures to ensure the holistic management and protection of water infrastructure at source and distribution network, and continually develops smart technologies while expanding our network of sensors to better monitor and detect anomalies such as potential leaks in our networks.

More water to the consumer, less waste

Singapore's potable water network has one of the lowest rate of Distribution Losses at approximately 8%. PUB is alerted to anomalies on water flow data transmitted via a network of sensors across the island, allowing PUB engineers on the ground to respond more quickly to incidents such as pipeline leaks.

Potable Water Network Management

PUB is committed to ensuring that potable water reaches consumers with minimal leaks and distribution losses throughout the network. We do this with a rigorous leak management programme which starts with good design and construction, implementing leak monitoring and detection systems, and carrying out network enhancements and renewal.

We also deploy online sensors at strategic locations to monitor water quality and conduct over 500,000 tests annually on various water quality parameters from samples throughout our network.



Used Water Network Management

Used water is a precious resource as it can be recycled into NEWater. Hence, we have adopted a multi-pronged approach to regulate the design and maintenance of sewerage systems, and ensure that used water collected is fit for recycling.

We have deployed smart technologies such as GPS tagging of construction machinery and geofencing of sewer corridors to detect situations where the construction machinery poses a risk of damaging our sewers, installed 125 volatile organic compound monitoring units and 175 microbial electrochemical sensors to deter illegal discharges, as well as developed a Sewer Analytics and Management System that analyses sewer water level data to detect potential blockages before it causes any overflow.

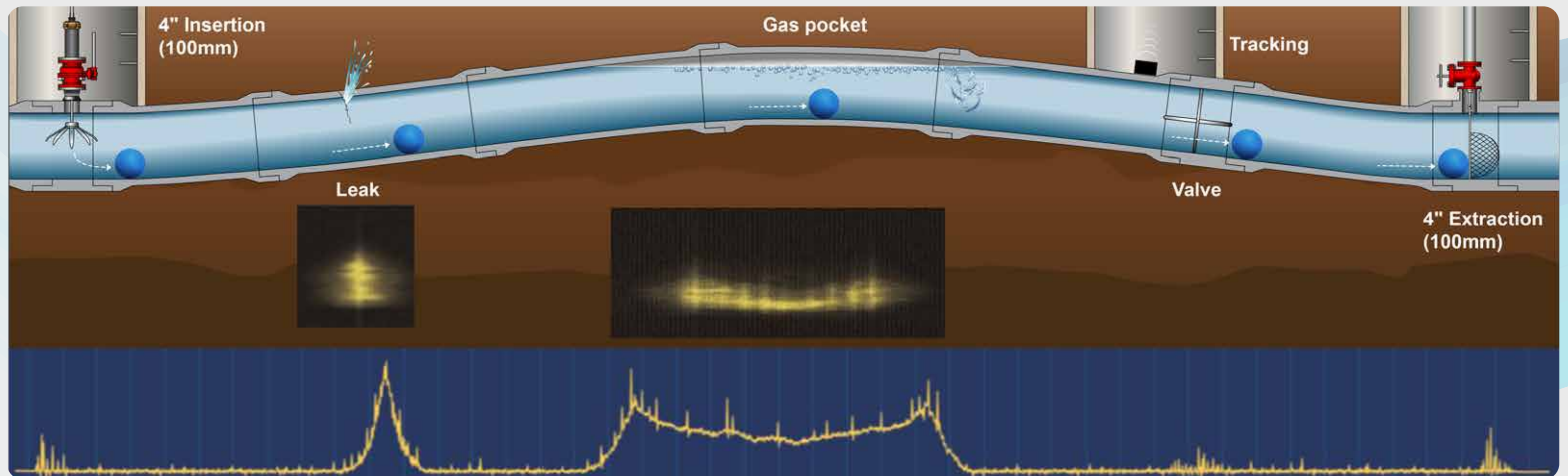
Sustainable Water System: Protection of Water Networks

Story

This fist-sized sphere is working hard to detect leaks in water pipes

Called SmartBall®, this round device is a leak detection tool that is inserted into live pipes for leak detection. Placed in a protective foam covering, SmartBall® picks up acoustic events related to leaks, cracks and anomalies while rolling through our network of pipes. After extracting SmartBall® from our pipes, the data is downloaded and analysed to pinpoint the locations of the anomalies.

SmartBall® considerably reduces the resources required for an inspection and allows us to cover long stretches of pipelines, localizing leaks within two metres, making it easier for PUB teams to fix leaks quickly. We plan to survey 500km of pipes with SmartBall® by 2025, which enhances PUB's ability to take a preventive approach to leak management, making our water network more resilient.



SmartBall® Schematic.

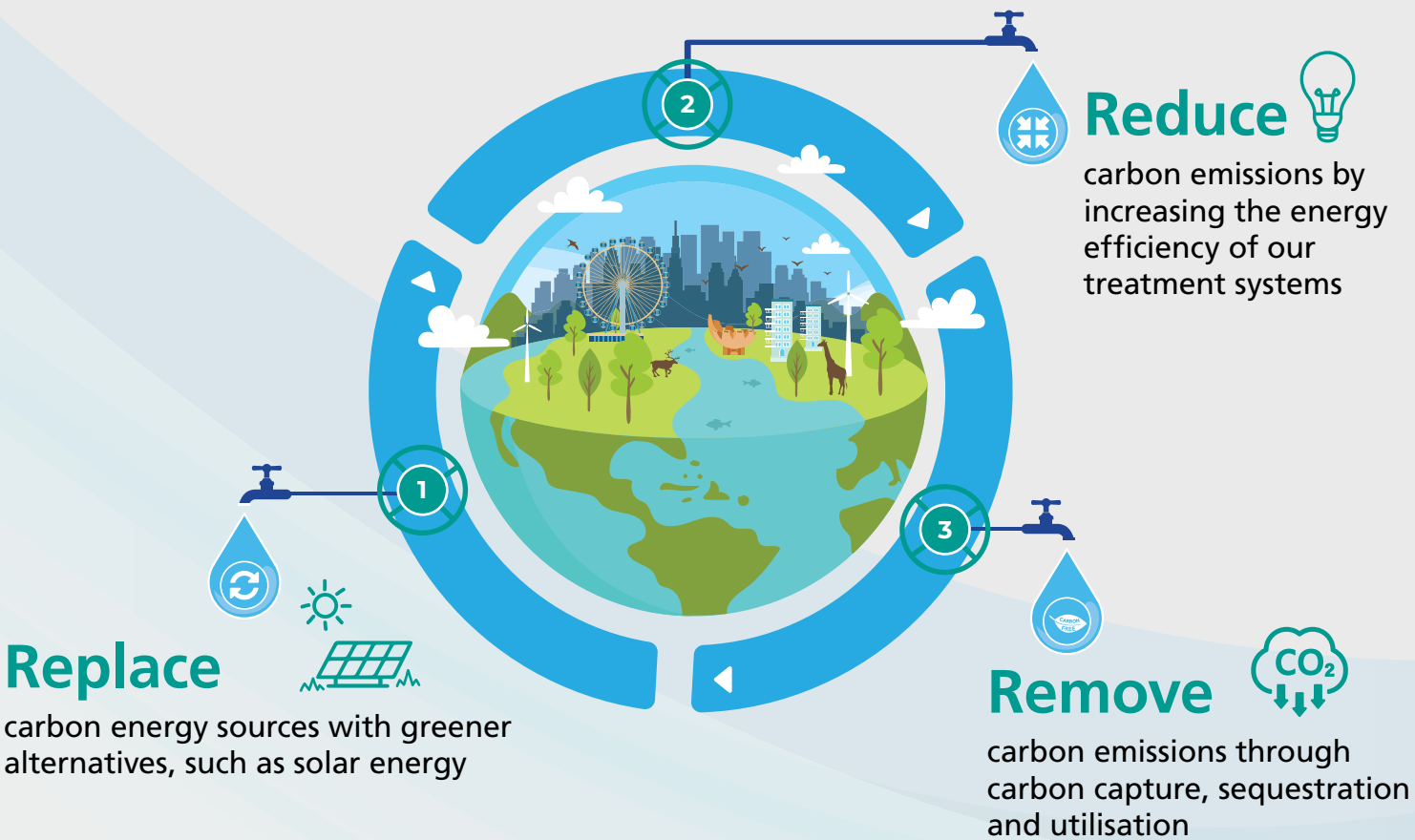
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Decarbonisation – Snapshot




Clean water from clean energy

As climate change increases our reliance on energy intensive sources of water, PUB will do our part to reduce our carbon footprint. PUB takes a proactive approach to decarbonisation across all levels of operations, always with our net zero target in sight.





PUB’s decarbonisation strategy takes a three-pronged approach:



Targets and Commitments

-  **Peak emissions** around 2025
-  **Achieve net zero** emissions around 2045, contingent on the progress of technologies and international cooperation to enable mitigation measures
-  **Achieve 10% reduction** in Energy Utilisation Index (EUI) from average of 2018 – 2020* levels by 2030

** Note: Applicable to PUB’s Standard Buildings only.*

Metrics	Performance	% Year-on-year improvement
 Total Scope 1 and 2 Carbon Emissions ⁸ (ktCO2e)	FY20 <div><div></div></div> 298 FY21 <div><div></div></div> 279 FY22 <div><div></div></div> 247	11% reduction
 Grid Electricity Consumption (GWh)	FY20 <div><div></div></div> 709.5 FY21 <div><div></div></div> 665.9 FY22 <div><div></div></div> 590.3	11% reduction
 Renewable Energy Consumption (GWh)	FY20 <div><div></div></div> 96.1 FY21 <div><div></div></div> 140.5 FY22 <div><div></div></div> 177.2	26% increase
 Energy Utilisation Index (EUI) (kWh/m2)	CY18 – 20 <div><div></div></div> 123.68 CY21 <div><div></div></div> 127.71 CY22 <div><div></div></div> 128.93	1% increase

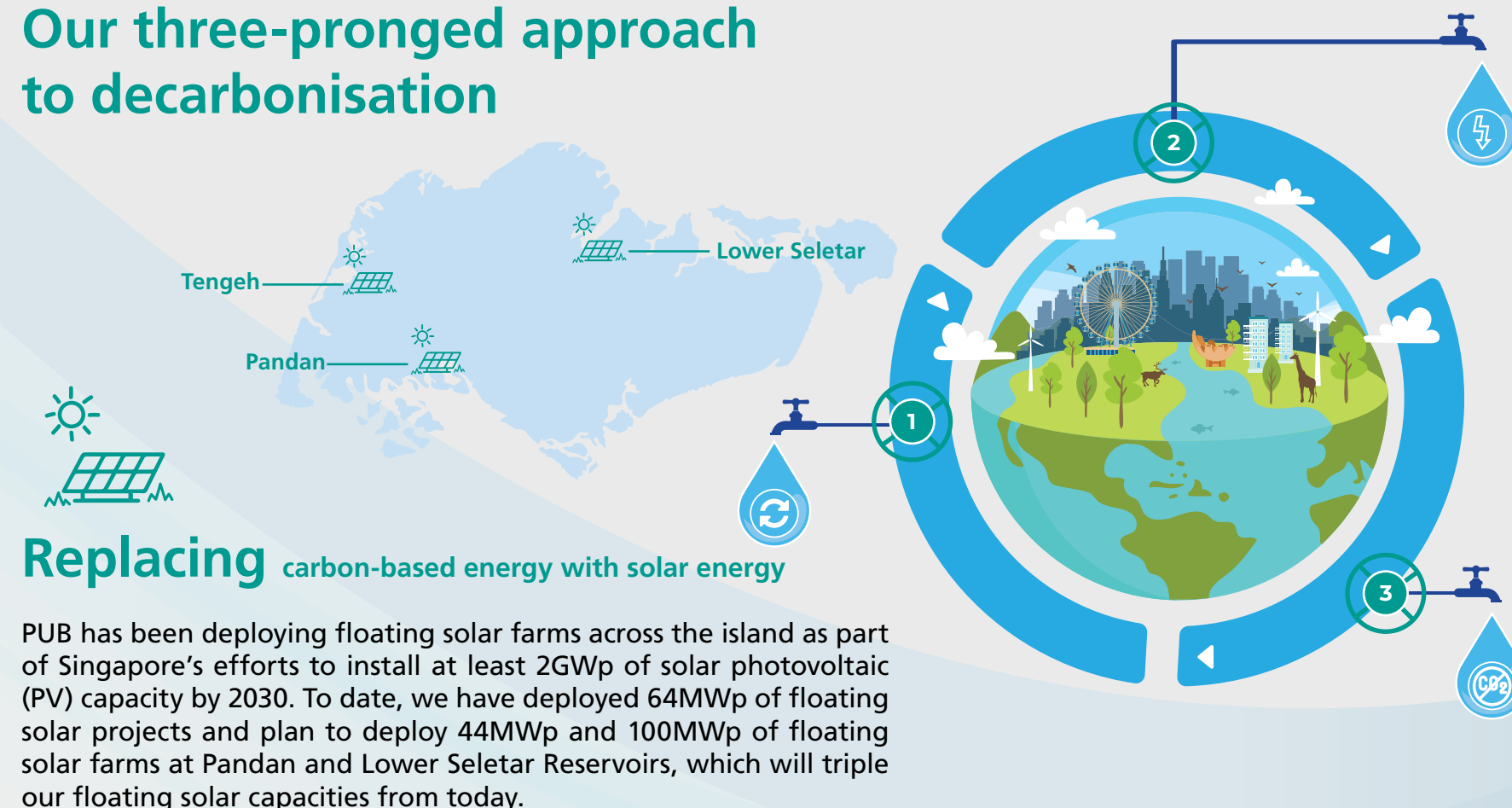
⁸ The scope and sources of reported GHG emissions are aligned to PUB’s GreenGov.SG reporting submission. PUB’s electricity consumption and emissions are largely dependent on public demand for PUB’s services such as water and used water treatment.

Decarbonisation: 3Rs Decarbonisation Strategy

Addressing our big challenge: Increased reliance on weather-resilient, energy intensive water sources

As weather patterns become more unpredictable and global temperatures rise with climate change, we will increasingly rely on climate-resilient sources of water such as NEWater and desalinated water to meet growing water demand. These sources of water are more energy intensive, which could lead to PUB's emissions potentially increasing from 247 kilotonne carbon dioxide equivalent (ktCO₂e) in FY 2022 to about 1 metric tonne carbon dioxide (MTCO₂e) in 2065 if we do not implement new mitigation measures. PUB will do our part to manage our growing energy and carbon footprint.

Our three-pronged approach to decarbonisation



Replacing carbon-based energy with solar energy

PUB has been deploying floating solar farms across the island as part of Singapore's efforts to install at least 2GWp of solar photovoltaic (PV) capacity by 2030. To date, we have deployed 64MWp of floating solar projects and plan to deploy 44MWp and 100MWp of floating solar farms at Pandan and Lower Seletar Reservoirs, which will triple our floating solar capacities from today.

Reducing our energy consumption

We have embarked on energy efficiency measures to reduce energy consumption in our operations, such as process optimisation and replacement of ageing seawater reverse osmosis membranes, which can help PUB reduce electricity consumption by approximately 17 GWh/year. We are also conducting energy audits to identify energy saving opportunities and help our facilities achieve Green Mark Platinum SLE certification. We are embarking on R&D projects with our research partners to develop new energy efficient technologies for NEWater production, desalination and used water treatment.

A pilot plant to validate Pressure Retarded Osmosis (PRO) technology has been set up at Changi Water Reclamation Plant to harness energy from the salinity difference between two waste streams — NEWater reverse osmosis (RO) brine and seawater RO brine. This initiative can potentially offset 14% of the amount of energy needed in the desalination process.

Removing carbon through carbon capture

To realise our net zero target, PUB is working with research partners to explore the integration of ocean carbon dioxide removal (CDR) technologies with PUB's operations. One of the key projects is in desalination-integrated CDR with Equatic.

Decarbonisation

Story

Pushing technological frontiers to capture carbon in the desalination process

PUB's Tuas R&D Facility is the site of some of our most significant innovations in desalination technologies. Here, a \$2.5 million pilot system, commissioned in May 2023 in partnership with Equatic, is testing the viability of desalination-integrated carbon dioxide removal technologies.

How the technology works

Passing an electrical current through seawater mineralises CO2 in seawater and produces hydrogen, which could be used as a green fuel. The CO2-depleted seawater is subsequently 'refilled' by bubbling atmospheric air through it which removes CO2 directly from the atmosphere. The pilot desalination-integrated ocean CDR (carbon dioxide removal) facility is expected to remove 100kg of atmospheric and oceanic carbon dioxide a day.

Worth the investment

The International Panel on Climate Change (IPCC) has affirmed the vital role of CDR technologies in achieving global climate ambitions to limit global warming to 1.50C. Through dedicated and rigorous research, PUB aims to collaborate with our research partners to push technological frontiers in this field and achieve our net zero target.

"The privilege to work with an international leader, PUB: Singapore's National Water Agency, which is focused on decarbonising its water supply, is an opportunity like no other. The coupling of the size and scale of the oceans with pioneering continuous electrolysis processes unlocks gigaton-scale, economic, and technological synergies that position this technology at the cutting-edge of permanent, durable and cost-effective carbon removal solutions."

Gaurav Sant
Pritzker Professor of Sustainability and Director, Institute for Carbon Management, UCLA



The pilot desalination-integrated ocean CDR facility.

Decarbonisation

Story

An upcoming floating photovoltaic system at Pandan Reservoir

PUB will be calling a tender to deploy a 44MWp minimum floating photovoltaic (FPV) system at Pandan Reservoir in 2023, as part of our continuous efforts to build a green and sustainable water system. The design and construction of the FPV system balances clean energy production with the preservation of a much-loved spot where residents and park-goers enjoy recreational activities.

Engaging with neighbours

To better understand and address the concerns of residents who could be affected by the deployment of FPVs in Pandan Reservoir, we invited residents and grassroots leaders from the Ayer Rajah-Gek Poh constituencies for an engagement session and tour at Tengeh Floating Solar Farm, Singapore's first large scale inland floating solar farm.

By sharing intricacies of FPV systems, and how birds and otters coexist with Tengeh Floating Solar Farm, we hope to allay residents' concerns about the impact of the FPV system on their daily lives while emphasising the importance of decarbonising our water treatment systems. PUB's initiatives are most successful with the support of the public, and we are committed to public engagement as we work to deliver clean water from clean energy.



Residents on a tour at Tengeh Floating Solar Farm.



Otters on solar panels at Tengeh Floating Solar Farm.
Photo credits: Sembcorp Industries.

The Pandan Reservoir is expected to have a minimum solar potential of 44MWp, generating 52GWh of renewable solar energy annually. That's the equivalent of powering 11,800 4-room flats and taking about 5,000 cars off the road.

GRI [2-23] [2-24] [2-25] [3-3] [306-1] [306-2] [306-3]

Resource Circularity – Snapshot

Getting more out of what we have

Our operations can lead to the generation of waste which impacts our natural environment. This can be mitigated through the pursuit of resource circularity. Being a small country with scarce resources, we must maximise what we have and reduce waste sent to our landfill. PUB is committed to minimising waste production, recovering value from our waste streams, and maximising synergies as part of our key sustainability initiatives.

PUB improves resource circularity with two main strategies:



Targets and Commitments









Minimise amount of waste generated and improve resource circularity



Reduce Waste Disposal Index (WDI) by 30% from 2022 levels by 2030*

* Note: Applicable to PUB's Standard Buildings only.

Metric	Performance	% Year-on-year improvement
 Mass of non-hazardous operational waste from used water and water treatment (tons) ⁹	FY20  201,430 FY21  193,393 FY22  190,861	1% reduction
 Waste Disposal Index (WDI) (kg/pax/day)	FY22  0.293	N/A

⁹ Operational waste, such as water and used water sludge makes up the bulk of PUB's overall waste. Sludge is a by product of PUB's water and wastewater treatment processes. The amount of waste that PUB generates is dependent on water demand and the quantity and quality of used water discharged by domestic and industrial sectors.

Resource Circularity: Sludge Reduction and Reuse Strategies

Moving towards zero waste to landfill

The production and treatment of potable and used water generate waste streams such as treatment sludge. Treated sludge is incinerated before it is transferred to Semakau Landfill. With limited land to dispose waste, Singapore targets to reduce the waste sent to Semakau Landfill by 30% by 2030. To minimise our waste footprint, PUB has embarked on research and development to develop new technologies to reduce and reuse our sludge waste streams, while maximising synergies from the water-waste-energy nexus to enhance energy generation.

Reduce and reuse sludge while harnessing synergies¹⁰

Reduce sludge generation

The amount of sludge produced is expected to increase with rising water demand. PUB will be adopting technologies such as biosorption and thermal hydrolysis processes in the upcoming Tuas WRP. These processes convert more organics in sludge into biogas which reduces sludge generation. We are also utilising alternative coagulants in waterworks to reduce sludge generation.

Reuse sludge

To convert various waste streams into higher value products, PUB is exploring mono-sludge gasification technology to produce slag from sewage sludge for both non-structural and structural concrete applications. PUB is also exploring the use of sintering technology to convert waterworks sludge into lightweight aggregate for gardening and concrete application.

Harnessing synergies

Planning a closed waste loop for the future and achieving resource circularity requires a collaborative effort. Tuas Nexus is a multi-agency effort, integrating the operations of PUB's Tuas WRP and NEA's Integrated Waste Management Facility (IWMF). For example, the co-digestion of used water sludge and food waste increases biogas production, which can be processed in high efficiency superheaters at IWMF to generate more electricity. Electricity generated will be used for plant operations and excess will be exported to the grid.



¹⁰ Please refer to PUB's inaugural Green Bond Report for more details on how Tuas WRP harnesses process synergies from used water and solid waste treatment.

Resource Circularity

Slag, a new material produced by recycling sludge

In March 2023, PUB concluded a three-year feasibility study with Nanyang Environment and Water Research Institute (NEWRI) to explore the co-gasification of PUB's waste streams with municipal solid waste (MSW). This produces slag (which can be used as sand replacement) while reducing sludge volumes.

How slag is produced

Slag is generated through gasification, a multi-step process that treats sludge at high temperatures. Through co-gasification with MSW, sludge waste could be potentially reduced by 90%, while producing slag in an integrated process.



Slag embedded in mortar.

Gasification means less sludge waste sent to the incinerator or landfill, while slag could replace sand use in non-structural applications in the construction sector. This supports Singapore's development of a circular economy and contributes towards Singapore's Zero Waste Nation ambition.

Story



Ceramic membranes at CCKWW.

Reducing liquid waste streams with ceramic membranes

In anticipation of water quality changes due to climate change, Choa Chua Kang WaterWorks has been fitted with ceramic membranes and ozone-biological activated carbon filters since 2019 to enhance its advanced water treatment processes. Ceramic membranes have longer lifespans compared to polymeric membranes and higher recovery rate which reduces waste streams. These make ceramic membranes a greener solution to waste reduction.

GRI [2-23] [2-24] [2-25] [3-3]

Coastal Protection and Flood Resilience – Snapshot

Our defence against climate change

Climate change adaptation is vital to our survival, as extreme weather events become more common and sea levels rise. PUB contributes to a more resilient Singapore by protecting our coastlines and managing stormwater to reduce flood risks. As a low-lying city encircled by the sea with approximately 30% of the island at less than five meters above mean sea level, Singapore is vulnerable to rising sea levels. These challenges underscore the importance of PUB's mission to protect our coastlines and manage stormwater for flood resilience.

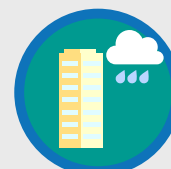
PUB pursues the following as we adapt to climate change:



Developing site-specific coastal adaptation plans to resist rising seas



Employing a Source-Pathway-Receptor approach to enhancing flood resilience



Source

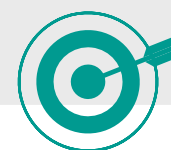


Pathway



Receptor



Targets and Commitments



Protect Singapore's coastlines from rising sea levels



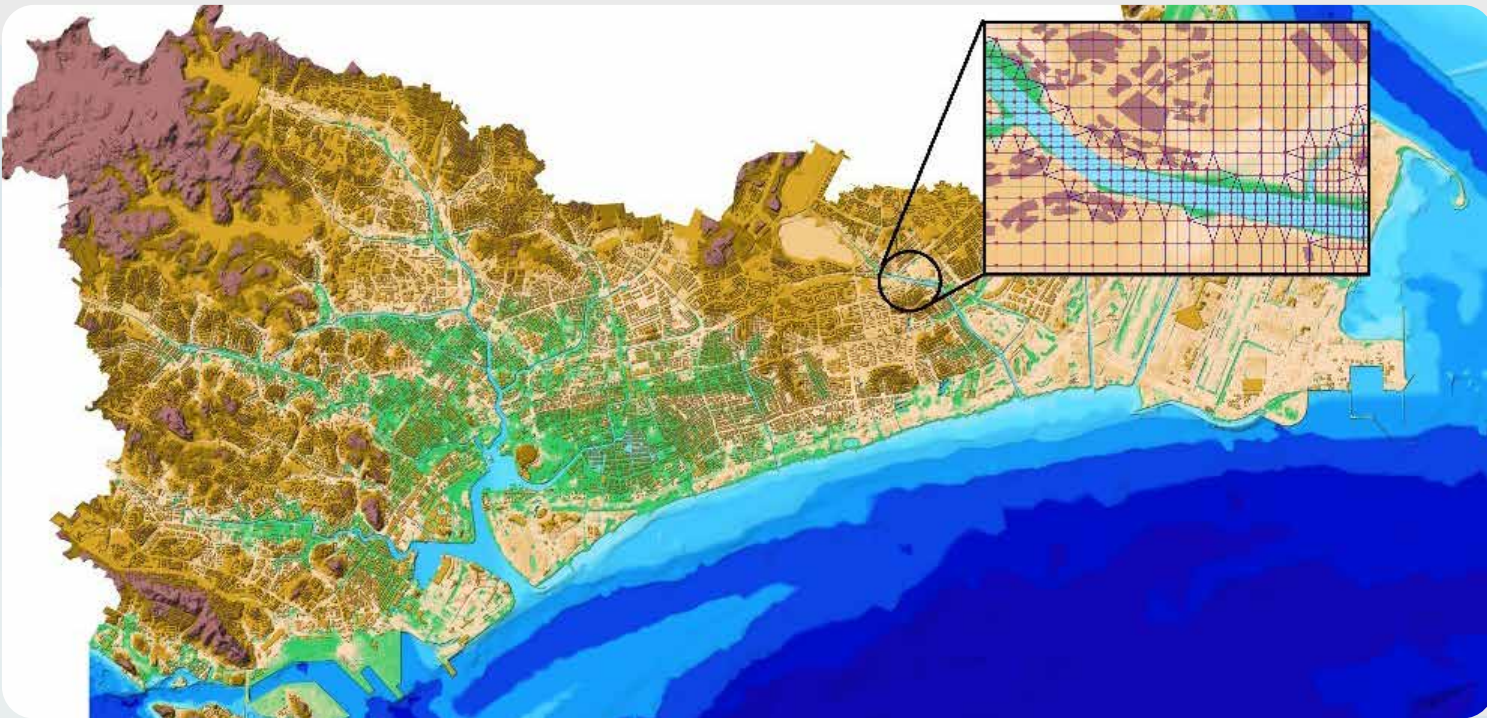
Tame stormwater by reducing our flood prone areas

Metric	Performance	% Year-on-year improvement
 No. of site-specific studies commenced (to date)	CY21 <div><div></div></div> 1 CY22 <div><div></div></div> 3 (Includes Jurong Island SSS, led by JTC)	NA
 No. of hectares (ha) of flood prone area	CY20 <div><div></div></div> 28 CY21 <div><div></div></div> 28 CY22 <div><div></div></div> 27	1 ha of FPA removed

Coastal Protection

Fulfilling our mandate to safeguard our coastlines against climate change

As Singapore’s national Coastal Protection Agency, PUB leads and coordinates whole-of-nation efforts to protect Singapore from the threat of rising sea levels. By 2100, the mean sea level is projected to rise by up to 1 metre due to higher temperatures, and sea levels could rise up to 4–5 metres in extreme events where high tides and storm surges coincide.



Coastal Inland Flood Model Simulation.



Possible coastal protection measures including hard engineering solutions such as seawalls designed to be multifunctional (for example, integrated with promenade) will be studied during the SSS.

With adequate planning and timely action, we can future-proof Singapore against rising sea levels and prevent disruption to lives and livelihoods. Site-specific studies (SSS) for various segments of Singapore’s coastline are being carried out progressively, starting with City-East Coast in 2021, followed by Northwestern Coast (Coastal Reservoirs) and Jurong Island in 2022.

Coastal Protection

Our Coastal Adaptation Strategies are underpinned by three approaches



Holistic risk assessment

Through the Coastal-Inland Flood Model, inland and coastal flood risks can be assessed holistically, to understand how Singapore's urbanised environment will be affected by the twin threats of intense rainfall and extreme sea levels. Incorporating the latest available climate science data, the model supports the planning and engineering design of coastal protection infrastructures as well as emergency response operations.



Adaptive and flexible approach

Climate projections are uncertain, with climate science still advancing. Hence, a flexible approach for our coastal protection measures will be adopted to allow short term investments in no-regret measures, with built-in options for long-term adaption when required.



Integrated Planning

No one-size-fits-all coastal protection measure can be implemented along Singapore's highly varied coastline. Coastal protection measures can complement land use and incorporate multi-functional designs, and will be formulated as part of the site-specific studies for various segments of Singapore's coastline, with inputs from experts and stakeholders.

Managing trade-offs

Current spending
vs future security



Multiple needs
for land use

Setting unified standards for Singapore's coastal protection infrastructure

We are developing a new code of practice to provide guidance to the industry in the design, construction, operation, and maintenance of coastal protection infrastructure. The infrastructure includes sea walls, tidal gates, pumping stations, etc. The code of practice requirements will ensure that coastal protection infrastructure is designed and maintained to the required standards to protect Singapore in the long run.

Coastal Protection

Committing to innovation: our \$125M Coastal Protection and Flood Management Research Programme (CFRP)

Tackling climate change requires investment in research and innovation, bringing together local and overseas multi-disciplinary experts to co-create, conceptualise and develop innovative coastal protection solutions. This is why PUB has launched a \$125 million research programme, funded by the National Research Foundation, dedicated to strengthen and advance Singapore’s coastal protection and flood management capabilities to support the long-term mission.

Innovation through intersections between research areas

The unique challenges of Singapore’s land-squeezed, highly urbanised environment necessitate creative solutions. Areas of research work funded through the programme include: developing innovative, sustainable and smart coastal protection solutions and integrating the use of nature-based solutions such as mangroves, understanding coastal science and undertaking digitalisation, monitoring and prediction of our coastal environment.

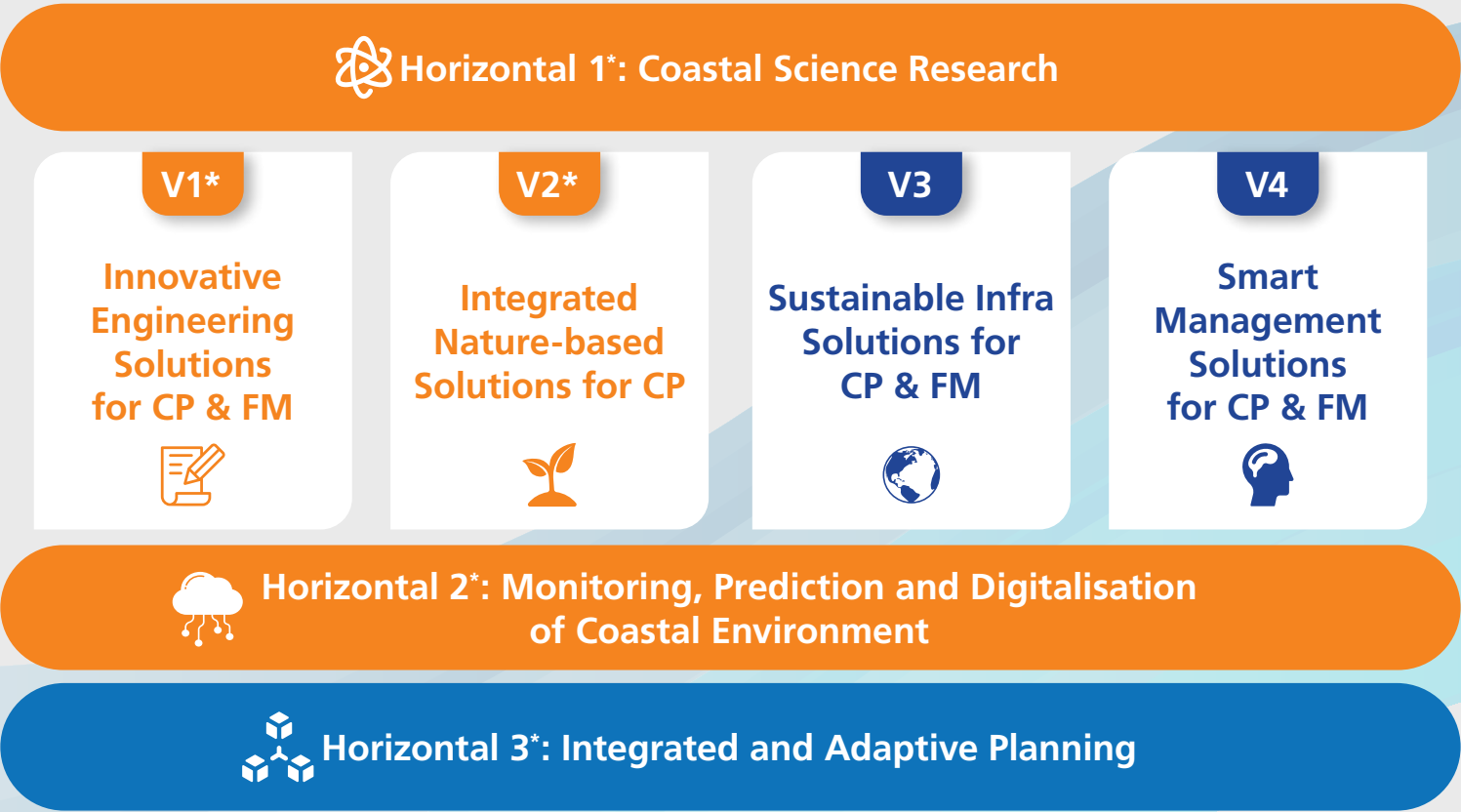
A partnership of minds, a new generation of experts

National University of Singapore will host the new multi-institutional Centre of Excellence (CoE), with the Nanyang Technological University, Singapore University of Technology and Design, Singapore Institute of Technology and Agency for Science, Technology and Research as partner institutes to the CoE. In addition to collaborating on coastal and flood management solutions, these institutions will also develop undergraduate and postgraduate programmes in coastal engineering, climate adaptation, and flood management. Through this, PUB hopes to develop a vibrant local research ecosystem which understands Singapore’s unique challenges and has the relevant expertise.

Story



OVERVIEW OF THE CFRP FRAMEWORK



CP = Coastal Protection | FM = Flood Management | *Under CFI Singapore’s scope

Coastal Protection

Our Coastal Conversation

On 15 and 28 October 2022, 135 members of the public with diverse backgrounds, joined by Minister of Sustainability and the Environment Grace Fu, Senior Minister of State Koh Poh Koon and Senior Minister of State Tan Kiat How, attended the inaugural Our Coastal Conversation. The series of dialogues were organised by PUB to engage and seek ideas and inputs from Singaporeans as PUB develops potential coastal protection measures along the shoreline.

Hearing new voices, seeing new perspectives

The participants represented a range of backgrounds and age groups, from everyday citizens to committed environmentalists and experts, resulting in a lively exchange of ideas and the sharing of fresh perspectives. Listening to one another highlighted how different individuals have varying views and concerns about coastal protection. Participants also forged a better understanding of the considerations, costs and trade-offs while accommodating and balancing different needs and aspirations when tackling the issue of intense rainfall and sea level rise.

Stepping up our climate resilience, together

Through this consultative approach, PUB aims to involve Singaporeans in the planning of coastal protection measures and create space for exchange of ideas. Such dialogues are an integral aspect for collective effort / collaboration to increase our resilience against climate change.

Story

"I do not, for one moment, think that we are helpless bystanders in climate change."

Ms Grace Fu,
Minister for Sustainability and the Environment,
at the inaugural Our Coastal Conversation, 15 October 2022



Senior Minister of State Koh Poh Koon participating in conversations at Our Coastal Conversation on 28 October 2022.



Participants interacting at Our Coastal Conversation.

Flood Resilience

Improving our resilience against heavy rainfall and flooding

Climate change has the potential to change weather patterns, making rainfall more frequent, intense, and unpredictable. By adopting a system-level Source-Pathway-Receptor approach, implementing drainage upgrading and improvement works, enhancing flood response capabilities and engaging the community, PUB aims to boost flood resilience to reduce flood risk and impact to lives and livelihoods.

Some Singaporeans may recall that floods were common in the 1970s. Since then, PUB's significant flood-mitigation and drainage expansion measures have reduced the flood prone areas in Singapore from 3,200 hectares (ha) to less than 30 ha today.

Our flood resilience measures



Drainage upgrading and improvement

We have been implementing major drainage upgrading and improvement projects across the island with a combination of long-term and interim solutions to enhance flood resilience. Recent projects which involve road raising and / or drainage improvement works include:

- Improvement to Bedok Canal Contract 2 between Upper Changi Road East and Bedok Junction (Jan 2023).
- Jurong East Street 21 (Jun 2023).
- Tampines Road Area from Hougang Ave 1 to Hougang Ave 7 (Jul 2023).
- Upper Changi Road / Bedok North Ave 4 (Jul 2023).



Leveraging technology for improved flood monitoring and response

PUB currently operates a network of more than 1000 water level sensors and more than 500 CCTVs installed across the island for flood monitoring. These sensors alert us to rapidly rising drain water levels and provide us with real-time site information, so that we can issue early alerts to the public and activate our Quick Response Teams to the affected areas to render necessary assistance on site and keep public out of harm's way.



Engaging the public to tackle floods together

Flood response works most effectively when it is a nationwide effort. We take the initiative to keep the public informed about flood risks through advance alerts across various platforms including Telegram, X, and myENV app, and issue location-specific alerts to motorists for them to avoid these locations with flood risks.

PUB encourages members of public to subscribe to PUB's Telegram Channel (<https://t.me/sgflood>) or myENV Mobile App to receive timely updates on heavy rain, potential flood risk locations and flash flood areas on-the-go.

PUB also loans flood barriers and flood bags to support residents in low-lying areas during the monsoon season, which can be deployed quickly during heavy rain.

Flood Resilience

Story

Members of the public can enjoy the scenic surrounds of Alkaff Lake with peace of mind. Water level sensors in the lake trigger a warning system when it rains, with public announcements and warning lights to alert the public to move out of the lake.



Artist's impression of Alkaff Lake when it is completed in end 2023.

Construction of Alkaff Lake

The new Alkaff Lake demonstrates PUB's approach to manage flood risks in land-constrained Singapore - a multifunctional solution that improves flood resilience while providing new recreational spaces.

Managing stormwater and improving flood resilience

Integrated within the 10-hectare Bidadari Park, Alkaff Lake serves as a retention pond that slows down and temporarily holds stormwater runoff during a heavy storm, taking pressure off the downstream public drainage system and thus reducing the risk of flash floods.

Peaceful green spaces for the community

The gently sloping banks of Alkaff Lake are integrated seamlessly with Bidadari Park, with a nest-shaped deck with panoramic views of the park to provide additional recreational spaces for the community, as well as a little island in the middle of the lake where a conserved rain tree stands. Active, Beautiful and Clean Waters (ABC Waters) features such as terraced wetlands and a cascading creek help to cleanse stormwater runoff before discharging into the lake.



DPM Lawrence Wong together with PUB's partners and the community, participated in a walk to raise awareness for water conservation during Singapore World Water Day 2023.

People and Partnerships

Just as our lives run on water, PUB thrives because of our people. By prioritising the well-being and safety of our staff, as well as equipping them with future-ready skillsets, PUB aspires to be an employer of choice. However, PUB cannot achieve our mission by ourselves. We engage the wider community, from industry partners and public agencies to schools, individuals and households to promote water conservation and strengthen our collective resilience to climate change.

2-1 Our People: Healthy, Safe, Competent
2-2 Customers and Community


"At the heart of PUB is Our People. Generations of PUB officers have dedicated their lifelong careers to turn the dream of having a resilient and reliable water supply into reality. Moving forward, in the face of climate change, our people remain the key source of inspiration and ingenuity, turning challenges into opportunities, as we continue to build a sustainable water system that generations after us can continue to depend upon."

Chong Mien Ling, Director
Human Resources Department, PUB

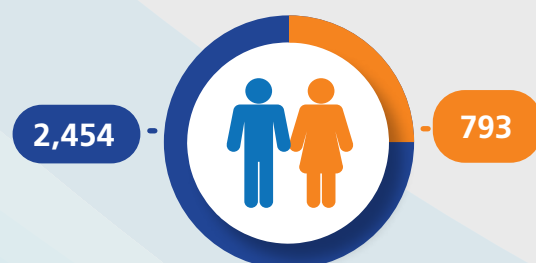
GRI [2-7] [2-30] [401-1] [404-3] [405-1]

FY22 Employee Profile

In FY22, the total number of employees in PUB was 3,247¹¹, comparable to FY21 at 3,260. Staff turnover¹² has decreased slightly from 316 (9.7%) in FY21 to 307 (9.5%) in FY22. PUB has launched new initiatives to enhance staff retention, such as a new Engineering and Science scheme of service and an alternative specialist career track for technically inclined officers. To build a positive work environment and leadership culture, PUB will be progressively rolling out 360 surveys for senior management and middle managers in 2023. These efforts complement the bi-annual performance review where all officers are engaged by their supervisors on their performance, developmental needs and career plans to enhance their professional development and growth.

 **Number of Employees**
(Total: 3,247)


by Gender



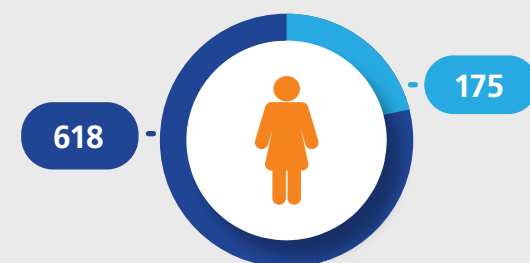
by Age Group



● Less than 30 years old ● More than 50 years old¹³
● 30 to 50 years old


 **Number of Employees by Employment Contract and Gender**
(Total: 3,247)

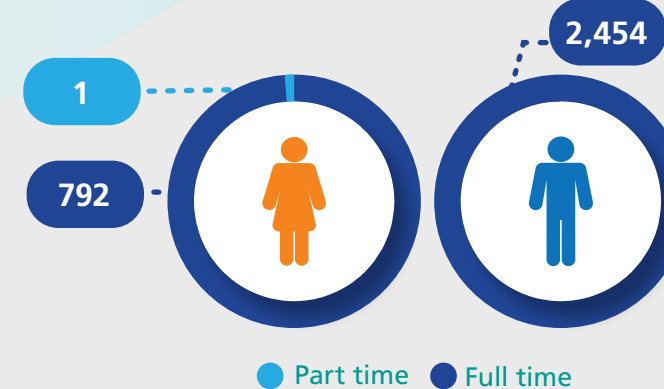
by Gender




● Contract ● Permanent

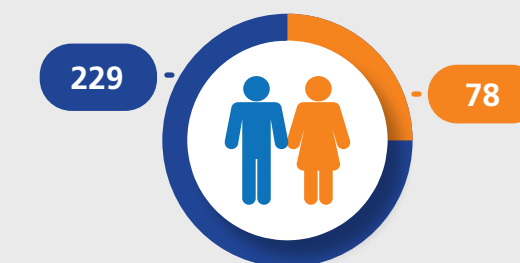


 **Number of Employees by Employment Contract and Gender**
(Total: 3,247)



 **Number of Turnovers**
(Total: 307)


by Gender



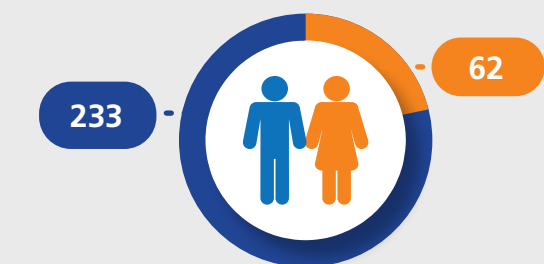
by Age Group



● Less than 30 years old ● More than 50 years old
● 30 to 50 years old

 **Number of New Hires**
(Total: 295)

by Gender




by Age Group



● Less than 30 years old ● More than 50 years old
● 30 to 50 years old

 **Number of Staff who are Union Members and covered by bargaining agreements**

 % of Staff Who are Union Members
80.7%

 Covered by Collective Bargaining Agreements
58.6%

¹¹ The employee profile covers officers with an employment relationship with PUB. This includes officers who are seconded out to other agencies, on study leave or on no pay leave. It excludes officers seconded from other agencies to PUB.

¹² Please refer to page 64 for a definition of turnover.

¹³ As at 31 March 2023, the total number of older workers who continued working past the retirement age of 63 is 298.

GRI [2-23] [2-24] [2-25] [3-3] [403-1] [403-2] [403-3] [403-4] [403-5] [403-6] [403-7] [403-8] [403-9] [404-1] [404-2]

Our People: Healthy, Safe, Competent – Snapshot

Empowering our workforce, prioritising their well-being

Our staff are our most important asset and sustain our entire spectrum of operations. PUB is committed to the health, safety and life-long learning of our staff for a more effective workforce. Our people bring a wide variety of skillsets and expertise to PUB. PUB supports their continued well-being and growth through the following strategies:

**Instituting
robust safety
management
systems and
structures**



**Upskilling our
staff through
competency-based
training**



Targets and Commitments





Zero work-related injuries and fatalities



Ensure all PUB officers go through competency-based training

¹⁴ There was a fatal incident (at Kranji Water Reclamation Plant) in August 2022 and two incidents that resulted in major injuries (one at DTSS Phase 2 Contract T-09 and another at CWRP Phase 2 Expansion Project Site) in April and September 2022, all involving contractor workers. In response to these incidents, PUB conducted safety timeouts at all our installations and project sites to share the incidents with the workers, reinforce the importance of workplace safety to our staff and contractors, and reviewed safe work procedures as part of the safety timeouts.

Metric	Performance	<div><div></div> Employees</div> <div><div></div> Contractors</div>	% Year-on-year improvement
 No. of Minor Injuries, Major Injuries and Fatalities	CY20: Minor Injuries 11 39 50 Major Injuries 1 1 2 Fatalities 1		Minor Injuries (-9), Major Injuries (+1 ¹⁴), Fatalities (+1 ¹⁴)
	CY21: Minor Injuries 6 36 42 Major Injuries 1 Fatalities 0		
	CY22: Minor Injuries 3 30 33 Major Injuries 2 Fatalities 1		
 Average number of training hours per employee	FY20 45 FY21 52 FY22 52		Maintained

Our People: Health & Safety

Health & Safety is an organisation-wide commitment at PUB

In PUB, we need to embrace a Zero Accident Mindset, learn from past incidents and take ownership of Health and Safety. The Health and Safety Board Committee guides PUB Management in setting and reviewing health and safety policies. Through PUB's Safety Steering Committee chaired by PUB's Chief Executive, Management sets the strategic direction for health and safety matters. The Steering Committee is in turn supported by the various committees such as the Plant, Construction and Health and Safety Excellence 2028 Safety Committees. Through our Safety Management System, we aspire to be a **zero-incident** workplace as well as to minimise safety lapses and impact on well-being. Health & Safety is everyone's responsibility.

Compliance

All staff, contractors and consultants are required to abide by PUB's Life Saving Rules and site-specific safety rules when performing work at PUB premises.



Audit and Inspection

PUB's project teams and departments conduct cross installation and construction safety audits to identify good safety practices that can be replicated across worksites to make the workplace safer.



Safety Management System

PUB's safety management system is aligned with the Ministry of Manpower (MOM)'s Workplace Safety and Health Guidelines and covers all activities, employees and workers at PUB. In addition, PUB adopts a learning and sharing approach towards safety. Audit observations and incident investigation findings are shared across PUB and its stakeholders regularly to ensure good practices and lessons are communicated and adopted.

Investigation

PUB investigates each incident thoroughly to identify the root cause, and compiles analytics to glean insights on how similar safety lapses could be minimised in future.



Risk Management

PUB is embracing robotics to reduce manual work and associated safety risks. We have deployed drones for remote surveillance of confined spaces and objects of interest at height, and robots to facilitate the cleaning of deep tanks.



Incident Reporting

PUBSafe, a one-stop safety management app, digitalises safety processes in PUB. It allows staff to report safety observations without fear of reprisals and carry out various safety related tasks such as Toolbox meetings and inspections more easily.



Our People: Competent

Relevant job-specific training for a future-ready workforce

We cannot maintain or plan for a sustainable water system, if we do not have committed, capable staff who are equipped with job-specific skillsets to perform their jobs effectively. In addition to focusing on the professional development of our employees, PUB acknowledges the growing significance of mental well-being in the workplace. This is crucial for cultivating a resilient and future-ready workforce to uphold our mission.

A competent, resilient workforce



Hardware – Forging skills for the future

Every PUB staff today has a structured training roadmap tailored to his or her job post with identified competencies that will allow staff to carry out their duties effectively. To support lifelong learning, PUB will continue to invest in the professional development of our staff by providing additional options for competency-based training, opportunities for professional certification, and pathways for academic qualifications.



Heartware – Nurturing a resilient workforce

COVID-19 has highlighted the importance of making mental wellness a priority, and PUB is committed to ensuring that staff are equipped with basic competencies in mental health awareness. PUB has sent our supervisors on training courses to raise general awareness on mental well-being. We partnered with external organisations to deliver mental wellness talks and provide tips to staff to enhance mental well-being. We have also set up a network of 58 Care & Wellness Ambassadors to promote a culture of care and mental wellness across departments to better support and care for our staff.

Developing our engineers' knowledge and skills on renewables



In our move towards more sustainable practices, our officers are given the opportunity to build their knowledge, skills, and familiarity with solar panels to support our decarbonisation efforts. This includes enrolling engineers in courses where they can attain the certification needed, e.g. the Green Mark Accredited Professional (GMAP) course.

Our People: Health and Safety

Stories

Senior management participation in experiential safety training

In partnership with our contractors McConnell Dowell and Jacobs, PUB has set up an experiential training facility at Tuas WRP to simulate hazardous working conditions for greater awareness of workplace safety. On 15 September 2022, senior management had the opportunity to step into this unique facility to experience simulation training first-hand.

Workplace safety risks in realistic scenarios

Eight safety simulator stations allow participants to experience common workplace safety risks such as work at height, confined space environment, and traffic management in construction workplace. All workers and staff at Tuas WRP use this facility as part of their mandatory safety induction to maintain a safe working environment at the Tuas WRP construction site.



CE visiting the Tuas WRP experiential safety training facility.

Participating in an immersive experience

Standing near heavy vehicles at a construction site is dangerous, as heavy vehicles have more blind spot areas than regular vehicles and can cause serious injuries when they move suddenly. While most people have not experienced this, the 'crushing by moving machinery' simulator demonstrates the danger in such a scenario and allows staff to gain greater appreciation of such hazards and the importance of workplace safety.



PUB staff using BWC to livestream routine inspection.

PUB Enterprise Wearable System

PUB has been harnessing innovative technologies to make work safer. Some 1,800 sets of Body Worn Cameras (BWCs) are being deployed to ground staff by 2024 to enable fall detection, SOS call and live streaming capabilities. These ensure that timely assistance and guidance can be provided to staff for a safer workplace. Please refer to page 24 of PUB's Annual Report 2023 for more details.

Our People: Competent

Building Sustainability Awareness through E-Learning

Awareness is the greatest agent for action, and it is critical to impart basic competencies in staff at every level so that we know how to contribute to a more sustainable future. Developed by agencies under the MSE Family, the Environmental Sustainability e-Primer which will be rolled out in September 2023, aims to impart key knowledge and basic understanding of environmental sustainability.

Being a Green Public Officer – It's Easy!

The Environmental Sustainability e-Primer covers key concepts in environmental sustainability, while increasing awareness of what public officers can do at the individual level to contribute towards a green government. For example, officers can turn to more energy efficient appliances with better energy efficiency ratings, take public transport and bring their own reusable bags, containers and utensils for a more sustainable lifestyle. To broaden officers' understanding of the national and international sustainability landscape, officers will also learn what MSE Family agencies are doing to manage water, waste and energy. Learning content will cover the Singapore Public Service's contribution to national sustainability efforts such as Singapore Green Plan, as well as both local and international efforts to address climate change.

Story

Designing the programme

"The e-learning content was designed to comprehensively introduce different levels of sustainability efforts, from the global to Singapore to Agency and individual levels. By imparting basic knowledge on environmental sustainability to our officers, we hope that everyone will have the awareness and aspirations to do their part for a more sustainable future."

Yap Wai Kit, Assistant Director, PUB



Leaders in the MSE-Family trying out the Environmental Sustainability e-Primer trial at MSE Family Connects.

GRI [2-23] [2-24] [2-25] [3-3]

Customers and Community – Snapshot

Working with the community towards shared sustainability ambitions

At PUB, we believe that the success and impact of all our sustainability initiatives, from water conservation to climate adaptation, hinge on obtaining widespread engagement and buy-in from the wide community in Singapore. We engage stakeholders, such as customers, schools, industry partners and the wider community on various focus areas, such as:

Targets and Commitments



Continue to engage stakeholders to conserve and protect our waters



Maintain high service standards for our customers

Water Conservation






Singapore World
Water Day 2023

Flood Resilience



Regular Community and
Resident Engagement

Metric	Performance	% Year-on-year improvement
 Successful execution of SWWD		NA
 % transactions completed digitally end to end	CY22 <div><div></div></div> 100%	Maintained
 Percentage of customer cases resolved within three working days ¹⁵	CY20 <div><div></div></div> 93% CY21 <div><div></div></div> 93.5% CY22 <div><div></div></div> 92%	-1.5 percentage points

¹⁵ PUB is committed to the timely resolution of customer feedback in an effective and efficient manner. For more information on PUB's service commitment to address various types of feedback and enquiries, please visit our website at <https://www.pub.gov.sg/about/servicecommitment>

Customers and Community: Engaging community

Singapore World Water Day 2023: a national celebration of a natural resource

In March 2023, PUB celebrated the annual Singapore World Water Day (SWWD), with a rich and interesting line-up of outreach and communication initiatives. We created greater awareness of the message that water is scarce and valuable, while helping individuals realise how their actions can help conserve water and build a sustainable future together.

Engaging Schools and Communities

Children are the future. We believe that education in water conservation, especially amidst climate threats, should start at a young age to empower the next generation to craft a better tomorrow.

All about Water Wednesdays

Over 200 schools participated in Water Wednesdays in March 2023, with quizzes, workshops, learning activities, and conversations about water conservation.



Water Wednesday at PCF Sparkletots.

Embracing sustainability through Learning Trails

Students from Tanjong Katong Girls' School accompanied younger children from Kong Hwa School on a Learning Trail along the Geylang River, teaching them about Singapore's Water Story and helping them to appreciate the importance of our waterways.



Students on a learning trail along Geylang River.

Experiencing water scarcity, first-hand

Over 100 schools participated in Water Rationing Exercises after a three-year hiatus. By shutting off the water supply at selected water points, youths and children gained an appreciation of severe water scarcity and learnt the importance and value of water.



Water Rationing Exercise.

Engaging Communities

The month of March 2023 also saw partners like grassroots, public agencies, non-governmental organisations, retailers and building owners getting involved in spreading the water conservation message through ground-up activities and retail promotion to reinforce the importance of water to the community.

Blue deals
across the island

To support SWWD 2023, participating retailers offered deals such as exclusive savings on water efficient products and appliances.

Ground-up
community events

Partners organised ground-up activities in March 2023 to educate their communities on water sustainability and inspire them to cherish our clean water resources. Some of these activities include Kayak Clean-Ups and Nature Walks.



Exclusive savings on water efficient products were offered as part of retailers' support for SWWD 2023.



Hong Kah North residents participating in a Kayak Clean-up activity at Jurong Lake.

Customers and Community

Story

Engaging residents to enhance flood resilience

During the monsoon season, PUB steps up checks around the island, including drainage systems at critical installations and higher flood risk locations to ensure that public drains around the sites are unobstructed for stormwater conveyance.

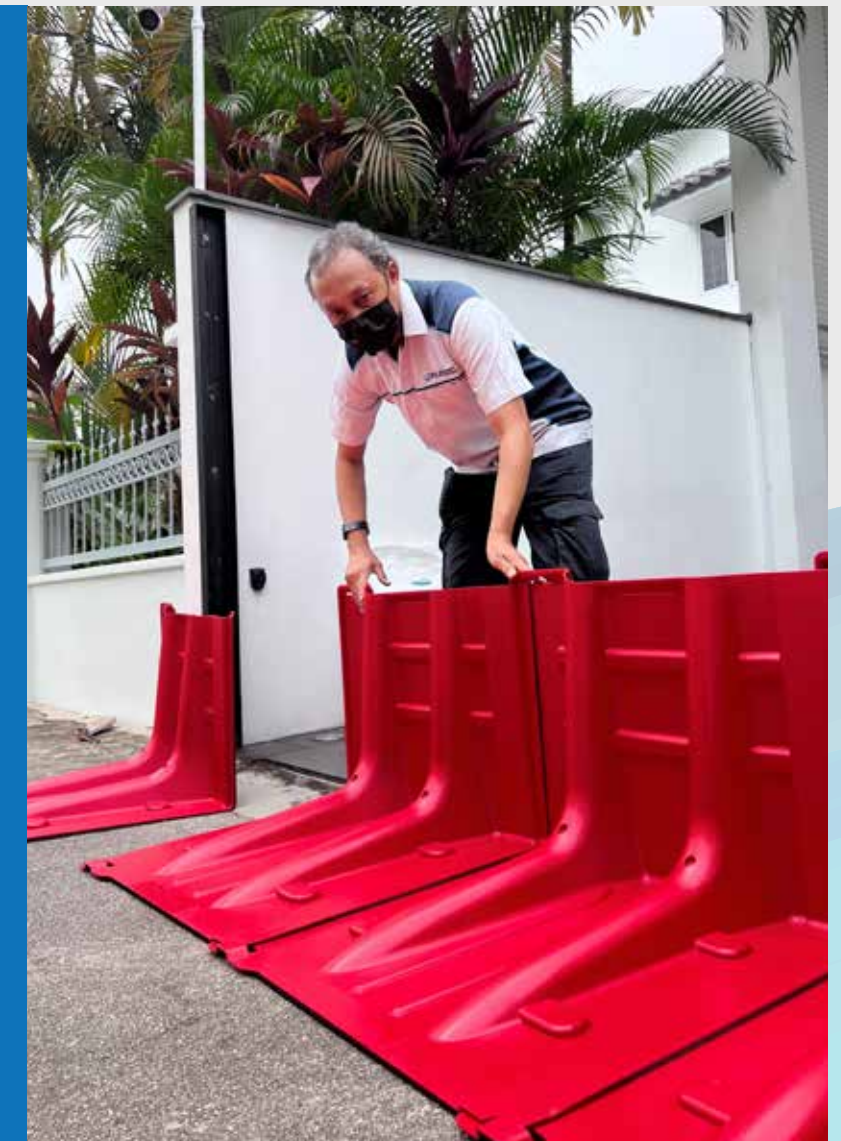
PUB also engages residents in low-lying areas and offers flood protection devices such as flood barriers and flood bags that can be deployed quickly during heavy rain. This helps to increase community resilience to flash floods and allows residents and owners to take early action to protect their properties.

In the event of flooding incidents, buildings and residential owners are encouraged to call PUB for advice at 1800-CALL-PUB.

How officers support residents' needs on the ground

"First and foremost is public safety. Analysing the affected areas (i.e. severity of the flood, vehicles affected etc.) will help us identify areas which may need more attention and guide our engagement with the affected premises. During this time, it's normal for residents to feel frustrated, so we just need to keep calm and show that we are there to help."

Muhammad Suffi Ahmad,
Engineer, PUB



PUB staff deploying flood barriers at residential areas.



Business Excellence

At PUB, the way we manage resources is as important as achieving the outcome. Amidst the day-to-day operations, PUB has to deal with increasing cyber threats, rising energy prices and tight labour market. Risk management and financial sustainability are the two key pillars that support PUB through these challenges, and are fundamental to business excellence and a sustainable PUB.

3-1 Risk Management
3-2 Financial Sustainability

“PUB is not spared from the cost pressures faced by organisations and businesses as a result of the inflationary environment, supply chain disruptions and shifts in the energy landscape in recent times. Coupled with the need to renew and expand PUB’s treatment and network capacities to support economic growth and meet the demands of a growing population, it is imperative that PUB is financially sustainable now and in the future to continue fulfilling our mission.”

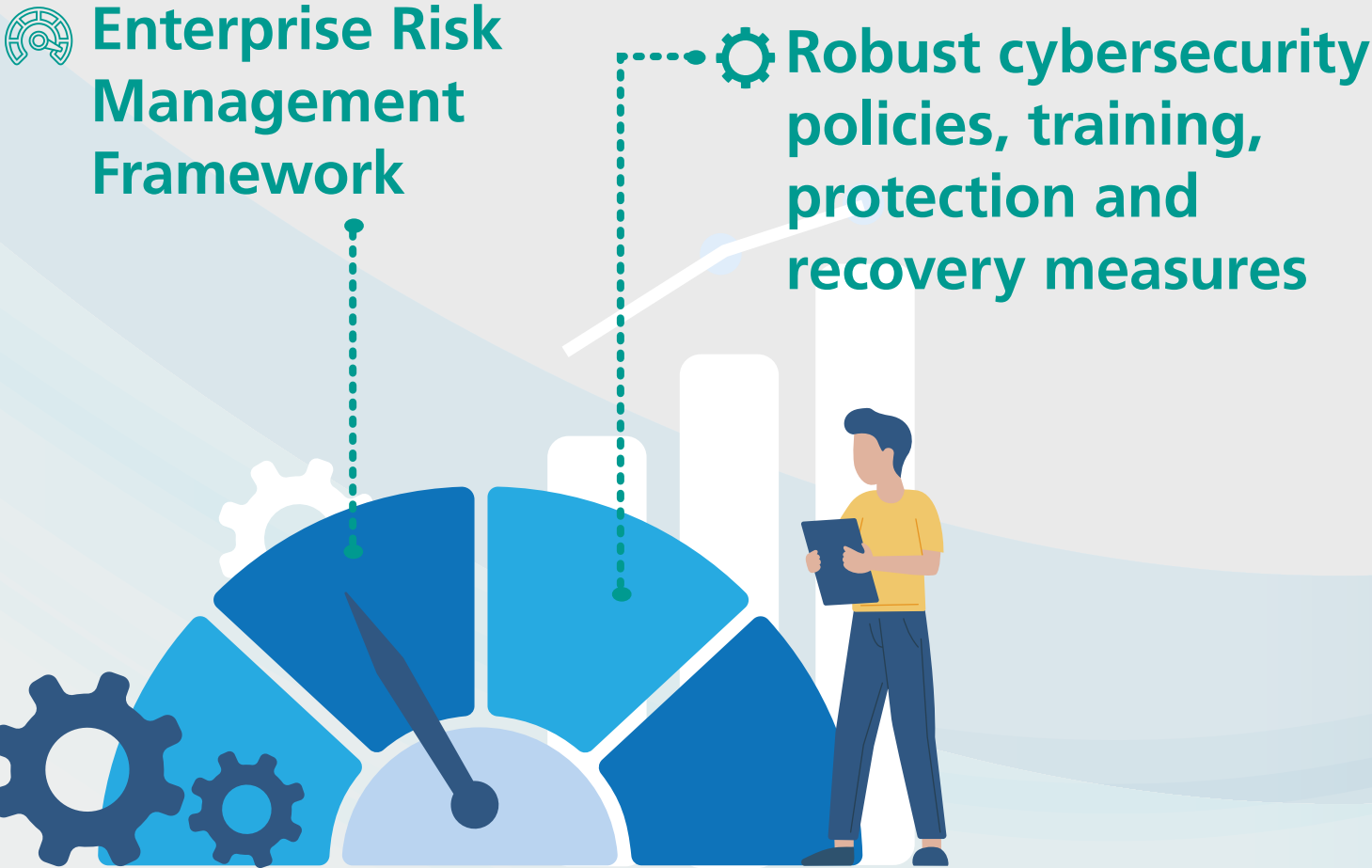
Chin Chee Kiat
Chief Financial Officer, PUB

GRI [2-23] [2-24] [2-25] [2-26] [3-3] [205-2]

Risk Management – Snapshot


Our holistic approach to enterprise and cybersecurity risk management

PUB’s wide-ranging operations expose the organisation to multiple enterprise and cybersecurity risks. Poor cybersecurity risk management may result in service disruption, causing inconvenience for customers and hindering our ability to achieve our mission. PUB aims to manage and mitigate our risks in a holistic and systematic manner so that we can continue to support operations on the ground for sustained mission success, through the following strategies:



Targets and Commitments

 Ensure robust risk, IT, and cybersecurity management

Metric	Performance	% Year-on-year improvement
 % completion of cybersecurity literacy training	CY22 <div><div></div></div> 100%	Maintained

(Please refer to PUB’s Sustainability Report 2021 and 2022 for more information about how PUB manages risk through our code of conduct, whistleblowing channel and financial controls and PUB’s procurement practices)

Risk Management

PUB's Enterprise Risk Management (ERM) Framework at a glance

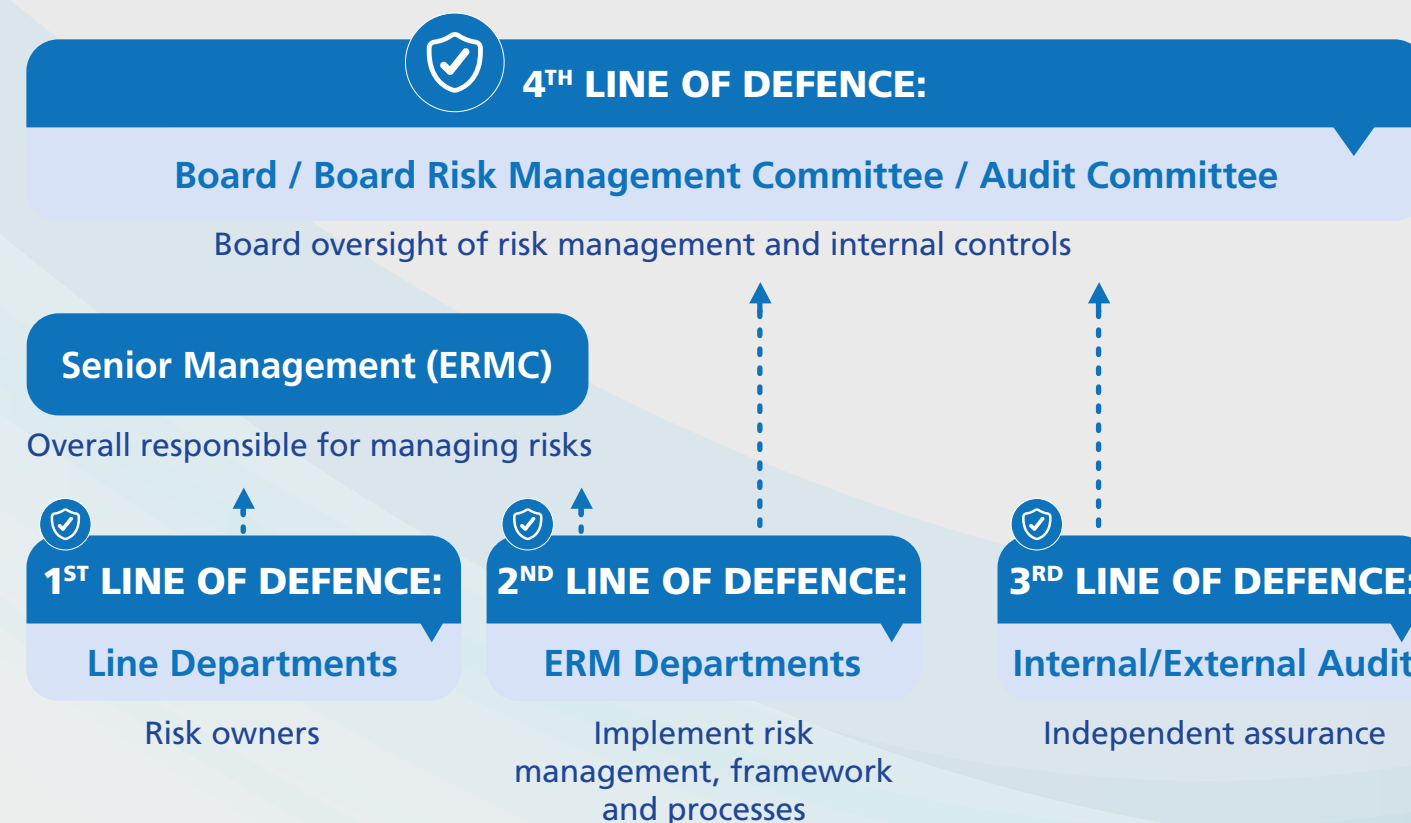
Enterprise risk management allows PUB to optimise the use of limited resources to manage a wide array of risks and enables us to better anticipate and respond to an increasingly complex and ever-changing internal and external environment. By putting in place a robust ERM framework, it gives us the confidence to carry out our mission and sustain a high standard of operations.

Risk Governance

PUB's Board, assisted by the Board Risk Management Committee (BRMC), provides independent oversight of the ERM framework and processes. With the four lines of defence in place (as shown in the chart below), PUB's risk governance structure ensures that key risks such as those pertaining to cybersecurity, environmental sustainability and climate change are effectively managed.

Risk Processes

PUB employs an iterative process to manage risks, beginning with risk identification, risk assessment, risk treatment and risk monitoring. In addition, regular environment scans are conducted to identify new and emerging risks, such as supply chain disruption and foreign manpower dependency in light of the COVID-19 pandemic.



Continuing operations when the world came to a standstill

Like many organisations, PUB sources our operations and maintenance (O&M) supplies from around the world. As countries went into lockdown during COVID-19 from 2020 to 2022, we acted quickly to assess and manage supply chain risks to sustain our operations and develop resilience in our supply chains. By securing alternative suppliers for critical O&M supplies, increasing stockpile levels and monitoring potential supply chain issues proactively, we have kept water flowing through our taps and minimised the impact of the pandemic on our supply chain, thus building greater operational resilience.



Risk Management

Securing our digital space through cybersecurity

As PUB embraces digitalisation, cybersecurity will continue to be a cornerstone of our policies, plans and projects. The increasing frequency, severity and sophistication of cyberattacks globally has necessitated more expansive and stringent protections, cybersecurity training and failsafe measures to harden our systems, so that we can continue to sustain our operations.

Strengthening our network

PUB is a member of Singapore's Operational Technology Information Sharing and Analysis Centre, a threat information sharing hub for companies and organisations in the energy, water, and other critical information infrastructure sectors.



Cybersecurity Policy

Other than mandatory cybersecurity requirements, PUB's cybersecurity policy includes best practices from the United States National Institute of Standards and Technology (NIST) to provide comprehensive protection from modern threats. Cybersecurity measures are also embedded in the design of PUB plants to limit risk exposure, and we conduct security testing for our systems, aligned to Cybersecurity Code of Practice (CCoP) and IM8, to ensure that our systems remain robust against cyberattacks.



Cybersecurity Training

The human factor is a critical line of defence against cyberattacks and all PUB staff have a role to play in ensuring the integrity of our digital systems. To develop basic cybersecurity competencies, all PUB staff undergo cybersecurity literacy training on an annual basis. This empowers staff with an understanding of cybersecurity threats and risks.



Recovery Measures

Despite our best efforts, some cyberattacks may succeed and we have invested in recovery measures to minimise the consequences of cyberattacks. This includes building redundancies and backup systems to ensure that operations can continue to function as normal.



Risk Management

Story

Leveraging technology to manage flood and water quality risks

Identifying and responding to flood and water quality risks is a significant part of our operations. To do this, our operations centres and engineers on the ground rely on our Catchment and Waterways Operations System (CWOS).

Understanding the CWOS

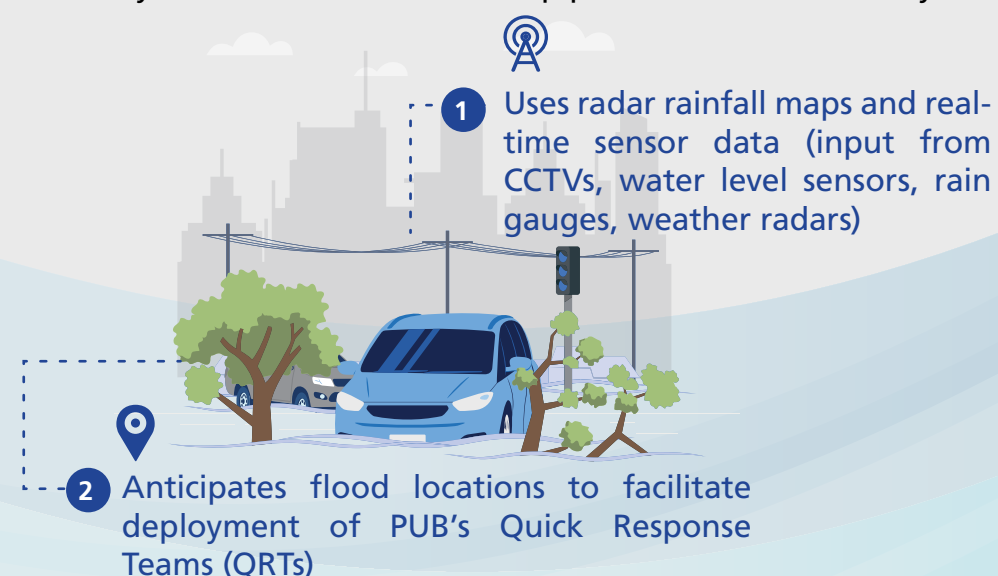
Integrated dashboard to consolidate and display real-time operations data



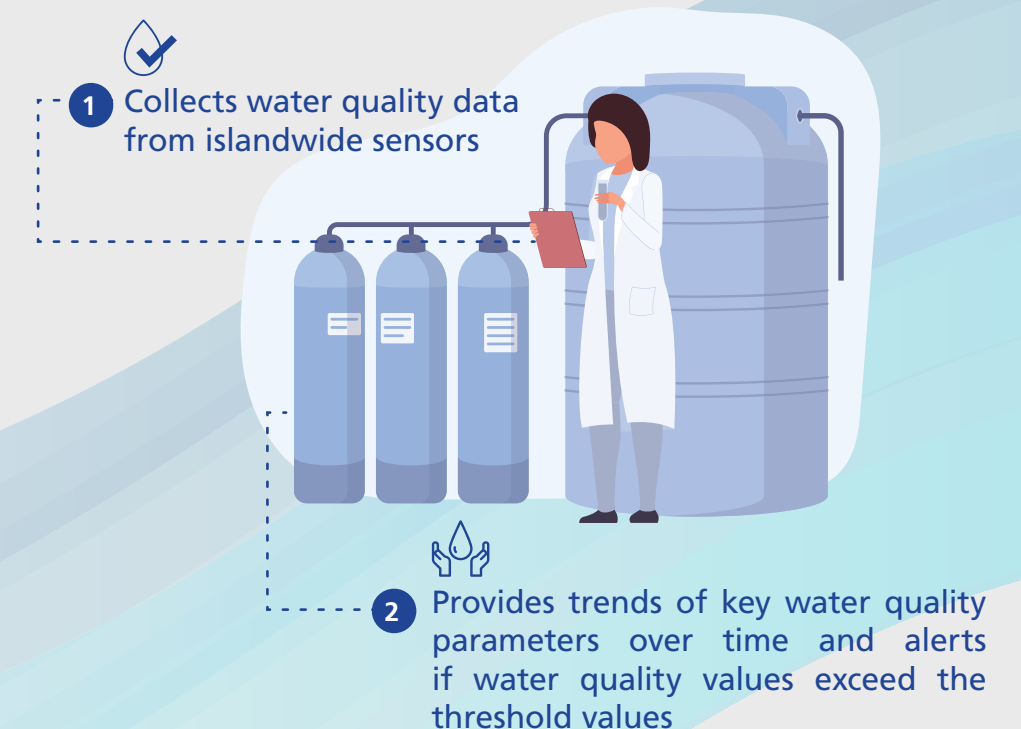
Flood management

CWOS, with inputs from various data sources (radar nowcast, forecast, water level sensors, rain gauges, etc.), helps to identify locations with high flood risk during a heavy rain event and alerts PUB officers on these potential flood locations.

This aids PUB in operational decision-making by timely deploying our Quick Response Teams (QRTs) to these locations to render necessary assistance on site and keep public out of harm's way.



Water quality management



GRI [2-23] [2-24] [3-3]

Financial Sustainability – Snapshot

Maintaining financial sustainability on our journey to a greener future

PUB receives revenue from water tariffs, supplemented by grants from the government. Our business practices balance financial prudence with environmental responsibility amidst cost pressures. In addition to ongoing measures to manage costs and ensure financial sustainability, green financing is a key tool that helps us to build a sustainable water future.




Innovation and technology are key enablers for PUB to overcome our challenges and constraints. Besides closing the water loop, PUB needs to close the carbon and waste loops to meet our sustainability targets. Through R&D as well as ground-up innovation efforts, PUB is looking into cost-effective solutions to reduce energy consumption and carbon emissions as well as recover useful resources from our water and used water treatment processes.



Target and Commitments



Ensure economic and financial sustainability

Metric	Performance	% Year-on-year improvement
 Raised \$800M of green bonds; earmarked for allocation to Tuas WRP and Tuas NEWater Factory 1 (TNF 1)		NA
 Number and value of R&D projects	CY20 <div><div></div></div> 33 – \$57.0M CY21 <div><div></div></div> 14 – \$21.7M CY22 <div><div></div></div> 32 – \$32.6M	50% increase in value of R&D projects awarded
 Number of innovation ideas submitted by staff	CY20 <div><div></div></div> 168 CY21 <div><div></div></div> 192 CY22 <div><div></div></div> 142	26% decrease in number of innovation ideas ¹⁶ submitted

¹⁶ The number of innovation ideas fluctuates year-to-year. There is a 26% decrease in number of innovation ideas submitted in CY2022 but overall, the number of innovation ideas submitted remains at a healthy level.

Financial Sustainability: Green financing

PUB's green financing initiatives

PUB is committed to achieving our mission and sustainability goals in a fiscally sound manner. The PUB Green Financing Framework (GFF), established in May 2022, is aligned to the ICMA Green Bond Principles 2021 and ASEAN Green Bond Standards 2018. PUB's GFF supports the financing of sustainable water monitoring, water collection, storage and distribution, water treatment, and renewable energy projects. Projects must meet various eligibility criteria, such as reduced emissions, water loss and waste, to qualify for green financing under PUB's GFF.



The challenges of transitioning to net zero

PUB's transition to a green utility is particularly challenging because of our unique operating context.

Land scarcity and competing land-use in Singapore drives us to build deeper and more compact water treatment facilities. These facilities, such as membrane bioreactor (used water treatment) and polymeric membranes (potable water treatment) tend to be more energy intensive than conventional treatment technologies (e.g. activated sludge, sand filters). At the same time, land constraints limit renewable energy deployment, such as solar farms, to decarbonise our water systems.

Nonetheless, through significant investments in R&D to develop best-in-class water treatment technologies, PUB aspires to construct sustainable infrastructure that meets internationally-recognised green standards.



Financial Sustainability

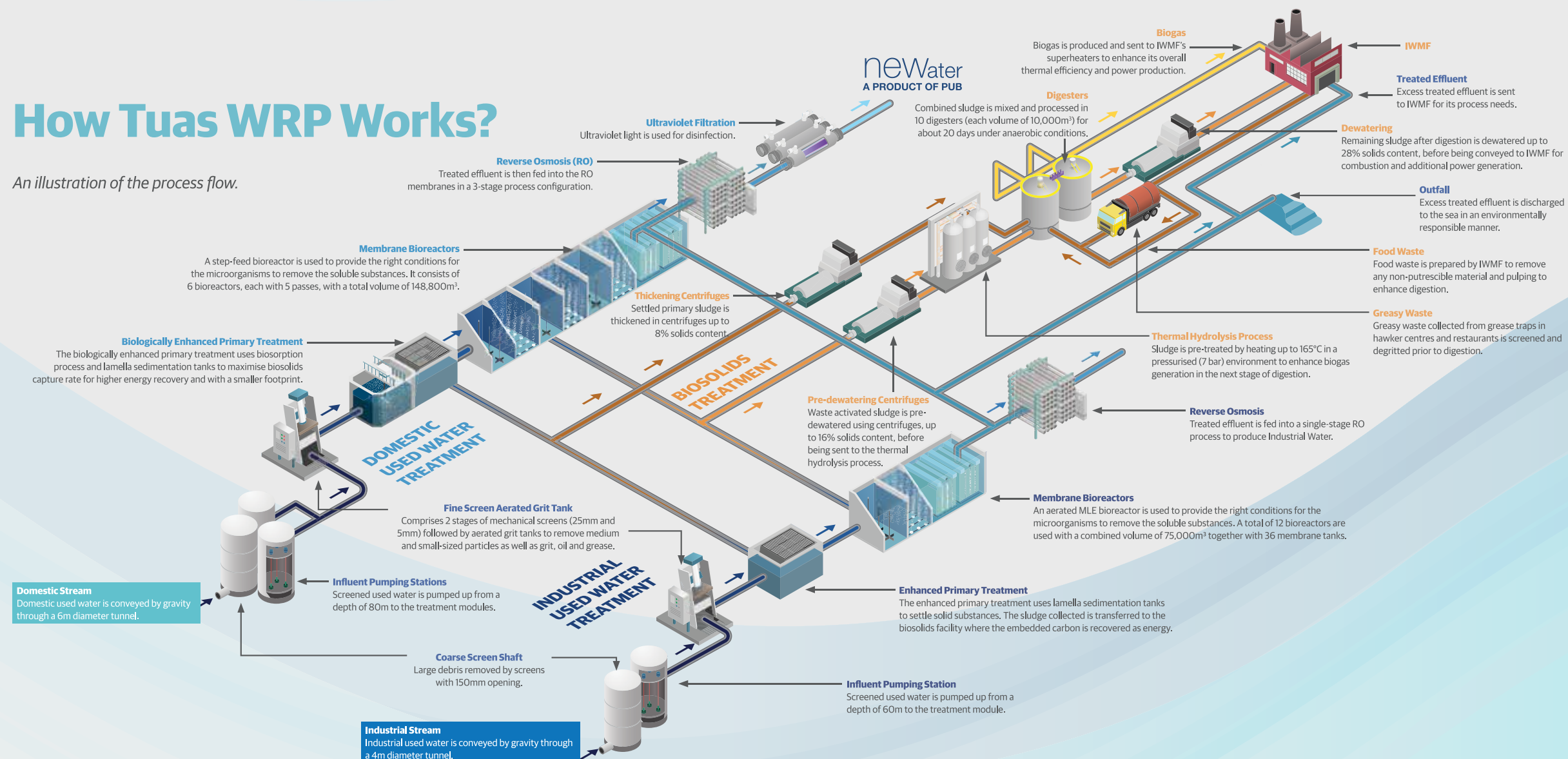
Story

Tapping green bonds to finance a significant step towards net zero





The upcoming Tuas WRP, scheduled for completion in 2026, will implement some of the most cutting-edge and energy-efficient technologies in used water treatment. To support this critical venture in our move towards net zero, PUB has earmarked \$800 million of bond proceeds to the financing of Tuas WRP and Tuas NEWater Factory 1 as of March 2023.

How Tuas WRP Works?




An illustration of the process flow.



Tuas WRP's green features

-  Treats up to 800 million litres of used water per day
-  Uses renewable resources such as biogas and solar energy to reduce non-renewable energy consumption to 0.25 kWh/m³ (excl. Deep Tunnel Sewerage System pumping)
-  Generates 0.01kg/m³ less waste compared to baseline
-  Facilitates water recycling through the production of NEWater feedstock

Harnessing process synergies from used water and solid waste treatment

-  Tuas WRP will be co-located with NEA's Integrated Waste Management Facility (IWWMF) at Tuas Nexus
-  IWWMF produces steam from the incineration of used water sludge; steam is then used at Tuas WRP for thermal hydrolysis of sludge
-  Co-digestion of used water sludge, greasy waste, and food waste generates more biogas for increased renewable energy generation

Hear from our team

"By co-locating and integrating the two facilities, we have been able to harness process synergies from the water-waste-energy nexus. Together, Tuas Nexus is greater than the sum of its parts."

Mark Wong, Senior Deputy Director, PUB



Tuas WRP team standing on the completed nearshore outfall.

Reporting Fundamentals

Methodological Review Environmental

GRI [302-1] [302-4] [305-1] [305-2] [305-3]

Energy and Greenhouse Gas (GHG) Emissions

⚡ FY2022 Energy consumption and GHG emissions					
⚡ Total energy consumption (Terajoules)			Direct (Scope 1) GHG emissions (ktCO ₂ e)	Energy indirect (Scope 2) GHG emissions (ktCO ₂ e)	Energy indirect (Scope 3) GHG emissions (ktCO ₂ e)
2780.0 TJ			7.2 kt	239.7 kt	80.6 kt
⚡ Total energy consumption from non-renewable sources (Terajoules)	⚡ Total electricity consumption from renewable sources (Terajoules)	💡 Grid electricity consumption (Terajoules)	Gases included in calculation: CO ₂ , CH ₄ , N ₂ O	Gases included in calculation: CO ₂ , CH ₄ , N ₂ O	Gases included in calculation: CO ₂ , CH ₄ , N ₂ O
16.9 TJ	637.9 TJ (177.2 GWh)	2125.2 TJ (590.3 GWh)			
Energy Sources: Diesel, Petrol	Energy Sources: Solar and biogas from used water sludge				

⚡ FY2021 Energy consumption and GHG emissions					
⚡ Total energy consumption (Terajoules)			Direct (Scope 1) GHG emissions (ktCO ₂ e)	Energy indirect (Scope 2) GHG emissions (ktCO ₂ e)	Energy indirect (Scope 3) GHG emissions (ktCO ₂ e)
2923.8 TJ			7.3 kt	271.7 kt	93.3 kt
⚡ Total energy consumption from non-renewable sources (Terajoules)	⚡ Total electricity consumption from renewable sources (Terajoules)	💡 Grid electricity consumption (Terajoules)	Gases included in calculation: CO ₂ , CH ₄ , N ₂ O	Gases included in calculation: CO ₂ , CH ₄ , N ₂ O	Gases included in calculation: CO ₂ , CH ₄ , N ₂ O
20.6 TJ	505.9 TJ (140.5 GWh)	2,397.3 TJ (655.9 GWh)			
Energy Sources: Diesel, Petrol	Energy Sources: Solar and biogas from used water sludge				

⚡ FY2020 Energy consumption and GHG emissions					
⚡ Total energy consumption (Terajoules)			Direct (Scope 1) GHG emissions (ktCO ₂ e)	Energy indirect (Scope 2) GHG emissions (ktCO ₂ e)	Energy indirect (Scope 3) GHG emissions (ktCO ₂ e)
2933.1 TJ			8.5 kt	289.8 kt	96.6 kt
⚡ Total energy consumption from non-renewable sources (Terajoules)	⚡ Total electricity consumption from renewable sources (Terajoules)	💡 Grid electricity consumption (Terajoules)	Gases included in calculation: CO ₂ , CH ₄ , N ₂ O	Gases included in calculation: CO ₂ , CH ₄ , N ₂ O	Gases included in calculation: CO ₂ , CH ₄ , N ₂ O
32.9 TJ	346.0 TJ (96.1 GWh)	2,554.2 TJ (709.5 GWh)			
Energy Sources: Diesel, Petrol	Energy Sources: Solar and biogas from used water sludge				

Reporting Scope, Period, and Approach

While PUB adopts the operational control approach as outlined in the GHG protocol corporate standard, the scope and sources of reported GHG emissions are aligned with PUB's GreenGov.SG Reporting Submissions. Data for energy and GHG emissions consumption has been compiled for Financial Year 2020, 2021 and 2022.

Energy Consumption within the Organisation

Energy consumption is derived from grid electricity, solar energy, biogas from used water sludge and non-renewable fuel sources such as diesel and petrol across all PUB-owned operational and corporate facilities that are covered under PUB's GreenGov.SG Reporting Submissions, including fuel consumption from PUB's vehicle fleet. The total energy consumption is expressed in terajoules (TJ).

GHG Emissions

This report discloses Scope 1, 2, and 3 GHG emissions. Global Warming Potential (GWP) values were sourced from the 2014 IPCC Fifth Assessment Report (AR5).

- Scope 1 emissions are emissions from sources that are owned or controlled by the organisation. For PUB's report, they include CO₂, CH₄ and N₂O from diesel use from operational facilities and vehicles (diesel) as well as wastewater treatment, expressed in tonnes of CO₂-equivalent. Emission factors for direct energy consumption are taken from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (i.e., 74.1 tCO₂/TJ for diesel, 69.3 tCO₂/TJ for petrol or motor gasoline). N₂O emissions are calculated based in IPCC 2006 Guidelines for wastewater treatment at advanced wastewater treatment plants.
- Scope 2 emissions are indirect emissions that result from the generation of purchased or acquired electricity, heating, cooling and steam consumed by the organisation. FY2020, FY2021 and FY2022 grid emission factors in Singapore are taken from the Singapore Energy Statistics 2019, 2020 and 2021 published by the Energy Market Authority in Singapore, at 0.4085 kilograms CO₂/kWh, 0.408 kilograms CO₂/kWh, and 0.406 kilograms CO₂/kWh.
- Scope 3 emissions are all other indirect emissions that are a consequence of the activities of the organisation, but occur from sources not owned or controlled by the organisation. For PUB's report, they include emissions from diesel use and electricity consumption at NEWater and Desalination Design, Build, Own and Operate (DBOO) Facilities, and emissions from the incineration of wastewater sludge.



EUI, WEI and WDI

PUB's EUI, WEI and WDI targets pertain to PUB's Standard Buildings only, i.e. PUB Recreation Club, Waterhub and Woodleigh Complex. A standard building refers to an enclosed premise with gross floor area and occupants/visitors using the premise. The resource consumption (energy, water and waste) of the building is proportional to the number of occupants/visitors using the premise.





GRI [306-3]

Waste

Waste generated is expressed in tonnes. It includes operational waste from used water and water treatment, and hazardous laboratory and operational waste. PUB engages private companies to help manage all waste generated by our operations. They ensure that the wastes are properly collected, transported, incinerated (where required) and disposed at the landfill, complying with all contractual requirements and prevailing regulations.

	 Waste from Used Water Treatment (tonnes)	 Waste from Water Treatment (tonnes)	Total (tonnes)
FY2020	187,677	13,753	201,430
FY2021	181,269	12,124	193,393
FY2022	178,695	12,166	190,861

Hazardous wastes are stored in purpose-built containers and designated areas before they are collected by licenced waste collectors for disposal off-site to prevent contamination to the environment.

Categories of Hazardous Wastes		FY2020	FY2021	FY2022
	Biohazardous Laboratory Waste (e.g. cultures and media)	23,040L	29,538L	31,920L
	Laboratory Waste Water (e.g. spent chemicals)	11,400L	9,225L	8,875L
	Laboratory Solid Waste (e.g. broken glassware, cupped stainless steel planchet from radiology lab, chemical spillage solid waste)	104 kg	197.5 kg	495.9 kg
	Used UV lamps	0	440 pieces	202 pieces

Note: FY22 figures for laboratory solid waste include empty solvent bottles.

Social

Employee Profile






Employees are individuals who are in an employment relationship with PUB.
New hires are employees who have joined PUB during the year.
Turnover includes all voluntary (resignation) and involuntary exits (e.g. retirement or leaving service on various exit schemes).

GRI [2-8] [403-9]

Health and Safety

Workers are individuals whose work, or workplace, is controlled by PUB including PUB's employees and contractors.
Major Injuries are non-fatal but severe injuries. They are defined by the nature of injury, part of the body injured, incident type and duration of medical leave. Examples include amputation, blindness, deafness, paralysis, crushing, fractures and dislocations of head, back, chest and abdomen, neck, hip and pelvis.
Minor injuries refer to non-severe injuries with any instance of medical leave or light duties.
Reportable work-related accidents are any work-related accident, workplace accidents, Dangerous Occurrences and Occupational Diseases.
Fatality and work injury rates are calculated using number of fatalities or injuries divided by the number of workers, multiplied by 100,000.


Health and Safety statistics are aligned with the latest WSHC definitions and compilation methodology of incident statistics as of 2022.





PUB's Workforce (Employees + Contractors)		CY2020		CY2021		CY2022	
 Estimated number of Workers		11,464		13,708		14,043	
		Number	Rate	Number	Rate	Number	Rate
 Fatalities		1	8.7	0	0	1	7.1
 Major Injuries		2	17.4	1	7.3	2	14.2
 Minor Injuries		50	436.2	42	306.4	33	235.0
 Main types of work-related injuries		Slip, trip, and fall Cut/stabbed by objects		Slip, trip and fall Caught in between objects		Slip, trip and fall Caught in between objects Struck by moving objects	





GRI [404-1]

Training hours

Average training hours are calculated using total number of training hours in the year divided by total number of employees at the end of the reporting period.

	<div>Average Training Hours per Employee</div>
FY2020	45
FY2021	52
FY2022	52

<div>Average Training Hours per Employee by Gender</div>			
 Employee category	FY2020	FY2021	FY2022
 Male	46.8	51.2	50.9
 Female	44.0	52.2	55.5

<div>Average Training Hours per Employee by Employee Category</div>			
 Employee category	FY2020	FY2021	FY2022
 Non-Management	46.6	50.1	50.9
 Management	35.8	61.6	60.8

GRI Content Index



CONTENT INDEX
ESSENTIALS SERVICE

2023

For the Content Index - Essentials Service, GRI Services reviewed that the GRI content index is clearly presented, in a manner consistent with the Standards, and that the references for disclosures 2-1 to 2-5, 3-1 and 3-2 are aligned with the appropriate sections in the body of the report.

Statement of Use: PUB has reported in accordance with the GRI Standards for the period 1 April 2022 to 31 March 2023.

GRI 1 Used: GRI 1: Foundation 2021

GENERAL DISCLOSURES (GRI 2: General Disclosures 2021)			
Disclosure		Report section and Remarks	Page reference
Organisation and its reporting process			
2-1	Organisational details	About PUB: Our Vital Role	4
2-2	Entitites included in the organisation's sustainability reporting	About This Report	4
2-3	Reporting period, frequency and contact point	About This Report	2
2-4	Restatements of information	No restatements have been made.	N/A
2-5	External assurance	External assurance has not been sought for this report. We may consider seeking external assurance for future reports.	
Activities and Workers			
2-6	Activities, value chain and other business relationships	About PUB: Our Vital Role Chairman's Message Chief Executive's Message	4 - 7
2-7	Employees	Employee Profile Employee data has been provided in accordance with the GRI Standards' required parameters, allowing for computation of the corresponding percentages. Disclosing the breakdown of PUB's employees by region covers confidential information of PUB's business affairs and are not to be disclosed due to confidentiality reasons.	41
2-8	Workers who are not employees	Reporting Fundamentals Description of the contractual relationship between workers and the organisation and type of work performed includes sensitive information of business affairs and are not to be disclosed due to confidentiality reasons.	64

GENERAL DISCLOSURES (GRI 2: General Disclosures 2021)			
Disclosure		Report section and Remarks	Page reference
Governance			
2-8	Workers who are not employees	Reporting Fundamentals Description of the contractual relationship between workers and the organisation and type of work performed includes sensitive information of business affairs and are not to be disclosed due to confidentiality reasons.	11
2-9	Governance structure and composition	Overview of Sustainability Governance Annual Report, Pages 7 and 8	
2-10	Nomination and selection of the highest governance body	The Board comprises members who as a group provide core competencies such as accounting or finance, business or management experiences, industry knowledge, strategic planning experience, and customer-based experience or knowledge. Approved by the Singapore Cabinet, the Board is guided by PUB’s Code of Board Governance to uphold their duties with care, skill and diligence.	
2-11	Chair of the highest governance body	The chair of the Board is not a senior executive of the organisation.	
2-12	Role of the highest governance body in overseeing the management of impacts	Overview of Sustainability Governance	11
2-13	Delegation of responsibility for managing impacts	Overview of Sustainability Governance	11
2-14	Role of the highest governance body in sustainability reporting	Overview of Sustainability Governance	11
2-15	Conflicts of interest	Processes to ensure that conflicts of interest are prevented and mitigated are set out in PUB’s Code of Board Governance. This includes sensitive information of PUB’s business affairs and are not to be disclosed.	
2-16	Communication of critical concerns	This includes sensitive information of business affairs and are not to be disclosed due to confidentiality reasons.	
2-17	Collective knowledge of the highest governance body	Overview of Sustainability Governance	11
2-18	Evaluation of performance of the highest governance body	This includes sensitive information of business affairs and are not to be disclosed due to confidentiality reasons.	
2-19	Remuneration policies		
2-20	Process to determine remuneration		
2-21	Annual total compensation ratio		
Strategy, policies and practices			
2-22	Statement on sustainable development strategy	Chairman’s Message Chief Executive’s Message	5-7

GENERAL DISCLOSURES (GRI 2: General Disclosures 2021)			
Disclosure		Report section and Remarks	Page reference
2-23	Policy commitments	Sustainable Water System	18
		Decarbonisation	26
		Resource Circularity	30
		Coastal Protection and Flood Resilience	33
		Our People: Healthy, Safe and Competent	42
		Customers and Community	47
		Risk Management	52
		Financial Sustainability	56
2-24	Embedding policy commitments	Sustainable Water System	18
		Decarbonisation	26
		Resource Circularity	30
		Coastal Protection and Flood Resilience	33
		Our People: Healthy, Safe and Competent	42
		Customers and Community	47
		Risk Management	52
		Financial Sustainability	56
2-25	Processes to remediate negative impacts	Sustainable Water System	18
		Decarbonisation	26
		Resource Circularity	30
		Coastal Protection and Flood Resilience	33
		Our People: Healthy, Safe and Competent	42
		Customers and Community	47
		Risk Management	52
2-26	Mechanisms for seeking advice and raising concerns	Stakeholder Engagement	15
		Risk Management	52
2-27	Compliance with laws and regulations	This includes sensitive information of business affairs and are not to be disclosed due to confidentiality reasons.	

GENERAL DISCLOSURES (GRI 2: General Disclosures 2021)			
Disclosure		Report section and Remarks	Page reference
2-28	Membership associations	1) International Water Association (IWA) Governing Council Member 2) International Water Association (IWA) Corporate Member 3) International Desalination Association (IDA) Corporate Member 4) World Water Council (WWC) Member 5) Asia Pacific Water Forum (APWF) Member 6) Asia Water Council (AWC) Member 7) Global Water Partnership Southeast Asia (GWP-SWA) Observing Member 8) Leading Utilities of the World (LUOW) Advisory Member 9) World Health Organisation Collaborating Centre (WHO CC) 10) American Water Works Association (AWWA) Member 11) Global Water Research Coalition (GWRC) 12) World Water Innovation Fund (WWIF) 13) K2i established by Booky Oren Global Water Technologies (BOGWT) 14) WaterShare by KWR Water Research Institute	
Stakeholder engagement			
2-29	Approach to stakeholder engagement	Stakeholder Engagement	15
2-30	Collective bargaining agreements	Employee Profile PUB's employment practices are aligned with Singapore's legislations (Employment Act, Workplace Safety and Health Act, and Retirement and Re-employment Act) and the fair employment principles set out by the Tripartite Alliance for Fair Employment Practices (TAFEP).	41
GRI 3: Material Topics 2021			
3-1	Process to determine material topics	PUB's Sustainability Approach	13
3-2	List of material topics	PUB's Sustainability Approach	14

PILLAR ONE: WATER AND SUSTAINABLE MANAGEMENT			
Disclosure		Report section and Remarks	Page reference
Sustainable Water System			
GRI 3: Material Topics 2021			
3-3	Management of material topics	Sustainable Water System	18
GRI 303: Water and Effluents 2018			
303-1	Interactions with water as a shared resource	Sustainable Water System	18
303-5	Water consumption	Sustainable Water System	19

PILLAR ONE: WATER AND SUSTAINABLE MANAGEMENT			
Disclosure		Report section and Remarks	Page reference
Decarbonisation			
GRI 3: Material Topics 2021			
3-3	Management of material topics	Sustainable Water System	26
GRI 302: Energy 2016			
302-1	Energy consumption within the organisation	Decarbonisation	26
		Reporting Fundamentals	60
302-3	Energy consumption intensity	Decarbonisation	26
302-4	Reduction of energy consumption	Decarbonisation	26
		Reporting Fundamentals	60
GRI 305: Emissions 2016			
305-1	Direct (Scope 1) GHG emissions	Decarbonisation	26
		Reporting Fundamentals	60
305-2	Energy indirect (Scope 2) GHG emissions	Decarbonisation	26
		Reporting Fundamentals	60
305-3	Other indirect (Scope 3) GHG emissions	Reporting Fundamentals	60
Resource Circularity			
GRI 3: Material Topics 2021			
3-3	Management of material topics	Resource Circularity	30
GRI 306: Waste 2020			
306-1	Waste generation and significant waste-related impacts	Resource Circularity	30
306-2	Management of significant waste-related impacts	Resource Circularity	30
306-3	Waste generated	Resource Circularity	30
		Reporting Fundamentals	63
Coastal Protection and Flood Resilience			
GRI 3: Material Topics 2021			
3-3	Management of material topics	Coastal Protection and Flood Resilience	33

PILLAR TWO: PEOPLE AND PARTNERSHIPS			
Disclosure		Report section and Remarks	Page reference
Our People: Healthy, Safe, Competent			
GRI 3: Material Topics 2021			
3-3	Management of material topics	Our People: Healthy, Safe, Competent	42
GRI 401: Employment 2016			
401-1	New employee hires and employee turnover	Employee Profile	41
		Employee data has been provided in accordance with the GRI Standards' required parameters, allowing for computation of the corresponding percentages. Disclosing the breakdown of PUB’s employees by region covers confidential information of PUB’s business affairs and are not to be disclosed due to confidentiality reasons.	
GRI 403: Occupational Health and Safety 2018			
403-1	Occupational health and safety management system	Our People: Healthy, Safe, Competent	43
403-2	Hazard identification, risk assessment, and incident investigation	Our People: Healthy, Safe, Competent	43
403-3	Occupational health services	Our People: Healthy, Safe, Competent	43
403-4	Worker participation, consultation, and communication on occupational health and safety	Our People: Healthy, Safe, Competent	43
403-5	Worker training on occupational health and safety	Our People: Healthy, Safe, Competent	43
403-6	Promotion of worker health	Our People: Healthy, Safe, Competent	43
403-7	Prevention and mitigation of occupational health and safety impacts directly linked by business relationships	Our People: Healthy, Safe, Competent	44
403-8	Workers covered by an occupational health and safety management system	Our People: Healthy, Safe, Competent	43
403-9	Work-related injuries	Our People: Healthy, Safe, Competent	42
		Reporting Fundamentals	64
GRI 404: Training and Education 2016			
404-1	Average hours of training per year per employee	Our People: Healthy, Safe, Competent	42
		Reporting Fundamentals	65
404-2	Programmes for upgrading employee skills and transition assistance programmes	Our People: Healthy, Safe, Competent	46
404-3	Percentage of employees receiving regular performance and career development reviews	Employee Profile	41

PILLAR TWO: PEOPLE AND PARTNERSHIPS			
Disclosure		Report section and Remarks	Page reference
GRI 405: Diversity and Equal Opportunity 2016			
405-1	Diversity of governance bodies and employees	Overview of Sustainability Governance	11
		Employee Profile	41
		Employee data has been provided in accordance with the GRI Standards’ required parameters, allowing for computation of the corresponding percentages.	
Customers and Community			
GRI 3: Material Topics 2021			
3-3	Management of material topics	Customers and Community	47
PILLAR THREE: BUSINESS EXCELLENCE			
Disclosure		Report section and Remarks	Page reference
Risk Management			
GRI 3: Material Topics 2021			
3-3	Management of material topics	Risk Management	52
GRI 205: Anti-corruption 2016			
205-2	Communication and training about anti-corruption policies and procedures	<p>Risk Management</p> <p>Specific to disclosure 205-2 (a) and (d), PUB has an internal code of board governance that articulates the responsibilities and conduct of the Board, and is communicated to the Board. Currently, PUB has not identified a need for dedicated anti-corruption training to be provided for the Board. Hence, the total number and percentage of governance body members that have received training on anti-corruption were not reported. In addition, PUB’s anti-corruption policy is communicated to all potential contractors in our standard Conditions of Contract.</p>	52
Financial Sustainability			
GRI 3: Material Topics 2021			
3-3	Management of material topics	Financial Sustainability	56