2022 Operating Environment Scan

VICTORIA State Government

Melbourne Water

Enhancing Life and Liveability

Melbourne Water and all participants of this study acknowledge the Aboriginal community and pay our respect to them, their culture and their Elders past, present and emerging. We hope the traditional owners and custodians of the land will benefit from this study that supports the enhancement of natural resources

Contents

Introduction

We cannot know what the world will look like in 10 years, but we know this will be the decade that matters.

Introduction

Over the past several years, the signals of change highlighted in successive Operating Environment Scans have prompted bold and urgent action from Melbourne Water and the wider sector to confront the challenges of our day. It has been clear that incremental responses are not enough. Population growth and demographic shifts, extreme weather and the effects of climate change, and digital technologies, such as artificial intelligence (AI) and automation, are already radically transforming the way we live, work, and play. This transformation will continue in the decade ahead – and indeed, transformation must define this decade if we are to realise our preferred future in which the health and prosperity of our communities thrive.

Melbourne Water believes that, as a sector, we are in the decade that matters, when the actions we take in the next few years can secure our preferred future for generations to come. Accordingly, Melbourne Water has worked to formulate an ambitious new agenda in 2022. This agenda aims to set up a step change for the years ahead in key strategic areas including decarbonisation, circularity, securing future water, Integrated Water Management (IWM), and supporting Traditional Owner self-determination.

In addition, we have recognised that the challenges we face are complex and cannot be overcome alone. In affirming our commitment to working with our closest partners in the years ahead, we have founded an industry-first agreement, *The Accord*, to ensure our greatest chance of success at confronting challenges like water scarcity, urbanisation, stressed catchments, and ageing infrastructure.

In the 2022 Operating Environment Scan (the 'Scan'), we have once again turned our minds to how our world is changing, with the specific aim of understanding how these changes may present emerging obstacles, which we will need to navigate to achieve our goals, or present emerging opportunities, to hasten the pursuit of our goals. In doing so, we create a solid foundation to explore alternate future possibilities, to test potential strategies, and find viable pathways from the present toward a future we prefer.

For Melbourne Water, the patterns of change outlined in this Scan can never represent a complete image of the future. Instead, the changes described are only indicative of multiple possible futures. Yet, it is within our understanding of those futures that we have the agency to see the wider possibilities available to us, to take more effective action today, and, in turn, to design a better future for the communities of Greater Melbourne.

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Our operating environment at a glance

Our operating environment at a glance

Drivers		Act now	Consider planning	Monitor
1	Population	Population growth		Metro exodus
2	Energy supply	Renewables investment; Energy supply chain vulnerabilities		
3	Water resources & use	Sourcing new water; Traditional Owner sovereignty		Non-revenue water reduction
4	Skilled labour	Recruiting for the future	Competition for talent; Reducing worker burnout	Unbundling of the worker
5	Financial resources & economy	Affordability & hardship	Water's role in economic recovery	Shifts in service demand
6	Customer & community expectations		Engagement at speed & depth; Our role in liveability; Building public trust and optimism	Licence to operate; Think local
7	Supply chain	Building resilient supply chains	Construction costs; Circular supply chains	
8	Natural & manmade disasters	Disaster impact preparedness		Seeking adaptation investment
9	Enterprise technology		Tech-enabled efficiencies; Redesign of work	Ethical tech application; New tech roles
10	Water technology		Risk appetite adjustment; Renewals with multiple benefits; Savings from smart water tech	Automation point of no return
11	Regulation & policy direction	Growing role of restorative justice; Increased cyber regulations; Increased environmental regulations		
12	Catchment health		Mitigating climate change impacts; Green economic transition; Contaminant caution	Contaminated circularity; Mitigating development risks

What is the Operating Environment Scan?

What is the Operating Environment Scan?

The 2022 Scan helps Melbourne Water identify changes in our context that are likely to have an impact on the business and broader sector, to support creative strategic explorations of the multiple possible futures that lie ahead, and, most importantly, to catalyse action today.

The Scan is a key input for Melbourne Water's strategic and business planning process, as shown in Figure 2. It captures the changes within our operating environment that present opportunities and risks to the organisation and identifies the areas for strategic focus in subsequent years.

The purpose of the Scan is to anticipate strategically significant change, so that the business can then explore and make strategic choices to seize opportunities or mitigate the risks brought about by these changes. Its purpose is to identify and scan around the key drivers of change most likely to influence our business and the wider sector, highlighting any opportunities for Melbourne Water to hasten its progress toward achieving its goals wherever possible.The Scan is provided to our Board and Leadership Team and is the basis of their exploration and deliberation to provoke thought and discussion, to help make informed decisions about organisational planning, and to identify strategic priorities for the future.

These priorities are then delivered through the Corporate Plan and Business Plan, with the initiatives cascading into individual performance plans. The Scan is also provided to Melbourne Water's customers and stakeholders in the spirit of knowledge sharing and to help prepare the water industry for the future. Its secondary purpose is to communicate to employees some of the external drivers for change.

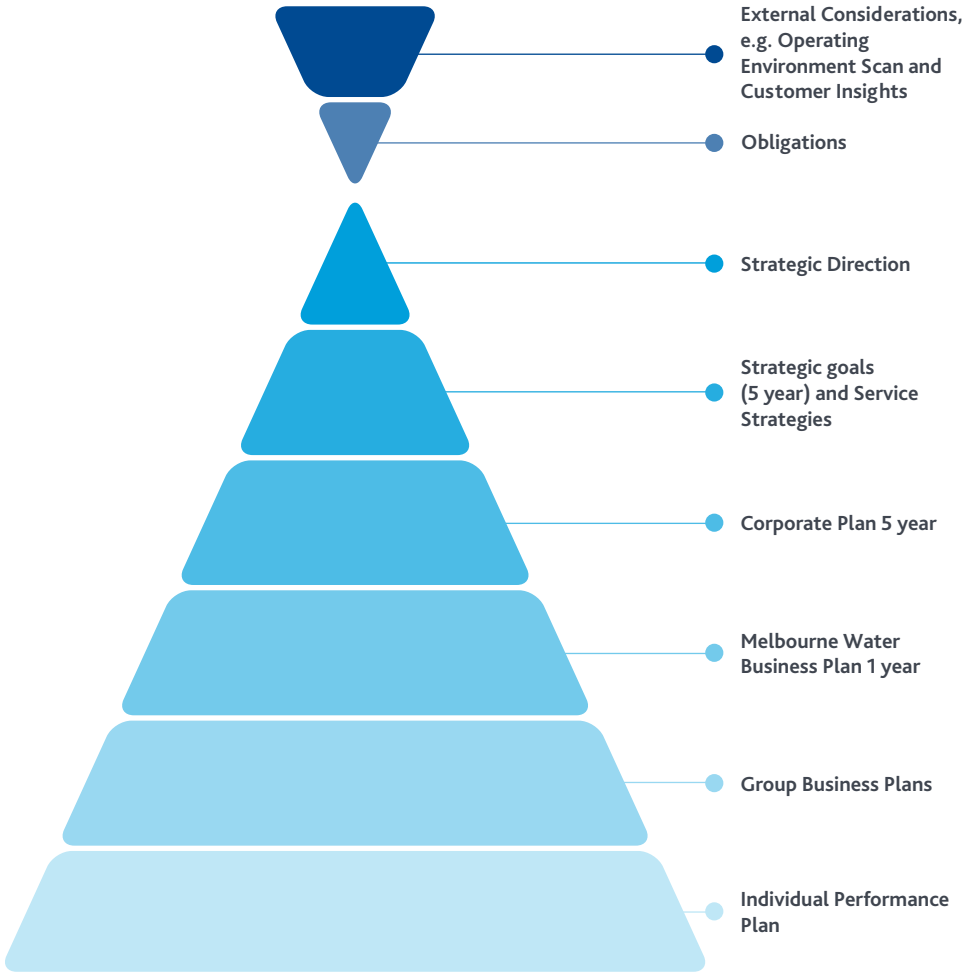

Figure 2 Melbourne Water's planning cycle starts with an Operating Environment Scan

Methodology

In previous years, Melbourne Water has adopted an 'outside-in' approach to environmental scanning. This approach has typically employed the use of a framework such as STEEP (Social, Technological, Economic, Environmental, Political) to conduct a broad, global sector-agnostic scan and to identify a range of signals of change in the environment (or 'scanning hits'). These 'hits' were then typically analysed for patterns and distilled into categories of current and emerging trends or weak signals, and their implications for the water sector were assessed.

In this Scan, Melbourne Water has taken an 'inside-out' approach (see Figure 3). The process began with an analysis of Melbourne Water's business ecosystem, to identify the range of 'pressure points' most sensitive to change originating from the external operating environment. Using influence mapping techniques, the major variables of Melbourne Water's business ecosystem were visually mapped, and a range of internal pressure points within that system were identified, along with twelve high-impact, external major drivers of change that substantively influence these pressure points. While not exhaustive, these drivers reflect the primary set of forces to which Melbourne Water's business is most sensitive, and which are either beyond our control (that is, entirely external to our business ecosystem) or which are substantively influenced by forces external to Melbourne Water.

This set of drivers of change then served as the framework to guide the scanning and research process to identify current and emerging trends or weak signals that are likely to affect these drivers in strategically significant ways.

To mitigate the risks of entrenched thinking and cognitive bias influencing the scanning process, scanning was performed by a combination of internal foresight practitioners, external professional foresight practitioners, and in consultation with Futures Platform, a subscriber-based professional futures intelligence service.

This scanning process yielded over 500 individual new 'scanning hits' with high relevance to one or more key drivers (many of these 'hits' are hyperlinked within this document for readers' reference). This raw information set was then analysed to identify the major ways in which each driver was changing and, in turn, the implications for Melbourne Water and the water sector in general.

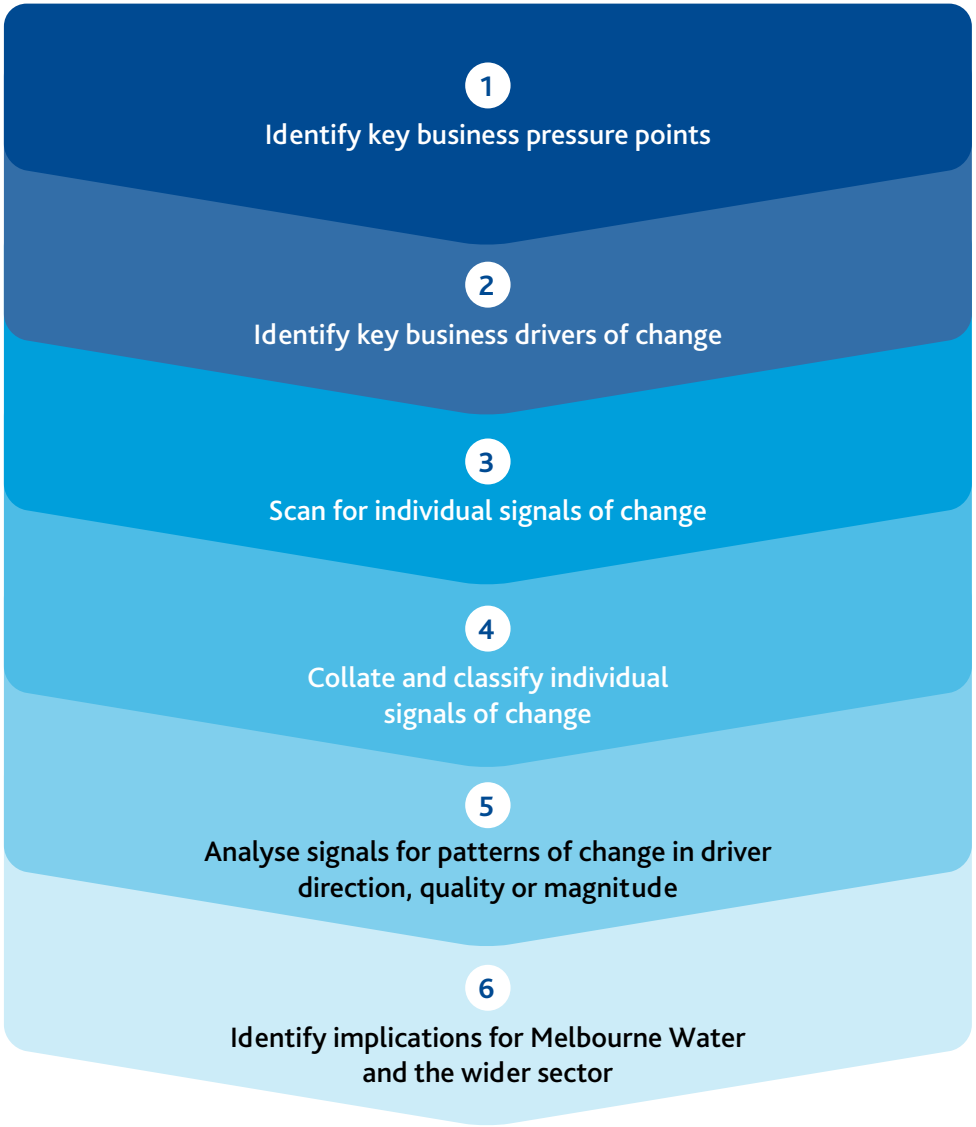

Figure 3 An inside-out approach to environmental scanning

Key drivers of change for Melbourne Water

Key drivers of change for Melbourne Water

'Drivers of change' commonly refer broadly to the range of macro forces at play in the world.

In this Scan, drivers of change refer more specifically to the smaller range of forces in the global and local operating environments to which Melbourne Water is most sensitive (see Figure 4).

Accordingly, the following twelve key drivers of change were shortlisted after it was identified that any change in their directionality, quality, or magnitude would have meaningful implications for Melbourne Water's strategic position or business performance. These drivers present new challenges or opportunities relevant to our mission of enhancing life and liveability for Greater Melbourne through delivery of our services.

- Population
- Energy supply
- Water resources and use
- Skilled labour
- Financial resources and economy
- Customer and community expectations
- Supply chain
- Natural and man-made disasters
- Enterprise technology
- Water technology
- Regulation and policy direction
- Catchment health

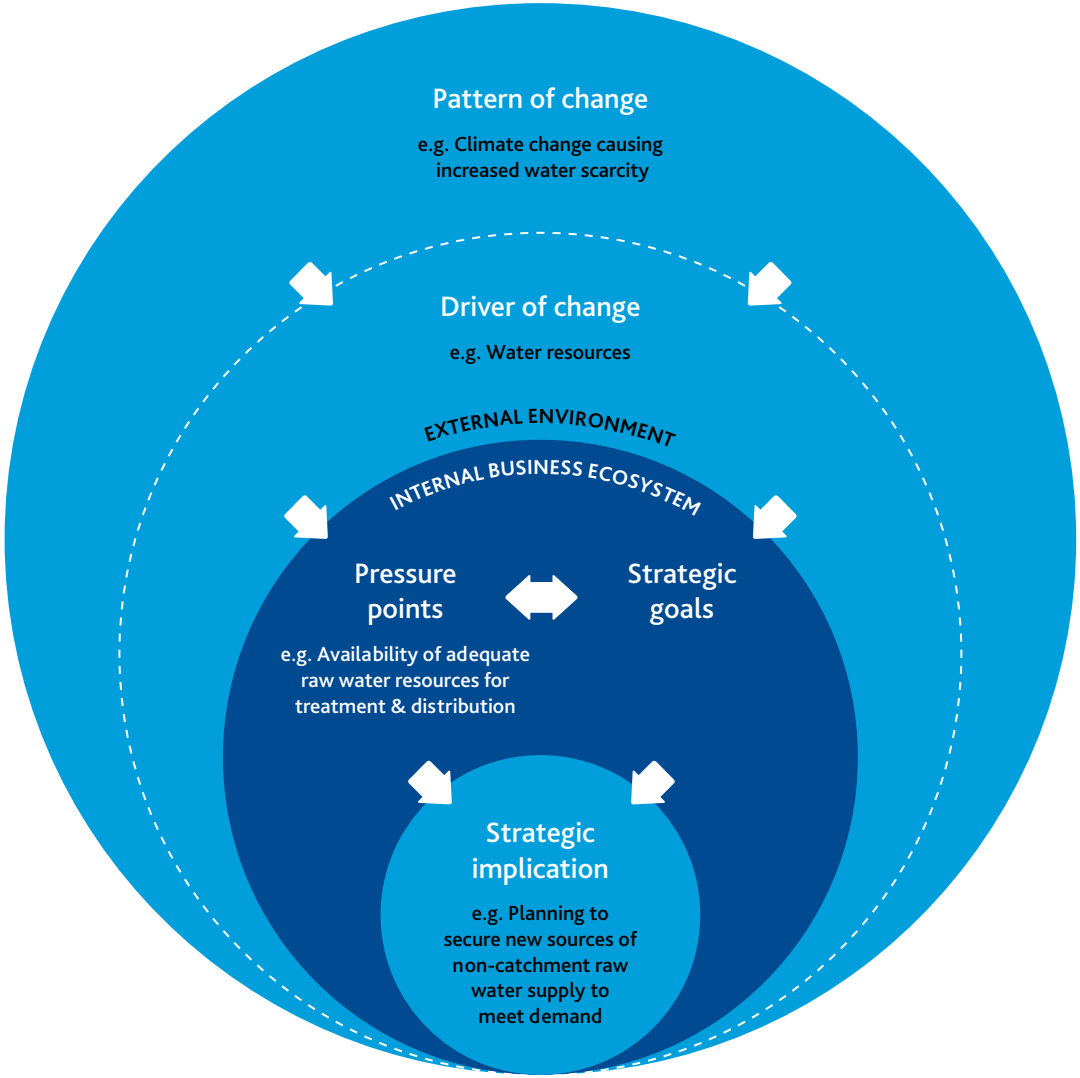

Figure 4 From patterns of change to strategic implications

Key drivers

Driver 1
Population

What is it?

Population growth within the Greater Melbourne service area has been one of the most important drivers of change for Melbourne Water. Increased urbanisation in Melbourne, resulting from population growth, places stress on existing infrastructure and provides the impetus for infrastructure network upgrades and expansion.

What is changing and why?

Population growth and the COVID-19 pandemic slowdown

- The global population will grow significantly throughout the 21st century and is expected to peak at 9.7 billion in 2064 before declining to 8.8 billion by 2100.
- Australia's population is estimated to have been 25.7 million at 30 June 2020, and is projected to increase to 29.3 million by 30 June 2032. Australia's population growth was among the most impacted, among developed countries, by the pandemic. While pre-pandemic growth is expected to resume in the years ahead, the overall population will be around 1.5 million people fewer by 2030-31 compared with pre-pandemic projections.
- The population of Victoria is projected to increase from 6.7 million in 2020-21 to 7.9 million in 2031-32. Growth was slowed during the pandemic due to reduced immigration to Australia and net negative interstate migration, but Victoria is expected to once again be the fastest growing state by 2024-5.
- The pandemic also increased the number of people moving to regional Victoria, mostly from Greater Melbourne. In 2021-21, 15,200 people moved to regional Victoria, compared with 9900 in 2018-19. Better lifestyle and amenity, being closer to the natural environment, and housing affordability were among the primary motivators for the exodus.

  Excess mortality, which has recently been significantly elevated in Australia, as well as in the United States and Europe, has been attributed only partly to COVID-19. Full causes remain unknown, and this trend may impact life expectancy if it continues in the long term.

Generation transition

- Millennials have become marginally the largest generation in Australia, comprising 21.6 per cent of the population, just ahead of baby boomers at 21.5 per cent.
- Between the 2016 and 2021 census counts, the proportion of people of retirement age increased from 15.7 per cent of the total population to 17.2 percent of the total population.
- Generation Z make up the largest population group globally, at 32 per cent of the world's population. This generation group have digital technology permeating every aspect of their lives. It is anticipated that by 2025, Generation Z will comprise 27 per cent of the workforce.

Climate-driven migration

- The displacement of populations is an emerging driver of Australia's immigration and internal migration patterns. Of the 59.1 million people internally displaced across the world in 2021, most were displaced by climate-related disasters.
- Governments are increasingly preparing for a surge in climate refugees in the years ahead. In 2021, the Australian Government signalled early preparations to accept climate refugees, particularly from affected Pacific nations. Meanwhile, in 2020, the UN's Human Rights Committee ruled that refugees fleeing the effects of the climate crisis cannot be forced to return home by their adoptive countries. Water scarcity is expected to be a key driver of migration.
- Some Australians are at risk of displacement, particularly those in drought-prone areas. Around 3.6 per cent of Australian properties and 2.5 per cent of Victorian properties are expected to be uninsurable by 2030 due to extreme weather risks.

Ageing population and declining fertility

- A combination of improved longevity, improved health in old age, and declining birth rates is causing the world population to age, with people aged over sixty-five expected to outnumber those aged under 20 by 670 million in 2100. In 2021, Victoria's population cohort aged over 60 comprised 22 per cent of the population. This proportion is expected to grow to 25 per cent by 2046.
- Fertility rates globally have dropped dramatically in the past 50 years. Declining fertility rates, combined with increased life expectancies, have contributed to an ageing global population, placing increased pressure on economic and healthcare systems globally.
- The fertility rate has declined due to lower child mortality, the cost of raising children, and women's participation in education and the workforce, leading women to have fewer children, later in life. In line with this, Australia's future fertility rate is expected to decline to 1.6 babies per woman by 2030-31.
- Exposure to harmful chemicals may be contributing to declining fertility. Sperm counts have halved in the last 40 years, a change that has been linked to exposure to hormone-disrupting chemicals in some manufactured products and in the environment (such as phthalates), which have been found in men to be at levels 100 times greater than acceptable values.

What might this mean for the water sector?

Population growth

- Population growth and urban expansion will amplify water security risks. By 2030, the gap between global demand and supply of fresh water is expected to reach 40 per cent. The climate crisis, population growth, and the transition to clean energy may increase that deficit further.
- Victoria's expected population growth over the next few decades will result in infill, with additional customers and demand within existing footprints, as well as greenfield development, requiring network expansion to service new customers.
- The ageing population could ultimately lead to a prolonged economic slowdown if countries don't prepare and alter their pension systems accordingly. A smaller working population puts more pressure on fewer workers to support those who are collecting pensions.
- There may be opportunities to delay renewals and new infrastructure builds to align with the updated projections of reduced population increases and reduce near term expenditure. However, the risk remains that other forces (for example, refugee influx) could overturn these projections.
- During the coming decades, 135 million people may suffer enforced displacement due to water insecurity, which could affect internal political stability, relations between states, and migratory flows (both south-north and, in particular, south-south).
- High levels of climate-driven migration could lead to more competition for jobs in cities and thus suppress wage growth, or it could raise consumer demand and spur economic growth.

Key drivers

Metro exodus

- Continued internal migration in Victoria to outer suburban and regional areas may rapidly accelerate the need for more distributed forms of service and network expansion. This migration may decrease pressures on inner metropolitan systems while increasing them elsewhere.
- With a greater number of people moving to regional areas, greater water resources may be required in those areas, particularly to the north of Melbourne. This presents a potential opportunity for Melbourne Water to expand its service region.

Possible pockets of the future in the present

1. **With Australia's fertility rate is at a record low, some experts are claiming this is 'a disaster waiting to happen'.**
2. **In late 2019, the NSW Government considered evacuating the residents of as many as 90 towns that were seriously affected by drought and running out of water.**
3. **The river town of Mongla in Bangladesh is leading the way in resettling climate refugees, transforming its port into a town that actively welcomes and resettles them.**
4. **Japan has the world's oldest population, with a median age of 48.6 years. Consequently, its economic growth is forecast to decline by 0.8 percent over the next 40 years.**

Driver 2
Energy supply

What is it?

Water utilities are energy-intensive businesses. The delivery of water and related services involves transportation, treatment, distribution, and disposal of water and sewerage. These processes depend on high volumes of energy inputs. There is also a significant amount of embedded energy within the materials used within the infrastructure networks and consumables we rely upon.

What is changing and why?

Strengthened energy transition ambitions

- Increasing urgency to decarbonise the global economy is driving the rapid uptake of renewable energy, which is expected to accelerate as the technology improves and becomes more cost-competitive with fossil fuels.
- In the past five years, Australia's renewable energy generation has nearly doubled, accounting for 32.5 per cent of Australia's total electricity generation.
- In Australia, government resolve to decarbonise has strengthened. In 2022, Australia's parliament passed legislation enshrining a pledge to aggressively cut carbon emissions by 43 per cent by 2030 and to achieve net zero by 2050. The same year, the Victorian Government announced plans to increase its commitment to 95 per cent renewables by 2035 and to re-establish the State Electricity Commission to build new renewable projects.
- Water utilities across Australia and New Zealand are increasing their own energy transition commitments, with 14 utilities, including Melbourne Water, joining the UN-led Race to Zero campaign. Other pioneering sector partnerships are setting ambitions to turn energy-intensive water utilities into net energy producers.

Improvements in renewable energy technologies

- Despite global transitions to clean energy still lagging against set goals, advances continue to be made across a range of renewable energy generation and storage technologies.
- Improvements in solar energy have included record harvesting efficiency breakthroughs, the solar-powered synthesis of aviation fuel, 'floatovoltaics' that promise greater energy yield using floating solar farm technology, and building-integrated photovoltaics that blend seamlessly into building roofs, glazing and facades.
- Hydrogen development remains strong, with the accelerated deployment of fuel cell electric vehicles (including heavy trucks), the first hydrogen-powered trains now running in Europe, improvements in efficiency in hydrogen production, and electrolyser manufacturing capacity doubling between 2021 and 2022.
- Wave energy has gained a foothold in Australia, with two sites in Victoria and South Australia being earmarked for development. Wave energy is one of the most powerful but least developed renewable energy technologies.

- There have been advances in energy storage, including the development of the A1-S battery, which is made from low-cost materials and capable of faster charging than lithium batteries, the activation of a large-scale water battery in Europe, and the use of quantum computers to inform the development of more efficient batteries and solar cells.

Energy scarcity and volatility

- The energy sector is increasingly volatile, with prices fluctuating rapidly and unexpectedly, making it difficult for businesses and consumers to budget for energy costs and leading to higher prices overall.
- Government action, aimed at encouraging populations to adapt to energy scarcity, is increasing in energy-stressed Europe, with some leaders reframing the crisis as the end of the 'era of abundance'. Measures have included providing financial incentives to use appliances during off-peak hours, setting mandatory energy-use reduction targets, prioritising supply to domestic energy markets over exporting power, and considering energy rationing programs.

The road to net zero emissions threatened

- The International Energy Agency (IEA) have assessed that only two of the 55 components of the global energy system that are critical for a clean energy transition are on track to achieve the IEA's Net Zero Emissions by 2050 Scenario. These are electric vehicles and lighting.
- Lack of progress has led some experts to doubt whether a transition to net zero is achievable, with this requiring a global reduction in fossil fuel energy supply from around 83 per cent to zero in the next three decades, after having achieved only a 3 per cent reduction in fossil fuel use in the past two decades.
- The costs of producing and transporting solar photovoltaic modules, wind turbines and biofuels have increased, potentially undermining future renewable energy projects. Contributing factors include supply chain challenges, rising commodity, energy, and shipping prices, restrictive trade measures, and geopolitical conflict.
- As shown in Europe, geopolitical events have the potential to disrupt decarbonisation efforts. In mid-2022, Germany resorted to reactivating coal-fired energy plants to save natural gas in response to disruptions in the supply chain stemming from the Ukraine–Russian conflict.

What might this mean for the water sector?

Renewables investment

- Water utilities, as land and infrastructure managers, may have increased opportunities to participate as energy producers in an increasingly decentralised energy network. There is a growing interest in decentralised energy production. BloombergNEF forecasts that by 2035, as much as 33 per cent of Australia's capacity will sit behind the meter rather than on the transmission network.
- By harnessing and recycling the energy and other resources generated by waste products from water treatment, water utilities can make substantial progress towards emission reduction targets.
- Transitioning to a clean energy system will result in lower energy costs and expand access to energy to people globally. Research by the University of Oxford has found that transitioning to a decarbonised energy system by 2050 would be expected to save at least US$12 trillion globally and that such savings should act as an impetus for companies and governments to invest in and transition to such technologies.
- Transition to use of alternative energy sources will enable emissions reduction, but can also fuel more energy-intensive water supply production processes such as desalination.

Key drivers

- Water utilities may become an attractive locus for investment in alternative energy source development, such as hydrogen and bioenergy, due to access to valuable resources and proximity to relevant infrastructure.
- Water utilities have a significant role in hydrogen power development because most wastewater treatment plants are located in ideal locations for hydrogen hubs – on transport corridors near industrial users and near gas networks. They can also contribute biosolids, with South East Water and RMIT University researchers recently developing a new technology to produce hydrogen using material derived from biosolids in wastewater treatment plants.
- Greenhouse gas emission reduction targets are creating a need to reduced energy demand and an increased focus on the circular economy, carbon offsets, and energy creation and use at treatment plants.
- Australia has an opportunity to lead on decarbonisation and resource recovery, influencing how energy demand is met. Bold climate action could deliver at least $26 trillion in net global economic benefits between now and 2030, compared with business as usual, including creating more than 65 million new low-carbon jobs.

Energy supply chain vulnerabilities

- Volatility in energy supply and prices is likely to be a feature of the market throughout any renewable energy transitions, and exacerbated by geopolitical stability. As such, water utilities, as energy-intensive essential services, must minimise exposure to this volatility and ensure robustness and resilience of energy supply.
- The global supply chains that underpin renewable energy may become precarious in the near term, indicating a growing need for the water sector to reduce supply chain vulnerabilities that could disrupt decarbonisation.
- Two key challenges for the sector are overcoming the initial high investment costs associated with renewables and ensuring a reliable and consistent supply of renewable energy.

Possible pockets of the future in the present

1. **In 2022, energy supply chain disruption in Europe prompted the European Union to adopt an emergency mandatory energy use reduction target of 5 per cent during peak hours.**
2. **In a bid to combat climate change, a state in Germany is rolling out a fleet of hydrogen-powered passenger trains and planning to phase out its 126 diesel-powered trains.**
3. **However, recent efforts by a South Korean team created a nuclear fusion reaction lasting 30 seconds at temperatures in excess of 100 million degrees, indicating that 'nuclear fusion is moving from being a physics problem to an engineering one'.**
4. **In Dubai, a multi-storey car park in Al Garhoud has been designed to be the first environmentally friendly parking building in the Emirate and is based on the principle of zero energy.**

Driver 3
Water resources and use

What is it?

Raw water resources, whether from catchment, desalinated or other sources, are a critical input for Melbourne Water's business. As water resources are not easily transportable, we are reliant on adequate and available supply of raw water resources from within or near to our service area. Accordingly, Melbourne Water and its services have a high degree of climate sensitivity.

What is changing and why?

Growing water scarcity

- Water security is a growing challenge for many countries globally today. Around 40 per cent of the world's population live in water-stressed areas, and an estimated one in four children will live in areas with extreme water shortages by 2040.
- Groundwater dependence, particularly in major cities, is intensifying, with nearly 50 per cent of the global urban population being supplied with water from groundwater sources. Continued depletion of groundwater sources in vulnerable areas, such as the Indian subcontinent, may drive a global climate refugee crisis.
- Climate change is likely exacerbating water scarcity challenges, mostly recently, producing extreme droughts in Europe, China, and parts of the United States. Left unmitigated, water scarcity driven by climate change can exacerbate health problems and socio-political issues such as famine and violent conflict.
- Australia has one of the most variable rates of rainfall and streamflow in the world, a pattern expected to be amplified by climate change. This variation leaves much of the country prone to periods of extreme flooding and drought.
- High rainfall and desalinated water have both contributed to the current high storage levels within Melbourne Water's system, which are the highest in over two decades.
- The Southern Oscillation cycle remains at La Niña, which is expected to persist throughout the Australian summer, increasing the chance of above average rainfall (and resultant increased flood risks) in northern and eastern Australia. Despite recent high rainfall and ample water storage, most models predict a return to neutral El Niño by early 2023, leading to increased risk of drought and bushfire conditions in the immediate years ahead.
- In Victoria, the climate is becoming warmer and drier, with less water flowing into storages in the long term. River water has declined by as much as 21 per cent and is expected to continue declining. Water demand is forecast to exceed supply in as early as 2028 unless further action is taken to increase water supply and improve efficiency in water use.

Increased demand for water

- Global water use has increased by a factor of six over the past 100 years and continues to grow steadily at a rate of about 1 per cent per year as a result of an increasing global population, economic development, and shifting consumption patterns.

- Agriculture consumes 70 per cent of water resources globally and over 40 per cent in OECD countries. It is expected that feeding an estimated 10 billion people by 2050 will require a 50 per cent increase in agricultural production and a 15 per cent increase in water withdrawals.
- In Australia, agriculture is the leading user of water and accounts for 24 per cent of water extractions. Across the Central and Gippsland Region, agriculture accounts for 39 per cent of water entitlements.
- The efficiency of water use affects demand for water. Yet, the efficiency of irrigation around the world is estimated to be around only 20–30 per cent, suggesting this is one area with strong opportunities to improve efficiency and reduce surface and groundwater withdrawals.
- As the uptake of renewable energy accelerates, the water used to produce energy is decreasing as the processes for generating energy by renewables are typically less water-intensive than for fossil fuels or nuclear energy.

Returning water to Traditional Owners

- In Victoria, government policy and water corporations are increasingly committed to returning greater volumes of water to Traditional Owners, as well as to the environment, to ensure healthy waterways and preservation of cultural values. This commitment is part of a restorative justice approach to address the legacy of colonisation and the exclusion of Aboriginal people from land and water ownership and management.

Growth in use of recycled water

- The recycling and reuse of water are slowly gaining acceptance globally. Technology that ensures safe recycling and reuse of water has advanced significantly. While the application of water recycling and reuse technologies is still lagging in much of the developed world, the global market for these technologies was estimated to be US$15.3 billion in 2020 and is projected to reach US$27.1 billion by 2026.
- Israel continues to lead in the recycling and reuse of water, with nearly 90 per cent of wastewater being recycled. Meanwhile, water recycling and reuse technologies continue to be used for novel purposes such as beer production in Denmark, the Czech Republic, and Singapore.
- In Victoria, recycled water use has not increased over the last decade. In 2021, an inquiry by the Auditor-General found that many Victorians have a limited understanding of water security and the risks and benefits of recycled water use.
- Although understanding is still limited among Melburnians, awareness of recycled water as a source of Melbourne's water supply have both been steadily increasing over the past to years. Today, 30 percent of Melburnians believe recycled water is a source.

Increased private investment in water

- Private investment in water has increased, particularly overseas, suggesting that growing scarcity could lead water to become a private asset in some countries or, at minimum, an increasingly politicised issue.[63]

What might this mean for the water sector?

Sourcing new water

- The Australian urban water industry should continue moving towards a diversified portfolio of water supply options to meet the water security needs for rapidly growing cities and regional centres.
- Optimising the use of multiple rainfall dependent and independent sources increases the sector's ability to balance resilience, security, and cost and other network constraints, while also meeting the diverse and evolving expectations of our customers and communities.
- Extended drought is likely to place additional strain on water availability and security. This strain will require water utilities to undertake supply augmentations to enhance resilience and to diversify their water portfolio to ensure security of customer supply, while also maintaining commitments to environmental flows and Traditional Owners.
- New water sources, such as desalination, are likely to be more energy intensive to produce, which may have implications for the decarbonisation of water services.

Key drivers

- Embedding IWM remains a highly effective way to improve water security, re-use waste, and achieve healthy waterways, consistent with community aspirations.
- Water literacy is critical to ensuring that the community can participate in water saving initiatives during times of drought, and to establishing trust in drinking water that comes from climate resilient sources such as desalination and purified recycled water. At the moment, those with a high water literacy level are significantly more likely than the average Melburnian to support the use of recycled water for non-drinking purposes (78%).

Traditional Owner water sovereignty

- The arrangements for water resource allocation and entitlements may change radically in the future with the progress of self-determination and government acceptance of Traditional Owners' role as sovereign partner with rights to Country. This has implications for future and unallocated water entitlements, as highlighted by the Central and Gippsland Region Sustainable Water Strategy. In the plan, for instance, 16 gigalitres of water in Gippsland would be reallocated to Traditional Owners, irrigated agriculture and the environment.

Non-revenue water reduction

- Recovery of non-revenue water (NRW) will be of increasing concern for water utilities. Researchers have estimated the global volume of NRW to be 126 billion cubic metre per year with the cost of water lost estimated at US$39 billion per year. Faced with the operating contexts of increasing scarcity and climate change, elevated NRW exacerbates the challenges for water utilities in providing full service coverage at reliable levels of service and affordable prices.

Possible pockets of the future in the present

1. A 2021 study by researchers at Tsinghua University reported that China had successfully used cloud-seeding to manipulate the weather for the centennial celebrations of the Chinese Communist Party, and intended to broaden its test area to 5.5 million square miles by 2025.
2. Multiple lines of evidence, including from observations and future climate change projections, point to a continuing trend of more frequent compound extreme events.
3. Climate change is making rain more difficult to predict, but a new AI forecasting system demonstrated it can predict rain, how intense that rain will be, and how long it will last at any location with greater than 90 per cent accuracy at least 96 hours in advance.
4. Germany's second-largest supermarket brand is promoting locavore shopping by growing and farming food on-site. The design of the supermarket includes an aquaponic farm inside the building and a modular greenhouse located on the roof.

Driver 4 Skilled labour

What is it?

Like all businesses, Melbourne Water depends fundamentally on its people. As a water utility, a significant proportion of our workforce comprises technical specialists, proficient at planning for, designing, constructing, operating, and maintaining water and related infrastructure. Melbourne Water also requires a contingent of skilled workers to maintain the corporate and administrative infrastructure of the organisation that supports service delivery, including information technology and digital specialists, customer service representatives, human resources and communications, financial specialists, and corporate planning and reporting.

What is changing and why?

Changing needs of an older workforce

- The population is growing older on average, influencing the needs and behaviours of the workforce. In the past two decades, the workforce participation rate of older Australians has more than doubled (from 6 per cent in 2001 to 15 per cent in 2021). Rising living costs are partly driving this trend, with 28 per cent of Australians believing they could not currently retire comfortably, a pattern also seen abroad.
- Employers today must manage a more complex health and safety profile of staff. In 2021, more than one in five Australians aged over 65 years reported suffering two or more long-term health conditions.

Women and equality continue to be a focus

- There is a growing desire for executive teams and boards to better reflect the diversity of the communities they serve, including gender equality. While Australia has made considerable progress towards achieving gender equality in the workplace, women still earned about $26,000 less, on average, than men in 2020-21 and held less than 20 per cent of Australian CEO positions, despite making up over 50 per cent of the workforce.
- Participation of Australian women in the workforce has grown in recent decades, but rates are lower than for men. Women's participation in the workforce is increasingly recognised as an economic imperative by business and government, particularly as economic recovery is needed.
- Women continue to report caring for their own and other children at higher numbers than men across all age ranges. With an increasing number of women participating in the workforce, businesses will likely need to continue to offer flexible working arrangements, particularly in fields experiencing skilled labour shortages.

Labour shortages increasing

- Skilled labour shortages have increased from 2021. Four in ten Australian businesses reported significant shortages in 2022, with the health and construction sectors reporting the greatest concerns. Wastewater and water infrastructure technicians, as well as engineers in general, are in moderately short supply around Australia and in Victoria specifically.
- Almost a third of Australia's most in-demand jobs facing shortages are digital. As businesses become increasingly digital, demand is growing rapidly for expertise in cloud computing, AI and machine learning (ML), and business intelligence and data analysis. Recently, the shortfall has driven up tech starting salary premiums by 20 to 30 per cent.

- Clean energy skills shortages are expected to be a significant challenge in the coming years, with the requisite skills for renewable energy projects already in short supply. Demand for clean energy skills is likely to increase significantly in the next 5 years.
- Uncertainty still remains as to the long-term consequences of COVID-19 on the workforce, with the enduring effects of long-COVID potentially driving a 'mass deterioration event' in the future.

Worker burnout, resistance and resignation

- The average Australian works 6.1 hours of unpaid overtime each week. Australian workers are also reportedly the most burnt out in the world, with more than half saying they had suffered burnout over the past year.
- Worker burnout, which has been linked to hybrid work, is thought to be a partial driver for the recently coined 'quiet-quitting' movement in which workers consciously opt to perform only the minimum requirements of their role to retain employment. Although stigmatised, the movement is also seen by some as an appropriate correction to overwork and burnout, often being reframed instead as 'acting your wage'.
- Workers and unions are now increasingly demanding the 'right to disconnect' in order to preserve the line between work and home, even writing this into enterprise bargaining agreements.
- An estimated 2 million Australians are ready to quit their jobs in the next six to 12 months due to staff burnout and discontent.
- Amid economic uncertainty and increasing social divisions, Australian workers are striking at the highest rate in almost two decades.

  Overemployment is emerging as a parallel trend, where remote workers secretly work more than one full-time job to reap the financial benefits, arguing that this is fair if role requirements are still met.

Employee experience becoming a battleground

- Businesses are increasingly using a range of incentives to attract talent, ranging from provision of skills and training and re-skilling, to more flexible working arrangements, such as the four-day work week, and access to health and wellbeing programs.
- Sense of purpose and corporate social responsibility are increasingly being seen as part of an optimal employee experience and talent attractor. Businesses with a purpose-driven brand and high social quotient are more likely to attract and retain values-led millennial and Generation Z employees, even when less competitive salaries are offered. Employers' commitment to driving diversity, equity, inclusion, and sustainability outcomes were among the key considerations for this cohort.
- Millennials' entry into the workforce has caused a shift away from material measures of success and toward a more value-driven mindset. Increasingly, people are seeking meaningful work that contributes to a larger goal, such as personal and professional growth or positive social impact.
- Over half of Australian businesses with staff working remotely at least part of the time expect their remote working arrangements to stay the same. Around a quarter of businesses expect teleworking to decrease, and a smaller portion again expect it to increase.

What might this mean for the water sector?

Competing for talent

- A constrained international labour market, increased competition across industries, and increasing costs for contractors may all increase the difficulty in sourcing appropriate labour within the water sector.
- The water sector has a continuing opportunity to lead the way in offering flexible work and carers' leave, promoting age, gender and ethnic diversity, and providing support for people with disability and to LGBTQI+ communities.
- Flexible employment conditions remain in demand among prospective employees. Shifts in demographics and values-based employee priorities will see the 'live to work' mentality continuing to lose its appeal in favour of a 'work to live' approach. This approach will drive demand for shorter work weeks, more flexible work environments, collaborative co-working environments, and a work-life balance that provides more freedom.
- Increased worker activism may emerge in response to intra-organisational pushback and dissent if organisations breach their 'social contract'.

Key drivers

- Aboriginal and Torres Strait Islanders are a relatively small talent pool, but increasing focus on justice for Traditional Owners and indigenous cultural competency within organisations is increasing competition for their skills and knowledge.

Recruiting for the future

- Water utilities will increasingly need to actively anticipate change and train people in the skills they will need in emerging jobs. The utility of the future is likely to have a heavy digital dependency, meaning that the sector will be competing with the wider world for professionals already in short supply including data specialists (such as data scientists, architects, and visualisation experts), cyber security specialists (to protect consumer information and network infrastructure), AI and ML trainers, and software and application programmers (for user experience and back-end processes).
- The expansion of the circular economy and use of renewables within the water sector will also increase exposure to another labour shortage vulnerability – the shift to a decarbonised energy landscape and resource re-use and zero waste economies will demand new skill sets and for industries to retool to reduce waste.

Reducing worker burnout

- Faced with the consequences of worker burnout, the sector will need to pivot to ensure that employment conditions and organisational culture support employees' physical and mental health and wellbeing.
- Quantitative valuation of mental health benefits is calculated to be 7 per cent of the total economic benefits of London parks, a large fraction (amounting to about £6.8 billion over 30 years) given that the major economic benefit considered was higher property values
- Mental health is of increasing concern, potentially being exacerbated by societal concerns such as climate change. Given both the quantitative and qualitative benefits of good mental health– for both workplace productivity and individual wellbeing – the water sector will likely need to continue to focus on providing programs that support mental health and wellbeing.

Possible pockets of the future in the present

1. **Unilever is trialling of a four-day working week in Australia until late 2023. The trial follows from the promising results of an 18-month trial in New Zealand, during which all 80 employees participated in a model trial, where staff retain 100 per cent of salaries, while working 80 per cent of the time, while still committing to 100 per cent delivery for the business.**
2. **In an effort to attract talent and tackle burnout, the UK fintech company Monzo is now giving its 2200 staff the right to take a three-month sabbatical for every four years they work at the firm.**
3. **Over 80 per cent of companies predict a rise in workforce activism, with 95 per cent expecting an increase in workers' use of social media to amplify their voices.**
4. **An 'overemployment' community now exists on Reddit, with over 100,000 members who exchange advice on how to secretly gain and maintain multiple full-time employment roles in order to reap the financial benefit.**
5. **A Dutch court has ruled that demanding employees turn on their webcams is a human rights violation.**

Driver 5
Financial resources and the economy

What is it?

Melbourne Water's service delivery is constrained largely by the revenue it is permitted to collect from customers by the Essential Services Commission (ESC), a price that is determined through the five-yearly Price Submission process and based on the estimated cost to operate in accordance with customer and community requirements and expectations of our services and their price. In addition, with the Victorian Government as our sole shareholder, Treasury also seeks a variable annual dividend from Melbourne Water, which varies according to the State Budget.

What is changing and why?

Global economic slowdown

- Global economic conditions are precarious in late 2022. Economic activity is experiencing a sharp slowdown, with higher inflation than in the past several decades. Global growth is forecast to slow, declining from 6.0 per cent in 2021 to 3.2 per cent in 2022 and 2.7 percent in 2023. This is the weakest growth profile since 2001, aside from declines seen during the Global Financial Crisis and the acute phase of the COVID-19 pandemic.
- The OECD assesses that the war in Ukraine, which has impacted economic conditions globally, is likely a key contributor to the slowdown, as are a tightening of monetary policy, and strict shutdowns associated with China's zero COVID-19 policy.
- Central banks continue trying to find ways to ease inflation, although continued tightening of monetary policy or mismanagement risk driving the global economy into recession.

Economic flux in Australia

- While the Australian economy is continuing to grow, the economic outlook for Australia is uncertain, with economists split in their opinions on the economy's robustness and ability to make a speedy recovery.
- Inflation in Australia remains high and interest rates have been increasing, with both putting pressure on household budgets, lowering consumer confidence, and contributing to a decline in house prices.
- The labour market remains tight, with recruitment difficulty continuing to be higher than in 2021.
- As at June 2022, 46 per cent of businesses experienced increased operating expenses over the previous month compared to 21 per cent of businesses in June 2021. These costs may be exacerbated by expected increases to wages and price pressures, and continued strains on supply chains, but are expected to moderate in 2023.
- Although the pandemic lockdowns saw an exodus of city-dwellers relocating to regional areas, the regional housing boom is slowing.
- Recent flood disasters in Australia have added to economic pressures and are expected to slightly slow economic growth in 2022, costing an estimated $5 billion in economic activity.
- In part a consequence of the COVID-19 pandemic, the Australian Government is facing swelling deficits and a debt of nearly a trillion dollars, despite reduced spending. The Victorian Government has also accrued record debt, the largest of all states and territories, but has signalled it will avoid austerity measures and will

instead grow the state out of debt and foster a post-pandemic recovery.

- The Victorian Government set an ambitious jobs target to create 400,000 jobs by 2025. According to the latest budget, progress toward the target is on track.
- Despite economic uncertainty, governments, both at home and abroad, continue to initiate large-scale infrastructure projects and continuing to drive a transition toward a more sustainable future.

Affordability concerns

- Amid an economic slowdown and the rising cost of living, affordability of products, services, and housing are among the top concerns for Australians.
- Household costs are rising. All household types have recorded an increase in cost of living between 4.6 and 5.2 per cent in the last year.
- Housing affordability is a significant, ongoing challenge. Among developed countries, Australia had the second largest decline in housing stock relative to the adult population in the two decades before the pandemic, and had just over 400 dwellings per 1,000 people in 2020.
- The number of mortgages with monthly repayments greater than $5000 increased 60.9 per cent, from 81,947 in 2016 to 131,873 in 2021. Mortgages with monthly repayments between $3000–3999 increased nearly 20 per cent for the same period.
- One in five working-aged households who rent are in financial stress, which is defined as skipping a meal, using charity, pawning something, or not heating the home.
- Although household wealth has grown as much in the last three years as it did in the previous 15, this has primarily been due to soaring property prices. Meanwhile, for low-income earners, life is more precarious, with 39 per cent unable to cover three weeks of lost income.

Increasing private investment in water

- In the overseas context, private investment in water has grown in recent years. With wider awareness of growing water scarcity, market-based solutions to water sector issues may become more widely adopted. Australia remains a highly attractive destination for investment in infrastructure.
- In China, online retailer Ali Baba initiated a quasi-philanthropic investment to protect water resources. In the United States, markets have commenced water futures trading, including listing water as a commodity for trading alongside oil on CME and Nasdaq.
- Moves toward market-based water trading are also receiving increasing scrutiny and criticism, with some calling for such markets to be 'shut down' amid concerns that such practices may nudge water into a dystopian future.
- Privatisation of water sector assets are accelerating worldwide, with 'water barons' (commonly banks, investment groups, businesses, and independent billionaires) buying up land with water access, water rights, water utilities, and shares in water engineering and technology companies.
- In Australia, reforms to the water market, including improved regulatory controls, are currently on the agenda for the federal government.

What might this mean for the water sector?

Shifts in service demand

- Economic conditions, including economic growth, relative unemployment rates and relative house prices, are important drivers of population growth (including migration between states and territories), demand for water, and number of connections to the grid. In particular, if Australia's housing policy and property market landscape changes, this could substantively affect demand for water sector services. than 65 million new low-carbon jobs.

Water's role in economic recovery

- The water sector will likely play a significant role in Victoria's economic recovery, with the government potentially seeking additional dividends, a 'shovel-ready' pipeline of critical infrastructure projects, and contributions towards the State Government's ambitious employment targets. Given the water sector's pre-existing orientation toward environmental protection and circularity, it is well positioned to be a key influence in shaping a 'green recovery'.
- Investment in digital and physical infrastructure by the water sector could help with economic recovery. Public stimulus can be used for investments that will enhance productivity, encourage innovation, and rebuild in ways that shift us towards a carbon-neutral future.
- With COVID-19 having changed the way we work, infrastructure investments can be balanced between digital connectivity, traditional modes of transport (such as road and rail), and infrastructure that increases local mobility (such as cycling and walking) to create more green, liveable cities.

Affordability and financial hardship

- Increasing regulatory commitments, combined with the need for large-scale system upgrades and supply augmentation, will place upward pressure on prices. At the same time, there will be an increase in customers experiencing financial hardship. The sector will need to balance the complex relationship between improving and maintaining service quality while keeping prices as low as possible.
- With an increasing number of customers entering hardship, the potential for defaulting on water bills continues to increase. Water utilities will likely be subject to increasing scrutiny regarding expenditure and continue to be required to provide more flexible hardship allowances for retail customers.

Possible pockets of the future in the present

1. A 2020 report by the Australian Securities and Investments Commission (ASIC) said that consumers using buy now, pay later purchasing increased 90 per cent between 2017-18 and 2018-19, with one in five customers missing repayments.
2. In 2020, the Spanish government launched one of the biggest universal basic income experiments yet, offering monthly payments of up to €1,015 (US$1,145) to the nation's poorest families.
3. Spain is seeking to tax banks for windfall profits made from net interest and fees charged to clients in an attempt to offset the impact of a worsening cost-of-living crisis.
4. Michael Burry, famous for having shorted the subprime lending market in 2008, is investing heavily in water-rich farmland away from governmental and infrastructural limitations.

Driver 6
Customer and community expectations

What is it?

Melbourne Water's services are largely determined through engagement with customers and the community in a five-yearly Price Submission process regulated by ESC. Expected service outcomes and funding for service delivery are determined by the outcomes of this process, and Melbourne Water is held to account on delivery against these customer expectations. Further, as an essential service provider, Melbourne Water recognises the social contract it holds with the wider public to deliver its services in alignment with evolving public expectations, particularly as it relates to environmental, social and governance responsibilities.

What is changing and why?

Consumers are becoming more conscientious

Standards for business ethics are continuously evolving and both organisations and corporate leaders are coming under increased scrutiny, with environmental, social and governance (ESG) credentials increasingly important to investors, employees, regulators, and customers.

- The 2021 Edelman Trust Barometer revealed that 86 per cent of respondents expect CEOs to publicly speak out about societal challenges and there is evidence that executives are responding by shifting into broader societal leadership roles.
- Awareness of and concern for sustainability issues continue to be influential considerations in the decision-making of Australians consumers. The top issues of concern included climate change, plastic waste, water pollution, human rights, wildlife conservation, and wealth inequality.
- Increased awareness of sustainability is affecting consumer attitudes and behaviours. Thirty-two per cent of consumers are 'highly engaged' with adopting a more sustainable lifestyle and 28 per cent have stopped buying certain products due to ethical and environmental concerns.
- Technologies such as blockchain, which can record the ultimate provenance of product and service inputs on an immutable public ledger, are making reporting more transparent and harder to falsify.
- Conscientious attitudes and behaviours are driven partly, albeit not exclusively, by the increasing influence of millennials and Generation Z on the cultural landscape, within the marketplace, and in the workplace. These influences are likely to grow as a disruptive force, shaping the standards of corporate responsibility, and driving product and service innovation and value.
- Brand engagement in social activism, particularly in relation to climate and environmental issues, is increasingly informing customer behaviour and decision-making. A survey by Deloitte found that 19 per cent of US customers strongly agreed that purpose-driven brand actions positively affected their purchasing behaviour, while 26 per cent said that negative brand behaviour also negatively affected their decision to buy.
- Over 80 per cent of Australian consumers express a willingness to reduce consumption to aid sustainability outcomes, and over 10 per cent say they are willing to pay more for products and services that contribute to these outcomes.

The digital customer experience

- Customer perceptions of service experience standards are influenced greatly by their experience in interacting with private sector companies. Although public sector organisations in Australia have improved customer experience dramatically throughout the pandemic, customers are increasingly expecting a higher standard from public sector organisations, with a particular focus on personalisation, empathy, consultation, and digital engagement channels.
- In recent years, Australia has caught up with global peers when it comes to offering digital channels for products and services. But, the digital habits and preferences of consumers continue to evolve rapidly. Today, a greater number of Australians are cautiously avoiding social media platforms, citing misinformation as a key deterrent.
- Millennial and Generation Z consumers increasingly prioritise experiences over material goods, a preference which will likely be targeted by companies as XR technologies and metaverse offerings grow more sophisticated. Currently, one in three users have visited a store within a virtual reality channel.
- Despite Australian customers becoming more digitally savvy, their concern around companies' use of their personal data is trending down. However, high profile cyberattack events, such as those targeting Medibank and Optus in late 2022, may, at least temporarily, increase customer concerns.

Declining trust in institutions

- In many developed countries, public trust in government and other institutions is in crisis. In Australia, trust in government ranks among the lowest in the world.
- Despite record-high levels of public trust being recorded in 2021, the Edelman Trust Barometer for 2022 shows a decline in public trust, with only 52 per cent of Australians trusting government to do the right thing and only 58 per cent trusting business. Only 43 per cent trust media, making it the only institution to be distrusted by a majority of Australians.
- A majority of Australians believe that journalists, government leaders and business leaders are actively trying to mislead them.
- Despite overall trust being low, consumer satisfaction in public utilities in Australia was higher than government at 69 per cent, and about average compared to global utilities.

What might this mean for the water sector?

Licence to operate

- As public utilities, water corporations in Australia are inextricably associated with government in the Australian public consciousness. As a result, although utilities have fared better than other public institutions in terms of public trust in recent years, the sector will likely continue to be impacted by the continued decline in public trust. Ensuring continued delivery on Price Submission outcomes and improving the sophistication of our public engagement processes will be critical to ensuring the sector remains buffered from any continued decline in trust.
- The impacts of our work, from construction to service delivery, will be under increasing scrutiny to meet quadruple bottom line outcomes, including sustainability and social equality. A social-ecological 'licence' may be required to operate, with citizens becoming increasingly unforgiving of those investors and businesses moving too slowly on key environmental and social actions.
- In the longer term, organisations may begin to move away from shareholder value to social (and ecological) value and consideration of the role of businesses in broader society.

Our role in liveability

- Liveability encompasses all aspects of health and wellbeing, and the water sector has a role to play in supporting local communities and encouraging access to green spaces, restoring waterways, and using resources to cool smart cities with nature-based solutions.
- Urbanisation and population growth are creating a growing need for green open spaces that are accessible to the community and can provide cooling benefits for people during summer. Blue-green corridors have the opportunity to increase the amenity and social value of waterways.

Think local

- Hyperlocal activity and engagement could require the water sector to rewire its operating model to provide a more granular presence at scale, including personalisation (particularly analytics, trigger-based messaging, and agile test-and-learn approaches) and renewed thinking about how to scale content supply chains and manage performance.
- The rapid growth of neighbourhood activity has triggered the perception that the water industry can perform a broader role in communities' resilience. This provides an opportunity to extend water services for landscapes, in-front and behind-the-meter services, and neighbourhood-scale alternative water schemes.

Key drivers

- Increased community demand for quality green spaces places greater pressure on water utilities to support local community aspirations and mental health through equitable access to nature and recreation spaces.

Building public trust and optimism

- Throughout the pandemic, businesses were being called upon by the public to demonstrate both ability and integrity – the key building blocks of trust. Business continues to be more trusted than government for much of the population, and the community will likely look to essential services such as water utilities to provide trusted leadership in a time of uncertainty and continuing transition.
- Building community trust may require a focus on improving customer communications and engagement through rapid monitoring and response.
- As providers of essential services, the water sector is in a prime position to offset consumer perceptions of feeling unsupported by government by providing continuity, stability, and order through its service delivery, as well as optimistic visions of the future.

Possible pockets of the future in the present

1. A growing number of Australian companies, including Atlassian, are supporting employees to walk off the job to protest against a lack of action on climate change.

2. In the Netherlands, ReGen Villages, is a new form of urban sprawl that offers residents a high-tech ecovillage that integrates AI to manage many of the micro-city's functions. Incorporating systems that will take care of renewable energy, food production and water supply, ReGen Villages provides a glimpse into a new trend for urban design that may be an ideal living situation for many.

3. Management researchers are now recommending businesses shift from 'customer-centricity' to 'life-centricity', to become more deeply attuned to the evolving forces, such as technology, health, and culture, that most profoundly affect their customers' lives, in order to maintain service and product relevance.

4. 'Reality privilege' is a term coined by Marc Andreessen, an American technology entrepreneur and investor. Andreessen used the term to describe the advantages conferred on socioeconomically wealthier populations to improve their experience in the physical world, while arguing for the need to prioritise 'improvements in virtuality' (for example, the metaverse) to benefit those who lack 'reality privilege'.

Driver 7
Supply chain

What is it?

Melbourne Water is the custodian of large-scale infrastructure networks and facilities that are critical for our service delivery. Our ability to maintain the condition, reliability, and continuity of this infrastructure depends, in part, on our ability to procure adequate supplies of materials, including pipes, pumps, and parts, as well as chemical inputs used for treatment processes. Like many other businesses, Melbourne Water is also increasingly reliant on digital infrastructure.

What is changing and why?

Global shocks revealing supply chain vulnerabilities

- Supply chains have been under pressure globally for some time, a situation that has been exacerbated by the COVID-19 pandemic. Numerous sectors are facing permanent structural change.
- The contemporary global economy is at an unprecedented level of interconnectedness. Global shocks, such as pandemics, war, and economic recession, can severely and rapidly disrupt these connections, producing unpredictable and catastrophic, cascading consequences on local and global scales. One such example was the extreme drought in China in 2022, which forced the rationing of energy and suspension of manufacturing in the hydropower-dependent south of the country. This local event had consequences for the global supply chain.
- Although industries can usually prepare for and withstand one or two risks, unforeseen, multiple cascading challenges can create 'perfect storm' conditions for supply chain disruption.

Supply chain disruption

- Globally, more than 90 per cent of Fortune 100 companies have been affected by supply chain issues during the pandemic.
- In Australia, as at June 2022, around 41 per cent of businesses reported supply chain disruptions, with around 80 per cent reporting supply chain constraints. Supply chain issues had, on average, eased in early 2022, dropping by 10 per cent from previous months.
- Supply chain challenges were also amplified (and sometimes caused by) staff unavailability. Twenty-two per cent of businesses reportedly had staff who were unavailable to work as at January 2022, with large businesses being the most affected. Although illness was a common reason for staff absence, industrial action in some sectors also compounded availability.
- The construction industry – a key partner for the water sector – has been hit hard by supply chain disruptions. Key construction inputs, such as copper, aluminium, timber, and steel – the very fabric of projects within the industry – are in short supply, with inflation exacerbating the issue.
- Disruption of water sector supply chains became common throughout the pandemic, with consequences ranging from raw material droughts, to worker shortages, manufacturing plant failures, and transportation bottlenecks.

Key drivers

Shift in focus from efficiency to resilience

- After decades of configuring supply chains to achieve just-in-time maximum efficiency, the COVID-19 pandemic revealed the lack of resilience to global shocks inherent in this approach. As a result, building supply chain resilience is expected to grow as an investment focus for business leaders in the next two years.
- Approaches to building more resilient supply chains vary widely across sectors, but the majority of businesses are considering increasing inventory size, finding local suppliers, diversification of suppliers, or tolerating residual risk.
- The repatriation of manufacturing is also expected to increase to buffer industry against future global disruption. Around 55 per cent of Australian manufacturers plan to reshore manufacturing operations to Australia by 2023.

Availability of critical supplies

- Critical raw materials and products for a range of industries are in short supply. In 2021, a shortage of semiconductor chips was spurred by some manufacturers cutting chip orders early in the pandemic to meet augmented demand. This shortage affected more than 169 industries, brought automotive production to a standstill, and delayed consumer electronic product launches.
- Australia is heavily dependent on China and surrounding East Asian nations for renewable energy infrastructure components and critical electronics components. China is the main supplier of about two-thirds of vulnerable products imported to Australia. China also maintains global market dominance in the production of lithium batteries and electrolysers used to produce hydrogen. Meanwhile, 92 per cent of semiconductor chips globally are manufactured in Taiwan, and the remaining 8 per cent in South Korea. Subsequently, disruptions and shocks across China and East Asia represent a potential vulnerability for supply chains central to renewable energy projects and digital transformation.
- Most supply chain risks for water utilities involve domestic products, sourced within Australia rather than abroad and not considered vulnerable. However, a number of gaps remain in critical supply chain global inputs required for maintaining essential water supply services, infrastructure, and equipment.
- Although some substitutes do exist for critical water treatment inputs such as chlorine, further investment in configuration of treatment facilities would be required to use them.

Increasing digitisation of procurement

- Digital tools, such as blockchain-based procurement and source-to-pay solutions, are increasingly playing a role in modernising processes, breaking down silos, and boosting access to data. Subsequently, it is likely that industries will have a renewed focus on technology within procurement.
- Increasing consumer and stakeholder focus on ESG factors is also leading to more investment in digital procurement. Cost reduction and ESG implementation are among the top reasons for developing technological tools that support digital procurement.

Transition toward resilient circularity

- The emerging circular economy model is being viewed by some as a way of enabling a move toward more resilient, agile supply chains. In relative terms, Australia is low in economic sophistication, but emerging perspectives hold that a more circular rethink of primary inputs, knowledge, innovation, and technologies may improve global standing.

What might this mean for the water sector?

Building resilient supply chains

- Given the supply chain fragilities revealed throughout the COVID-19 pandemic, government and the community may raise their expectations of utilities to prioritise resilience over efficiency.
- Operations should be flexible and resilient enough to adapt and adjust in real-time to changes in trade flows, new regulations, the ongoing impacts of COVID-19, climate change, trade tensions, and other geopolitical events. Technology should be leveraged to help reduce operating costs, provide visibility, and diversify the way supply chain needs are met.
- To address supply chain vulnerabilities, organisations will need to focus on building inventory , diversifying sources, and building a network of trusted vendors (customers, supply chain partners, and suppliers) to help manage disruptions and support business continuity. By enabling cross-functional integration and collaboration across an ecosystem of vendors and partners, the sector can create a more resilient supply chain profile.
- A return to local manufacturing will drive changes in water services, population, employment, and local economic growth, with implications for assets and infrastructure investment.

Key drivers

Circular supply chains

- Moving toward circularity can offer the water sector the twin benefits of diversifying and localising supply chains, both of which can result in greater supply chain resilience.
- There is growing understanding of the impact of finite resources on costs for waste disposal (landfill availability) and the need to reduce carbon impacts on climate variability, causing several water businesses to investigate options around resource recovery and the circular economy.
- Some water utilities have made commitments to waste reduction which could require operational changes incurring costs. However, there is an opportunity to offset these costs through new revenue streams, for example, from recycling and energy production and savings.
- The water sector can contribute to meeting important circularity goals. For example, resources such as phosphorous, and clean water itself, will increasingly be recovered from wastewater.

Construction costs

- With construction costs predicted to continue rising by 4 to 8 per cent throughout the 2022-23 financial year, the water sector may see tighter project budgets for critical projects.
- With some degree of deglobalisation of supply chains underway, repatriated production of previously imported goods and services may boost resilience, but may come at a cost passed on to customers.

Possible pockets of the future in the present

1. **Voters in Zurich have overwhelmingly approved enshrining the circular economy in their constitution, creating frameworks that promote circular supply chains through the adoption of cleaner, more efficient closed-loop industrial practices.**
2. **Researchers at Virginia Tech have discovered a way to recycle polystyrene waste into more valuable products, tackling the growing accumulation of non-degradable waste polluting cities and waterways.**
3. **Biochar is receiving increasing support on offset markets. The soil additive product, which is produced by burning waste biomass in a process called pyrolysis, is considered the 'black gold' of agricultural circular economies.**
4. **7bridges is an AI-powered logistics platform that helps supply chain managers identify opportunities to reduce their carbon footprint and tackle the increasingly stringent sustainability demands of regulators.**

Driver 8
Natural and man-made disasters

What is it?

Infrastructure networks can be damaged or disabled by natural and man-made disasters, impacting service continuity and quality, with potentially significant consequences for human health. Although natural and man-made disasters have always been a part of the operating environment for water utilities, phenomena such as climate change and the rapid digitisation of society are compounding these challenges, making them more likely to occur at higher frequency and magnitude.

What is changing and why?

Incidence of extreme weather events

- The increasing frequency of extreme weather events and natural disasters in Australia poses a challenge to our utility networks.
- It is predicted that Australia will face a range of major changes to the climate in the near future, including continuing temperature rises, more heatwaves, a greater proportion of high-intensity storms, and a longer bushfire season.
- In the wake of the floods in Victoria and New South Wales in 2022, some experts are calling for flood risk standards, such as the 'one-in-100-year' flood, to be scrapped.

Climate change tipping points

- When changes in a climate system become self-perpetuating, this system can be said to have reached a 'climate tipping point'. When a tipping point is reached, these changes may lead to abrupt, irreversible, and dangerous impacts with serious implications for humanity. Five dangerous tipping points may already have been passed by global heating. These include the collapse of Greenland's ice cap, which will eventually produce a significant sea level rise, the collapse of a key current in the North Atlantic Ocean, disrupting rain upon which billions of people depend for the production of food, and an abrupt melting of carbon-rich permafrost.

Increasing incidence of cyberattacks

- The incidence of large geopolitical cyberattacks have increased dramatically in the last decade, with almost 500 such attacks occurring since 2009. On 8 February 2021, a water treatment plant in Oldsmar, Florida, USA was the subject of a cyberattack.
- Cyberattacks directed at states and companies are growing in number and scope. Such attacks are still considered to be in the grey zone between civil felonies and actual warfare. The actors behind cyberattacks are usually difficult to identify and punish, making it an easy playing ground for many. If the current rate of attacks speeds up, the situation may well be called one of global cyberwarfare.

Continues threat of terrorism

Terrorism continues to be a threat, with Australia's intelligence agencies assessing this threat as 'probable'. Agencies have said that terrorists globally are attracted by the symbolic appeal of attacking governments and authorities, such as the military, police, and security agencies. They also continue to attack the general public.

The war in Ukraine

- The current conflict in Ukraine has raised the prospect of nuclear war, with foreign policy experts assessing the situation as the closest to nuclear exchange since the Cuban Missile Crisis of 1962.

- Even a limited nuclear exchange could have catastrophic consequences for the entire world. The potential effects of nuclear weapon use would include immediate loss of life due of blasts and radiation, massive infrastructure damage, and, in the longer term, reduced global food production causing widespread famine and loss of life.
- Amid escalating tensions between Russia and the American-led NATO security alliance, Russia has threatened use of nuclear weapons, while the US has deployed 4700 soldiers from the 101st Airborne Division to Europe.

Potential for conflict between the US and China

- Geopolitical tensions between the US and China have shown signs of escalation throughout 2022, with fears of military conflict increasing. It has been stated, by the chief of US naval operations, that the US military needs to be ready to respond to a potential invasion of Taiwan in as early as 2022.
- In late 2022, Chinese president Xi Jinping indicated intentions to steer China's policy away from reconciliation with the West, warning of 'grave international developments' not seen in the past 100 years.
- New US export controls have disrupted the Chinese tech industry, with leading chip equipment suppliers suspending sales and services to semiconductor manufacturers in China.

Threat of global collapse

- The notion of global collapse should 'merit serious consideration' by the scientific community, according to a recent study. With the increasing risk of climate collapse, so too is there an increased risk of civilisation collapse, encompassing a loss of societal capacity to maintain essential governance functions, such as security, the rule of law, and the provision of basic necessities such as food and water.
- In 2022, a United Nations study found that at least four of the nine planetary boundaries now seem to be operating outside the safe operating space, with ecosystems and biospheres increasingly at risk of collapse.

What might this mean for the water sector?

Disaster impact preparedness

- Natural disasters of increasing severity – particularly floods, bushfires, and droughts – may threaten infrastructure, water resources, and workforce health and safety, requiring additional resources to ensure government and community expectations of disaster preparedness and resilience are met.
- Extreme weather is likely to impact population health and safety, shaping workforce availability, productivity and health and wellbeing.
- Climate change is leading to reduced inflows to storages and increasing the incidence of natural disasters and algal blooms, putting a strain on the water security of the system.
- Changes in climate conditions may disrupt electricity supply and accelerate the deterioration of assets such as overhead lines and underground cables.
- Increasing partnerships with Traditional Owners, already evidenced by support for a cultural framework that sees Traditional Owners in control of their own fire programs.
- Storms, floods and fires increase the potential for water contamination

and sewerage spills. With such events becoming more common, utilities may need to increasingly adopt multiple early warning systems, both human and digital, to ensure that contamination events are identified and resolved in a timely way.

- Bushfires can leave harmful chemicals, such as arsenic, in our water systems. In some cases, these levels have been found to exceed regulatory limits, even in processed drinking water.

Seeking adaptation investment

- Natural disasters of increasing severity will require funding for recovery. Governments are likely to place greater emphasis on preparedness and resilience, perhaps leading to formalised natural disaster preparedness budgets.
- Infrastructure augmentations that achieve multiple benefits, including to enhance resilience against bushfires, drought and flooding, can increase overall costs in the short term and can be difficult to progress. However, such projects may attract more support in the wake of disasters, providing a net positive community benefit in the longer term.
- Addressing the effects of climate change will affect the industry by increasing adaptation costs and, potentially, bringing forward some expenditure (for example, major supply augmentations). The effect will be dependent on the circumstances of individual utilities, including how much capacity they currently have, how exposed they are to changes in climate, when climate change effects manifest, and when adaptation investments are required.

Possible pockets of the future in the present

1. **The extreme effects of climate change have prompted some cities in the United States to hire Chief Heat Officers to tackle the growing threats to urban populations.**
2. **Californian Pacific Gas and Electric faces bankruptcy after it was found liable for US$1.7 billion in damages as a result of failing to maintain ageing infrastructure and inadequate vegetation management.**
3. **A study funded by the National Science Foundation demonstrated that stratospheric aerosol injection of microscopic sulphur dioxide particles into the atmosphere could feasibly refreeze the poles and return subpolar regions to pre-industrial temperatures.**
4. **In an effort to mitigate climate change, scientists are unearthing a decades-old idea to seed the planet's oceans with more phytoplankton, an organism that is responsible for producing 50 per cent of the oxygen in our atmosphere from carbon dioxide and sunlight.**

Driver 9 Enterprise technology

What is it?

The technological systems and processes adopted by an organisation provide critical support to the delivery of its core services. The nature of these systems, particularly whether they are fit for purpose, have a significant impact on the performance of the organisation and its employees in delivering appropriate service levels.

What is changing and why?

Advancements in artificial intelligence and machine learning

- The pace of improvement to AI and ML technologies exploded in the last year. AI models, such as OpenAI's GPT-3 and Stable Diffusion, have demonstrated stunning creative and information synthesis capabilities.
- Trained on massive datasets, AI is now capable of producing sophisticated analyses of subjects that were previously thought to only be the domain of experts.
- AI experts predict that by 2026, 90 per cent of all online content will be generated by AI.
- The use of RPA to automate business processes is increasing. RPA is software, often underpinned by AI, that enables anyone to automate digital tasks.
- The workforce is being increasingly augmented by technology, particularly by AI, ML and automation.

  Job augmentation is likely to become more common, with human workers automating parts of their own role with the help of AI, or even job-sharing with digital workers.
- AI and ML tools are currently being used in some parts of the water sector to automate asset monitoring and in defect detection, to detect contaminants faster and more reliably, and to optimise energy use and treatment processes.
- Synthetic data is helping businesses to overcome the challenges of training AI, when they lack access to the large datasets needed to do so. Synthetic data is solving this issue by generating data based on simulations of a small set of real-world data. This process reduces the need for access to original data and concerns around data privacy.
- As AI grows more sophisticated, there is rising distrust of its capabilities and the risks and threats associated with its use. As AI becomes more common within workplaces, how it is used could become a divisive issue for workers.

Internet of Things (IoT) and 5G

5G is having a positive impact on a range of industries, including utilities. This technology supports the development of smart systems and the IoT. Its low latency enables real-time asset monitoring and maintenance of the electricity grid. The IoT connects devices and systems, enabling businesses to collect and analyse data in real time.

- Globally, the uptake of 5G is expected to increase significantly from less than 200 million users in 2019 to over one billion users in 2023, driven mainly by expanded use of IoT applications. By 2025, over 75 billion IoT devices will be installed worldwide.

Extended reality is becoming part of the toolkit

- XR, which includes virtual reality and augmented reality technologies, is expected to change the way businesses interact with their customers, employees, and products in the near term.
- Entrepreneurs, technology platforms, Web3 and metaverse pioneers, gaming companies, and entertainment brands are reinventing education, piloting new ways of learning and creating new routes to skills-based rewards and recognition. Underpinning this innovation is the expectation that every job in future will require a level of technological proficiency.
- Some common uses of XR technologies in business contexts include creative communications, training and education, data visualisation, and design and modelling.

Increasing importance of cyber security

- The increasing digitisation of utilities, and the water sector in particular, increases vulnerability to cyberattacks and highlights the rising need for improved cyber security and greater regulation to reduce cyber risk. The water sector manages critical infrastructure, making it a prime target for attackers.
- Globally, ransomware attacks are increasingly common. A ransomware attack on a business occurs approximately every 11 seconds. In 2021, damage losses from ransomware attacks were estimated to be US$20 billion. In 2022, Optus and Medibank were subjected to highly publicised ransomware attacks, facing ransom demands over stolen customer data.
- ML is increasingly being drawn upon to protect critical infrastructure systems, providing early threat detection, intelligence production, and even threat prevention.

Rise of new technology roles

- The acceleration of digitalisation has impacted the range of skills needed within the workforce. Business leaders in Australia consider digital transformation, upskilling, and reskilling to be among the top priorities for businesses in the next three to five years.
- The World Economic Forum has reported that, on average, 40 per cent of workers will require reskilling and 94 per cent of businesses have indicated that they expect their staff to acquire new skills.

Technology creating new challenges and opportunities

- AI technology brings with it significant risk that the assumptions and biases of developers are embedded into the software design. Examples of this might be gender or racial bias. This bias can create unintended consequences and challenges for governments and companies using this technology, particularly for automated decision-making purposes.
- AI can make accurate inferences about individuals from large data sets and this can create privacy and ethical challenges. For instance, an AI system used for recruitment could infer an applicant's political persuasion from other information they have supplied and incorporate it into the decision-making process.

  Digital-savvy boards play a critical role in helping companies navigate both the significant risks and opportunities from technological advances.

Rise in workplace surveillance

- Remote work has led to a decline in the traditional leadership practice of 'management by walking around' and a rise in the use of employee surveillance software to track productivity.
- Advances in technology are increasingly exposing workers to automatic surveillance and privacy intrusions. An example is computers and smartphones that track an employee's activities and location while off duty. Greater monitoring, however, can erode trust within organisations, leading to lower productivity and morale.

What might this mean for the water sector?

Redesign of work

- Automation, ML and AI-enabled digitisation may drive a radical redesign of work. This redesign may include labour augmentation and full or partial replacement of roles and tasks, presenting new opportunities to increase efficiency, pressure to upskill labour to retain talent, as well as new ethical issues to navigate.

Tech-enabled efficiencies

- IoT will provide opportunities for operational improvements such as grid reliability, enhanced safety for workers and customers, and an improved customer experience. These improvements can drive insights to prevent water wastage and reduce consumption.
- Some water utilities have made commitments to waste reduction which could require operational changes that would incur costs. However, there is an opportunity to offset these costs through new revenue streams, such as from recycling.
- Digital projects may need to be better prioritised. Companies often have many digital initiatives underway concurrently, leading to confusion and wasted resources. Digital tracking tools can help segment the portfolio and prioritise initiatives with the greatest short-term return on investment, reducing costs and complexity, and enabling companies to make faster progress toward their digitisation goals.

Ethical tech application

- The growing use of blockchain-based technologies will likely render business transactions more transparent and frictionless, leading to increased certainty around supply chain provenance, as well as increased public visibility and scrutiny of the socio-ecological impacts of water utilities.
- New protections against role automation and surveillance could form part of employee contracts.

New tech roles

- Professionals with skill sets synonymous with digitalisation and the IoT world are in high demand, and include data specialists (such as data scientists, architects, and visualisation experts), cyber security specialists (to protect not only consumer information but also the network infrastructure), and software and application programmers (for user experience and back-end processes).

Possible pockets of the future in the present

1. **An increasing number of companies are reporting that prospective employees are using real-time deepfake video and deepfake audio for remote interviews to gain financial advantage, advance their careers, or even for purposes of espionage.**
2. **A number of recent breakthroughs in quantum computing mean this technology could soon be a reality. Promising to exponentially reduce processing times, solve previously intractable problems, and disrupt traditional computing, the application of quantum computing will constitute an unprecedented leap forward for digital technologies.**
3. **A new study reveals the growing role of AI in technological optimisation, demonstrating that AI can direct robots in rapidly finding advanced new battery formulations much faster than with brute-force human testing.**
4. **Dependence on digital technologies is being exploited by activist workers seeking to sabotage corporate productivity, who are using tools like Zoom Escaper, which interferes with teleconferencing audio signals, and Slow Hot Computer, which slow computer processing and reduces the possible pace of work.**

Driver 10 Water technology

What is it?

Technology is continually evolving, and new water-specific technological innovations are emerging all the time. The water technology systems and processes adopted by a utility are critically important to service delivery, affecting service performance, operational efficiency, the cost-to-serve, robustness and resilience, and what human skills are needed for their maintenance.

What is changing and why?

Better ways of making and harvesting water

- Globally, several new ways to produce clean water, based on innovative materials and techniques, have been proposed to address the shortage of clean drinking water.
- Desalination techniques are improving, including the development of a faster, more efficient selective membrane for purifying saltwater. This technology uses a fluorine-based nanostructure to filter salt from water several thousand times faster than existing technologies.
- A team of researchers from Clean TeQ Water subsidiary NematiQ have developed a commercially scalable graphene membrane product that removes chemicals, micropollutants and pathogens from water, enabling the purification of both wastewater and seawater with minimal energy expenditure.
- Scientists at Princeton University have developed a way to purify water with less energy using carbon dioxide. The method removes the need to push water through a membrane, dramatically reducing energy expenditure incurred through the more traditional process.
- Researchers at the University of Texas are developing technology to harvest water from the air, making it possible for anyone to have an affordable, portable device that can provide access to water anywhere, at any time, and using no external energy.
- As the water sector faces pressures to innovate to ensure its resilience and sustainability, utilities and business have increased their investment in the testing and uptake of promising technologies including the remote sensing of water, NRW remediation, and the IoT, which enables smart irrigation, water quality control, and supports the development of complex models for water management.

The advancement of smart systems to manage water

- In the contexts of economic pressures, population growth, and looming water scarcity, the water sector is under pressure to achieve optimum efficiency as well as resilience. Smart water technologies have an increasingly vital role in responding to this challenge, with the global smart water network market estimated to be worth US$22 billion and expected to grow by six to 18 per cent annually.

  Improvements in metering are helping to track system leaks, track water demand, and improve billing, while also providing households with access to data to inform their water-saving behaviours.
- The WaterOn device is one example of a smart metering and automated leakage prevention system, which has been used

on apartment buildings in India, saving an average of 35 per cent in water consumption for 40,000 households.

- Water loss through leakage and NRW are perpetual issues for water utilities. The market continues to generate innovative solutions, such as devices that enable acoustic-based leak detection.
- Advancements are being made in the development of self-regulating, smart infrastructure, which senses, predicts and augments itself to ensure a system operates within optimal parameters. An example of this is 'Smart sewer' technology, developed by researchers at the University of Notre Dame. This relies on a network of sensors to monitor the flow of stormwater and wastewater and divert it to areas of excess capacity within a combined system to reduce or prevent overflows. The implementation of this technology is expected to save US$437 million for the city of South Bend, as part of a plan to reduce sewer overflows in the city .
- In the UK, a company has developed an advanced pressure-management system that saves water through the use of sensors that learn the pressure requirements at different times of the day and adjust them automatically to match need. This technology was deployed during Cape Town's extreme drought in 2018, delivering 70 per cent of the demand reduction target needed to stop the city's water supply running dry. Such technology can reduce the risks of bursts and water loss, offer continual optimisation, and reduce energy costs .
- Agriculture is one of the most water-intensive industries. Optimisation of irrigation is essential for reducing water use and increasing yields. In recent years, innovations in irrigation systems have delivered increasingly effective water management solutions. New smart irrigation methods that improve cropping efficiency are emerging, making it possible to grow more food using less water .

Use of digital twins in the water sector

- A digital twin is a virtual copy of the water supply system that simulates how the system behaves and helps to make better decisions, based on the holistic view this twin provides of the system and its ability to simulate various scenarios. These replicas use data, including real-time data integrated via IoT technologies and AI, to simulate and predict how a system might perform under specified conditions and how a product or process will perform.
- Digital twins can help companies better understand performance of their water systems and predict and optimise future performance. By simulating the impacts of potential changes in the virtual world, digital twins can limit the risks to real-world operations and help utilities make quick, data-driven decisions and respond in the best way to crises and other scenarios.
- Digital twins are currently being used in the water sector to successfully reduce NRW.
- Digital twins have also been used to assist cities to understand the implications of their strategic ambitions.

Shift to decentralised solutions

- Technologies that lend themselves to decentralisation of water, sewerage, and energy are increasingly attractive due to their cost and resilience benefits and potential to support decarbonisation. While not all such technologies are currently scalable, they may increasingly make up part of the mix of sources, combining centralised and decentralised water supply. In Singapore, nearly 90 government housing blocks are being installed with the UrbanWater Harvesting System (UWHS), which harvests rainwater for non-potable uses in common areas.
- An Israeli company has developed an air-to-water generator, named Mobile Box. This generator sucks in air through a fan, runs it through a filtration system on the way to the patented heat exchanger that extracts water through condensation, processes it through a multi-level filtration system that includes UV light, and stores it in a reservoir.

What might this mean for the water sector?

Savings from smart water tech

- AI has already demonstrated its applicability for asset management. Sensors can detect a potential fracture before it occurs, making it cheaper to repair, reducing water wastage, minimising community disruption, and resolving a problem before it happens.
- The operational opportunities provided by IoT can lead to reduced operating costs for utility companies.
- Smart digital solutions may offer the water sector more cost-effective ways to meet compliance requirements in both the short term and long term.

Risk appetite adjustment

- Although there are clear benefits from adopting new water technologies, utilities exploring the adoption of such technologies may need to recalibrate their risk appetite accordingly to ensure that legacy thinking does not impede the realisation of such benefit. Distinguishing clearly between 'new for us' and 'new for the global water sector' will be important.

Key drivers

Automation point of no return

- The sector must be aware of and plan to mitigate the vulnerabilities created by its increasing dependency on technology, ensuring its business continuity planning factors in redundancy in critical knowledge and skills that can be leveraged in the event of technical failure.

Renewals with multiple benefits

- New water technologies, digital and otherwise, are unlocking a range of potential benefits. Increasingly, the water sector will need to ensure its infrastructure design and project decision-making processes leverage technologies that meet multiple criteria, including emissions reduction, energy efficiency, waste recovery, long-term cost savings, and service delivery.
- Water technologies that lend themselves to decentralised applications continue to advance. Although centralised water systems may continue to be the central feature of water utility infrastructure, the parallel advances of IoT and decentralised water harvesting and treatment, as well as sewerage treatment, may become more technically and economically viable options in the future as utilities consider more resilient options when renewing or replacing ageing infrastructure.

Possible pockets of the future in the present

1. In 2022, 12,000 'floatovoltaic' solar panels were installed on Alqueva reservoir as part of Portugal's ambition to reduce reliance on imported fossil fuels, saving valuable real estate, reducing water evaporation, and increasing energy generation efficiency by up to 15 per cent.
2. Nokia's Smart Water Management initiative is promising to transform water utilities by deploying smart water applications across the operations lifecycle, including leakage control, pressure management, water efficiency, grey water reuse, rainwater and effluent, and demand management.
3. In 2022, Singapore's National Water Agency (PUB) won three awards for its use of a digital twin, which featured a whole plant simulation model that integrated a real-time data feed and predictive capabilities to test operational changes and improve operator training.
4. In Panama City, a semi-autonomous trash interceptor, powered by flowing water and sunlight and capable of eating plastic, has been deployed to help rehabilitate the heavily polluted Juan Diaz River.

Driver 11
Regulation and policy direction

What is it?

As a water corporation operating in Victoria, Melbourne Water is afforded the mandate to operate under Victorian Government legislation and is beholden to a range of legislative and regulatory requirements. Melbourne Water is also a policy delivery arm of the Victorian Government and is obligated to implement policy aims where directed.

What is changing and why?

Policy around climate change and environment-related issues

- As we approach climatic tipping points, governments are looking to enhance policy and regulation to ensure that both the public and private sectors meet climate and environmental goals.

  Energy-related regulatory reform is expected to continue as Australia transitions away from a centralised, coal-based energy system to one that is decentralised and focused on renewables.
- In 2022, the Victorian Government announced plans to increase the renewable energy storage target to 6.3 gigawatts by 2035, which is enough energy to power approximately half of Victorian households during peak energy use.
- A scheme to issue biodiversity credits has recently been proposed by the environment minister, whereby credits are awarded to private landowners or projects that restore and protect habitats for native species and waterways.
- In 2020, a study found that half of global gross domestic product (GDP) was dependent on nature and its services. In the context of increasing urgency to tackle climate change and environmental issues, new risk management and disclosure frameworks are gaining support.

  While the frameworks created under the Task Force on Climate-related Financial Disclosures and the Task Force on Nature-related Financial Disclosures are not yet embedded into Australian regulatory mechanisms, this remains a possibility in the years to come.

Carbon emissions labelling of goods and services

- In 2022, the French Parliament enacted a law that requires every item of clothing sold in France to be labelled with information detailing its precise climatic impact, with a similar rule expected to be embedded across the European Union by 2026.
- Brands such as Unilever, Allbirds, Logitech, and Panera have already adopted carbon emissions labelling to show customers the environmental costs of product generation and consumption.

Standardisation of critical infrastructure and cyber security

- As water utilities and other critical infrastructure custodians digitise their operations and services, it is expected that cyber security best practices will increasingly be mandated and standardised. In December 2021, the Security of Critical Infrastructure Act 2018 was amended and expanded to include several new asset classes. The Act seeks to manage the complex and evolving national security risks of sabotage, espionage, and coercion to Australia's

critical infrastructure, and applies this to our water and sewerage service providers.

- In 2021, the Australian Government launched its Ransomware Action Plan, which seeks to prevent, prepare for, respond to, and recover from attacks, as well as implement methods to disrupt them.

Justice and self-determination for Traditional Owners

- Victoria is leading the nation on the journey to treaty with Traditional Owners, as the First Peoples' Assembly of Victoria continues to work together to develop a path towards true self-determination for Traditional Owners. In addition, Traditional Owners are pursuing self-determination through formal agreements with partners, particularly those within the public sector, which will also enable self-determination outside of the treaty process.
- There is growing public expectation and, in some cases, regulatory requirements to ensure Traditional Owners are joint decision-makers in matters concerning Country and management of natural resources.
- In 2022, the Australian Government released a proposed draft change to the Constitution to provide Indigenous Australians with a forum to deliver independent advice to parliament and the government. The proposal is expected to go to a referendum in 2023.
- Separately, the Australian Government signalled its intention to take further action to secure the water interests of Indigenous Australians.

What might this mean for the water sector?

Growing role in restorative justice

- Restorative justice processes will likely continue to reveal past injustices, including those resulting from activities of the water sector. These processes will require reflection, consideration, and reconciliation, including through formal agreements with Traditional Owners to redress injustices and support self-determination.
- There is an increasing requirement and expectation from government for the water sector to partner with Traditional Owners, particularly if Wurundjeri Woi Wurrung or Bunurong are afforded similar agreements to the Taungurung. Such partnerships will increase the ability of Traditional Owners to participate in and provide informed consent as part of the planning and decision-making processes that affect the management of Country and the movement and use of land and water.
- The water sector will increasingly be required to conduct quadruple bottom line accounting, requiring more careful management of heritage sites, as well as larger future system augmentations that allow the return of water to Traditional Owners.
- The water sector will be required to support, as needed and requested, the building of operational skill and governance capacity of Traditional

Owner partners. Such measures of support will include actively growing the water sector's Aboriginal workforce and supporting Aboriginal people in leadership roles.

- Building the cultural competency of water professionals will be a key requirement for the sector, to deepen understanding, pride, and acceptance of our shared history and respect for living indigenous cultures.

Increased environmental regulation

- Demands on water utilities, and business decision-makers more broadly, to demonstrate action on emissions reduction, decarbonisation pledges, renewable energy projects, and clear mitigation for climate risk, are likely to increase, especially if the global climate indicators trigger increased urgency throughout the decade.
- Victorian utilities are required to meet carbon mitigation targets set by the State Government and have already incurred costs in relation to this challenge.
- Enhanced environmental and health regulations have the potential to drive up costs associated with compliance activities for utilities. The cost of meeting future changes to health and environmental regulations is expected to result in a significant increase in capital expenditure requirements for the industry.
- Accounting for ecological operational and reputational risk may become a core expectation for business decision-making and reporting.
- Meeting the Sustainable Development Goals will require institutional and technological innovations to supply, allocate, and manage water, as well as a sustained political and financial commitment to address those who might be left behind.

Increased cyber regulations

- The *Security of Critical Infrastructure Act 2018* imposes mandatory cyber incident reporting on water utilities and gives the government information gathering power in pursuit of the Act's goals. The Act also affords water utilities government assistance in the event of a cyber incident.
- The Ransomware Action Plan requires mandatory reporting of ransomware incidents affecting businesses with a minimum $10 million a year turnover and imposes new penalties for non-compliance.
- Some jobs may be eliminated without direct replacement because of tighter regulation and social demands (especially, in high-polluting industries and sectors relying heavily on natural resources).

Possible pockets of the future in the present

1. **In September 2022, the use of fossil fuels was reframed as a human health issue when a large group of prominent health professionals and organisations, backed by the World Health Organization, called for governments to establish a binding international treaty on phasing out fossil fuels, calling them 'a grave and escalating threat to human health'.**
2. **In 2022, founder of the clothing company Patagonia, Inc., Yvon Chouinard, announced that he was giving away his company to nature to help fight the climate crisis, stating that 'all profits, in perpetuity, will go to our mission to "save our home planet'.**
3. **In a European first, Spain granted personhood status to one of Europe's largest saltwater lagoons, allowing the rights of the lagoon's threatened ecosystem to be defended in court as though it were a person or business.**
4. **Environmental law researchers are currently examining the ways in which Australia might redress past injustices to Traditional Owners, including the adoption of models from New Zealand and Chile under which governments fund the reallocation of water to the custodianship of Aboriginal communities.**

Driver 12 Catchment health

What is it?

Victoria's catchments are rich in environmental, economic, and cultural value. As vibrant hubs for biodiversity and natural assets, the five distinct but interconnected and interdependent major catchment systems within the Port Phillip and Western Port region are home to some of Victoria's most iconic species and the major source of raw water that Melbourne Water harvests to treat and provide to its customers. Water quality is affected significantly by the health and integrity of the catchment, which functions as the front-line filter and storage for raw water resources. Many of our primary catchments are protected for this reason, but their protection must always be balanced against competing interests.

What is changing and why?

Continuing environmental degradation

- In 2022, *Australia's State of the Environment Report* indicated that the country is suffering from 'poor and deteriorating' environmental conditions resulting from climate change, habitat loss, invasive species, pollution, and resource extraction.
- Despite efforts to protect and improve biodiversity, the number of species listed as being a priority for protection grew by 8 per cent since 2016, a figure expected to grow further in the wake of recent flooding and bushfire events.
- Assessment outcomes of Australia's freshwater ecosystems in southern, eastern, and south-western Australia are concerning, with results indicating very poor conditions with reduced ecological function. Aquatic ecosystems are recognised as being among the most vulnerable to climate change, with freshwater systems being particularly vulnerable and predicted to suffer from substantial changes to the mix of species in Australian rivers well before the end of this century.

Climate change impacting catchment health

- Climate change is causing shifts in precipitation patterns around the world, which are affecting the ecological health of local water catchments through biodiversity loss and reduction in water quality.

  Wildfires experienced in North America not only impacted upon wildlife and biodiversity loss, but also resulted in additional environmental harm including ash-filled erosion that threatened to pollute local drinking water sources.

Increasing urbanisation pressures

- Overdevelopment and change in land use are among key threats to the health of water catchments. Urbanisation and population growth can lead to increased demand on water resources, decreased water quality and quantity, increased flooding and erosion, and changes in hydrology.

  According to CSIRO, the increased competition for land resources in Australia has resulted in continued declines in native vegetation, soil, and biodiversity, so much so that it may take many decades for ecosystems to fully recover.

  Natural environments and green spaces are under pressure from land clearing, pollution, and biodiversity loss. Biodiverse urban areas are valuable not only for the ecology of those areas, but also for the identity, health, and wellbeing of urban citizens.

Emerging contaminants

Emerging contaminants continue to be a complex yet important concern, with levels of Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) in rainwater now exceeding the guidelines set by the US Environmental Protection Agency, even in the most remote regions on earth.

Microplastics and their transport agents within water supplies are a growing concern for water utilities and public health authorities around the world, yet few attempts at curtailing the production and use of microplastics through regulation have been made to date.

Negative impacts of agriculture and farming

- Land clearing for agricultural purposes is stated as one of the greatest impacts on the natural environment. In 2017, approximately half of Australia's land mass was used for agricultural production, mostly for grazing, cropping, and forestry.

  Pesticides and chemical pollutants from agricultural practices are suspected to have caused 8 per cent of fish deaths in coastal and inland catchments in New South Wales over the past 20 years.

Citizen-led action groups paving the way forward

- Citizen-led environmental action groups (such as Landcare and Friends Of groups) are well represented across Melbourne Water's catchment area, with 557 groups, involving over 14,000 volunteers, dedicating approximately $26 million worth of labour hours to the cause annually.
- Citizen-led action groups are seeking to achieve a reality where Australian individuals, communities, non-government organisations, and businesses engage with nature and support biodiversity and heritage.
- Successful on-ground actions include the work of Indigenous rangers, citizen science, and restoration actions at many scales, providing opportunities that deliver benefits for people and Country. Urban planners and governments are recognising the need for a more collaborative, whole-of-system approach, with place-based outcomes that can build greater resilience and regenerate our urban areas.

What might this mean for the water sector?

Green economic transition

- As custodians of land, waterways, and natural resources, the water sector will likely be subject to increasing expectations from government and the community to play a major role in society's transition to a green economy and mitigation of ecological harm. Throughout any such transition, accounting for ecological impacts and associated operational and reputational risk may increasingly become a core expectation for business decision-making and reporting.

Mitigating development risks

- As cities expand and densify, more stormwater will be generated as additional hard surfaces (such as roofs and roads) are built. Without careful management, this could result in increased flooding of properties and buildings.
- Urbanisation and population growth is leading to the presence of more nutrients, pesticides, and litter in stormwater runoff, which is impacting the biodiversity health of waterways.
- Growing urbanisation means we have 'a catchment in crisis' – a rapid increase in the customer base squeezing the most out of ageing infrastructure.
- Infill targets for new housing in Australia's largest cities range from 65 per cent (in Brisbane) to 85 per cent (in Adelaide), with Melbourne and Sydney falling in between this range. Northern regions of Greater Melbourne will see significant growth, putting pressure on the existing sewerage treatment system.
- With grassroots citizen science and conservation groups continuing to grow in Victoria, there are a range of opportunities for the water sector to partner with volunteer organisations at the local level to achieve catchment health outcomes.

Mitigating climate change impacts

- The impacts of climate change are likely to negatively impact the ecological health of catchments, thereby increasing the costs to protect and rehabilitate affected areas.
- Extended drought places strain on water availability and security. Climate change is leading to reduced overall rainfall volumes. In 2019, Melbourne Water's Long-Term Water Resources Assessment (LTWRA) found that the impact of reduced water availability was disproportionately carried by the environment.

Key drivers

- Increased stormwater is a major threat to waterway health, as water runs off hard surfaces into rivers and creeks and takes pollutants with it. As vegetated areas are replaced with hard, impervious surfaces that drain directly into waterways via stormwater systems, infiltration to the soil and groundwater system is reduced. This affects the waterway system by causing rapid runoff in wet conditions and a lack of soil moisture during dry conditions.

Contaminated circularity

- Recycling and waste repurposing may increase the sector's exposure to the risk of new contaminants, requiring increased investment in monitoring, remediation, and management of community and workforce health as well as reputational risks.

Contaminant caution

- New contaminants continue to emerge, and public concern over known contaminants will grow as the long-term health effects of PFAS, microplastics, phthalates, and others become known. Accordingly, the water sector will have to continue to carefully track the science as it evolves, and potentially take a leading role in driving the science to gain greater certainty and to develop risk mitigation strategies.

- In some cases, the water sector may have opportunities to promote the uptake of more sustainable forms of agriculture within catchment areas and encourage appropriate pesticide and herbicide use and proper management of agricultural run-off.

Possible pockets of the future in the present

1. **In Singapore, the first smart and sustainable 'forest town' is being developed. The development will comprise 42,000 homes and will include a car-free town centre, smart infrastructure, and a 100-metre-wide forest corridor running through the town centre.**

2. **Researchers at the Earth Law Center have said that to protect the Earth's marine environments, oceans should be considered living entities with their own set of rights and protections.**

3. **Researchers have developed a biodegradable system based on silk to replace the microplastics added to agricultural products, paints, and cosmetics.**

4. **Working in partnership with landowner United Utilities, nature conservation charity RSPB Haweswater is ten years into a transformation of their catchment, restoring the catchment's ability to slow and purify water, bringing back some of its natural riches, and encouraging changes in farming practices that improve catchment health.**

Now what?

The world is always changing, and we continue to monitor our operating environment for shifts that have implications for our business and the wider sector. We have identified a range of high-impact trends in this Scan which could plausibly converge and interact to shape our environment in the years ahead. Some of the major contours of change, occurring in the present and described in this Scan, include climate change and its impacts, population growth and demographic change, the accelerated pace of technological change (particularly AI), and the constantly evolving set of social and cultural values that influence customer, community, and employee expectations, as well as regulations and policy directions.

Our aim in scanning our operating environment is to better understand the forces that are at play in our world today and their corresponding implications, so that we may identify the opportunities and challenges for our business and the wider sector and, in turn, take decisive action in the present to bring about the futures we prefer.

To do this, we need to take the insights from this research and turn them into action by considering the following questions:

1. **Are there opportunities to fast-track any of our strategic goals?**
2. **What strategic goals might be at risk?**
3. **Do any developments in the operating environment warrant any new strategic priorities?**

Melbourne Water continues to look to the future to inform our decision-making today. We are committed to ensuring that Greater Melbourne remains one of the most liveable cities, working in partnership with our customers and the community to plan for a resilient, sustainable city that will continue to thrive and benefit Melburnians today and for generations to come.