MEASURING YOUR EMISSIONS ON A PATHWAY TO NET ZERO

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ABSTRACT

Transformational change is required for Aotearoa to reach the Government's Net Zero carbon emission targets. As a public utility, Watercare Services Limited (Watercare) recognises its role in both reducing the operational emissions (Scope 1 and 2) and influencing its supply chain to reduce the indirect emissions (Scope 3) that are associated with providing reliable, safe and efficient water and wastewater services. This paper will provide insights into the key greenhouse gas emission sources that contribute to the carbon footprint of a water and wastewater utility, take a deep dive into capital (embodied carbon) and look at opportunities for mapping a pathway towards a Net Zero emissions future based on International trends.

Accurate reporting of emission data is integral to reporting against published reduction targets. Watercare has been reporting its operational greenhouse gas emission inventory publicly since its formation in 2010. In 2020 a baseline was established for capital carbon which saw the total footprint of the organisation effectively double through the provision of this new information.

Reporting of current emissions is just one half of the story, planning for a low carbon future is the second half. Scope 1 and 2 data sources are included within a reduction roadmap. We are targeting reduction of our Scope 3 emissions through our Enterprise Model program, which includes a 40% reduction in capital (embodied) carbon.

Carbon reduction roadmaps (also known as pathways) are increasingly being used to communicate the methodology for achieving climate related mitigation targets. Currently there are a number of international exemplars in the Water and Wastewater Industry which can be used to assist water utilities in defining their own roadmaps. This paper will present a high-level overview of the main components of these along with the steps that Watercare has taken to develop their Carbon reduction roadmap.

KEYWORDS

climate change, mitigation, emission reduction, carbon reporting, greenhouse gases

PRESENTER PROFILE

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Glenn Conley is the Sustainability Business Partner for Watercare Services Limited with experience in greenhouse gas reporting and verification and reduction planning. Glenn is passionate about his ability to assist Watercare's infrastructure planners, designers and supply partners deliver infrastructure that will meet its climate change objectives.

Chris Thurston:

Chris Thurston is Head of Sustainability for Watercare Services Limited. Chris supports the company's 'Fully Sustainable' strategic objective with a specific focus on climate change issues. Chris established Watercare's first climate change strategy and has been a key figure in their '40:20:20 Build Better Infrastructure' vision. He has a focus on identifying challenges and opportunities for the water industry to thrive as New Zealand transitions to a low carbon economy and society.

INTRODUCTION

Watercare is New Zealand's largest water utility providing water and wastewater services to more than 1.7M people in the Auckland region. Watercare understands that climate change is one of the largest challenges that will be faced by our community and recognizes its role in continuing to meet the needs of current generations while leaving a positive legacy for those to come. It is in this context that Watercare has established a Climate strategy and carbon emission reduction targets.

Meaningful emissions data is required to inform emission mitigation strategies. Traditionally these have focused on those emission sources for which an organisation has direct control (Scope 1 and 2 emissions), however as external drivers such as net zero targets evolve, a more holistic approach to carbon reporting and reduction is required.

This paper provides an overview of the process Watercare has taken to determine the carbon emissions associated with it's operational activities and infrastructure program. Rather than provide a scientific discussion of the emission factor derivation (e.g. in wastewater treatment plants), it will provide a high level discussion on the main greenhouse gas (GHG) emission sources and methodologies for reporting these.

For reduction targets to be achieved, sector relevant reduction opportunities are required to be identified and implemented. Watercare has established carbon reduction programs associated with its emissions profile. A brief overview of the initiatives to reduce both operational and capital carbon emissions is also described within this paper.

EMISSION REDUCTION CONTEXT

GLOBAL TARGET SETTING CONTEXT

The Paris Agreement is the world's response to addressing climate change beyond 2020. The Paris Agreement's defined purpose includes keeping global average temperatures well below 2°C above pre-industrial levels, and pursuing efforts to limit temperature rise to below 1.5°C. In 2020 (the hottest year on record), global average temperatures had warmed by more than 1°C since the late 19th century. Global average temperatures are projected to increase by about 3 to 5°C above pre-industrial levels by 2100 without additional action to reduce emissions.

The purpose of the Paris Agreement is to:

- keep the global average temperature well below 2° C above pre-industrial levels, while pursuing efforts to limit the temperature increase to 1.5° C
- strengthen the ability of countries to deal with the impacts of climate change
- make sure that financial flows support the development of low-carbon and climate-resilient economies.

New Zealand contributes only 0.16 per cent of global emissions, however on a per capita basis our emissions are higher than all but five of the Annex 1 (industrialised) countries (Ministry for Environment and Stats NZ, 2019). New Zealand's greenhouse gas emissions have grown 23 per cent since 1990 and though they have levelled in recent years (1% decrease between 2015 and 2018) significant reductions are not being achieved.

The Paris Agreement entered into force on 4 November 2016 and took effect from 2020. This means New Zealand's commitments to reduce greenhouse gas emissions, the Nationally Determined Contribution (NDC), applies from 2021.

NEW ZEALANDS NATIONALLY DETERMINED CONTRIBUTION

New Zealand has made climate change commitments domestically under the Climate Change Response Act and internationally under the United Nations Framework Convention on Climate Change, the Paris Agreement (Ministry for Environment, 2020). These targets include:

Domestic

- Net zero emissions of all GHG other than biogenic methane by 2050
- 24 to 47 per cent reduction below 2017 biogenic methane emissions by 2050, including 10 per cent reduction below 2017 biogenic methane emissions by 2030.

International

- Our net emissions will be 30 per cent below 2005 (or 11 per cent below 1990) gross emissions for the period 1 January 2021 to 31 December 2030.

These targets are used to support policy development and are the mechanism under which the Climate Change Commission provide advice and greenhouse gas budgets for the country. They can also be used as a guide for organisational emission reduction target setting.

WATER INDUSTRY ROLE

All industries have a role to play in meeting the climate challenge. In the water sector there are both specific challenges and opportunities that should be considered and which also mean there is specific responsibility to be taken.

The impacts of climate change are often felt through water first. The projections for a changing climate have a direct influence on water availability, whether it is through too little water with increased temperatures and droughts or too much water with increased severity of storm events. Additionally many water and wastewater assets as well as the communities that the industry serves are near to the coast and will be impacted by sea level rise. These impacts have been documented as risks in the National Climate Change Risk Assessment (Ministry for the Environment, 2020c) which highlights "risk to potable water supply (availability and quality)" as having the highest urgency score.

The water sector also generates a significant amount of emissions delivering its water and wastewater services. Though there are opportunities for emission reduction there are trends in the industry which are leading to increased emissions. Over the period to 2040, the amount of energy used in the water sector is projected to more than double (IEA, 2020). There are three key factors which contribute to these increases:

1. Population growth and therefore more demand for water and wastewater services and infrastructure
2. Increased energy intensity of new water supplies that are not gravity fed or are emerging such as wastewater reuse or desalination
3. Increased energy intensity of wastewater treatment technology to meet discharge requirements.

However, there are also unique advantages that the water sector has which can lead to significant contributions to national emission reductions and an opportunity for leadership in climate action, these include:

- Land use – both water supply catchments as well as wastewater treatment plants require significant areas of land. This land can be used for natural or engineered emission reduction activities that can often improve desired operational outcomes as well as have a positive adaptation impact (e.g. native forest regeneration in catchment areas to sequester carbon as well as improve land stability).
- Resource recovery – particularly in wastewater there are numerous options for beneficial re-use of treatment by-products (bioresources). For example, methane gases can be captured to run through a combined power and heat engine reducing the need for electricity from the grid.

Globally water utilities and cities are taking strategic actions to reduce their emissions and tackle the climate challenge. Notably WaterUK has recently established an industry routemap for net zero emissions by 2030 (WaterUK, 2020). In Australia the Water Services Association of Australia has established a position statement on climate change (WSAA, 2021) which includes net zero by 2050 (or sooner depending on customer demand) as well as other commitments.

REPORTING GREENHOUSE GAS EMISSIONS

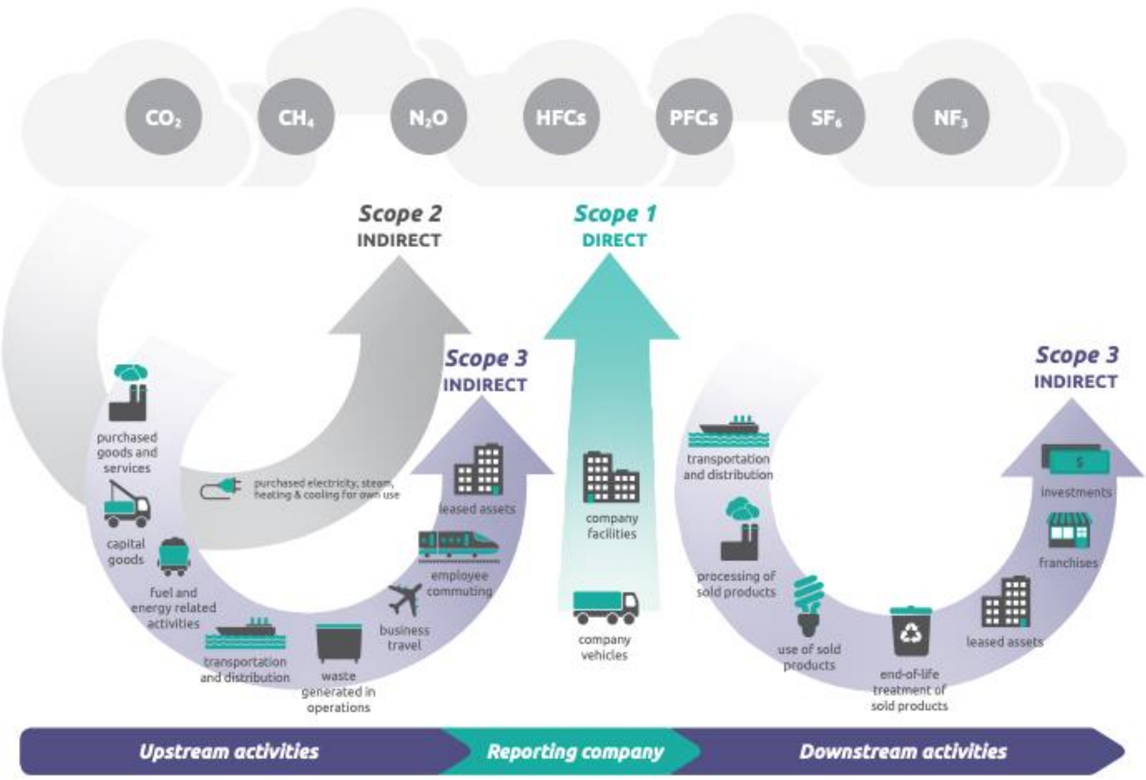
OPERATIONAL GHG EMISSIONS REPORTING

Meaningful GHG emissions data forms the basis for an organisation's "carbon footprint", also known as a GHG emissions inventory. This data is used to generate a baseline from which reduction targets are established. Watercare has been calculating and externally reporting its carbon footprint since 2010. The inventory been calculated in conformance with the "Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard" (GHG Protocol) (World Resources Institute, 2004).

This GHG Protocol provides standards and guidance for organisations preparing a GHG emissions inventory. It covers the accounting and reporting of the six greenhouse gases covered by the Kyoto Protocol—carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF6).

The GHG Protocol requires organisations to report their emission sources based on ownership and their ability to control the amount of emissions generated as represented in Figure 1.

Figure 1: Overview of GHG emission scopes and emissions across the values chain (World Resources Institute, 2011)



The use of scopes allows for the delineation of ownership of emission sources to support reporting as well as reduction focus. This approach also ensures that emissions are counted considering control and influence. Prior to determining relevant emission sources within each scope category, an organisation must determine the accounting approach based on the legal ownership of the emissions as well as the reporting boundary. This is termed the control approach (World Resources Institute, 2004). Where an entity has the ability to control the emissions that it generates through operating policies, it typically adopts an "operational control" approach for reporting. If the entity does not have operational control but maintains a financial interest only, it adopts a financial control reporting approach. The distinction is important, particularly as legal liability for GHG emissions increases under more rigorous climate related disclosure regimes that are evolving.

Once the control boundary has been defined, organisations then set their operational reporting boundaries. This involves identifying emissions associated with its operations, categorizing them as direct and indirect emissions, and choosing the scope of accounting and reporting for indirect emissions (World Resources Institute, 2004).

Scope 1 emissions are generated directly from an organisation's activities. Watercare's scope 1 emission sources include combustion of fuel in stationary plant (e.g. cogeneration, boilers and diesel generators) and vehicles, process emissions (e.g. N_2O and CH_4 from wastewater treatment processes), and fugitive emissions (refrigerants, overflows from the wastewater network and biosolid disposal to landfill).

Scope 2 emissions are indirect and wholly attributed to purchased electricity that is consumed in the operation of Watercare's water and wastewater plant, distribution networks and buildings.

Scope 3 emissions are indirect emissions that are a consequence of the activities of the reporting company but occur from sources not owned or controlled by the company (World Resources Institute, 2004). Watercare has completed a materiality analysis of its scope 3 emission sources to determine those which should be reported, these include purchased goods and services (lime use in water and wastewater treatment and fuel use by our main contractors), transmission and distribution losses for fuel and electricity, waste to landfill, business travel and scope 1 and 2 emissions relating to the operation of Waikato District Council water and wastewater services which Watercare undertakes under contract.

QUANTIFICATION OF EMISSIONS

Estimating the GHG emissions relating to the operational activities requires multiplication of activity data e.g. total kWh of electricity, with a GHG emission factor. Emission factors generally incorporate the emissions of each GHG (CO_2, CH_4, N_2O, etc.) converted to CO_2 equivalents based on their global warming potential. Currently for direct emissions, ISO 14064-1:2018 (International Standards Organisation, 2018) requires that organisations report emissions by GHG as well as in carbon dioxide equivalents (CO_2e). They are typically published based on regional data (see for example Ministry for Environment, 2020a) or where published factors are not available unique emission factors can be calculated in accordance with industry specific guidance. Note that these factors require third party verification prior to public reporting.

Table 1 provides an overview of Watercare's GHG emission sources. Watercare uses a combination of published and industry specific emission factors. For standard emission sources such as vehicle fuel, electricity and business travel, New Zealand specific factors sourced from the Ministry for Environment (MfE) are used (see Ministry for Environment, 2020a).

Ministry for Environment provides a standard/average emission factor for water supply as well as a range of treatment specific average emission factors in New Zealand (Ministry for Environment, 2020a). These can useful when there is no data available or a very high level understanding of the emissions from water or wastewater consumption is required. These are not recommended for use by a water utility but may be useful for other organisations looking to understand the emissions contribution of water use when more granular data is not available. These emission factors have been created using data from the Water NZ National Performance Review where total energy consumption and water delivered has been provided from across the country and then an average emission factor figure calculated.

For wastewater treatment process emission factors Watercare relies on a combination of internationally recommended (e.g., IPCC, 2006) values, values proposed by the MfE and values found in accredited scientific literature. Where appropriate, the emission factors are further adjusted to best represent the processes employed. The field of wastewater treatment emission factors is a fast evolving one with new information arising from collaborations between the academic, public and private sector across the Globe. The focus is on real-time measurement of emissions from various types of treatment technologies to enable informed selection of the most carbon-efficient treatment and to inform operating practices. Watercare is contributing to this development via its participation in a Water NZ Steering Group and through internal research.

In accordance with the GHG Protocol biogenic CO_2 emissions are not reported as part of the inventory total. These are commonly understood to be part of a short carbon cycle and do not add to the global anthropogenic emissions. Key biogenic emissions include CO_2 from the combustion of biogas and other wastewater treatment processes and accounted for ~60,000 tonnes in the 2020 reporting year.

Table 1: Watercare GHG Inventory FY20

Scope	Category	Emission Source	tCO2e	% of total emissions
Scope 1	Stationary combustion	Natural gas use	1604	3.80%
		Biogas combustion	390	0.92%
	Mobile combustion	Fuel use in corporate vehicles	71562	3.70%
		On-site fuel use	320	0.76%
	Process emissions	Wastewater treatment	3456	8.18%
		Effluent discharge to water and land	1439	3.41%
		Refrigerants	34	0.08%
	Fugitive emissions	Overflows from network	243	0.58%
		Fugitive emissions from network	1537	3.64%
		Biosolids in land rehabilitation	2682	6.35%
	Sub-total Scope 1		**13,265**	**31.39%**
Scope 2	Purchased electricity	Electricity use	15210	36.00%
	Sub-total Scope 2		**15,210**	**36.00%**
Scope 3	Purchased goods and services	Lime	6320	14.96%
		Maintenance contractor fuel use	1687	3.99%
	Fuel and energy related activities not included in Scope 1 and 2	T&D loss electricity	1152	2.73%
		T&D loss natural gas	256	0.61%
	Waste generated in operations and WWT	Waste to landfill	42	0.10%
		Sludge to landfill	1308	3.10%
		Sludge to land remediation (Omaha)	270	0.64%
		Sludge transport	26	0.06%
	Business travel	Air travel	78	0.18%
		Taxi	6	0.01%
		Private mileage	23	0.05%
		Accomodation	8	0.02%
	Contracted services (Use of sold product)	Electricity – Waikato contract	463	1.10%
		Petrol-Waikato contract	1	0.00%
		Diesel-Waikato contract	127	0.30%
		Wastewater process emissions -Waikato contract	2013	4.76%
	Sub-total Scope 3		**13,780**	**32.61%**
	Total		**42,256**	

EMBODIED (CAPITAL CARBON) EMISSIONS

Traditionally GHG reporting has been limited to carbon emitted during operational activities, with little consideration given to the carbon embodied within the materials that are used by the organisation to deliver its services. For a water utility, these are typically associated with the building of infrastructure used for transmission and treatment of water and wastewater. Watercare have measured the embodied emissions associated with approximately $2.2 billion of projects being delivered over the next 10 years through its Asset Management Plan (AMP). The capital carbon baseline includes embodied emissions relating to manufacture of the raw materials used in infrastructure, as well as transportation and construction related emissions.

As described by Edmond et al. (2020), Watercare worked with a partner Mott Macdonald to establish the baseline, as they had previous international experience in similar projects. The process used to establish the baseline included:

- Identify projects that would be included within the reporting boundary based on level of scope definition and design detail available.
- Apply a scope rating and allowable contingency depending on this information.
- Scope each individual project's proposed components with Watercare planning and design teams and partners.
- Source and modify carbon data to meet local construction context and internal standards.
- Update emission factors to reflect New Zealand context.
- Apply quantification of materials and emission factors to build up the carbon baseline.
- Finalise the baseline considering the uncertainty levels as described above.

The outcome is a baseline of 374,695 t/CO_2e from 72 individual projects that start construction before 2029. Figure 2 shows the percentage breakdown of programme level hotspots in the capital carbon baseline. This highlights that approximately half of the carbon in the baseline is within the materials used to deliver assets. It also highlights that just under 40% is associated with excavation, backfill and reinstatement, which is expected as Networks are the major investment area. Consequently, there are large opportunities in reviewing material selection and construction technique.

Figure 2: Summary of capital carbon hotspots across the baseline

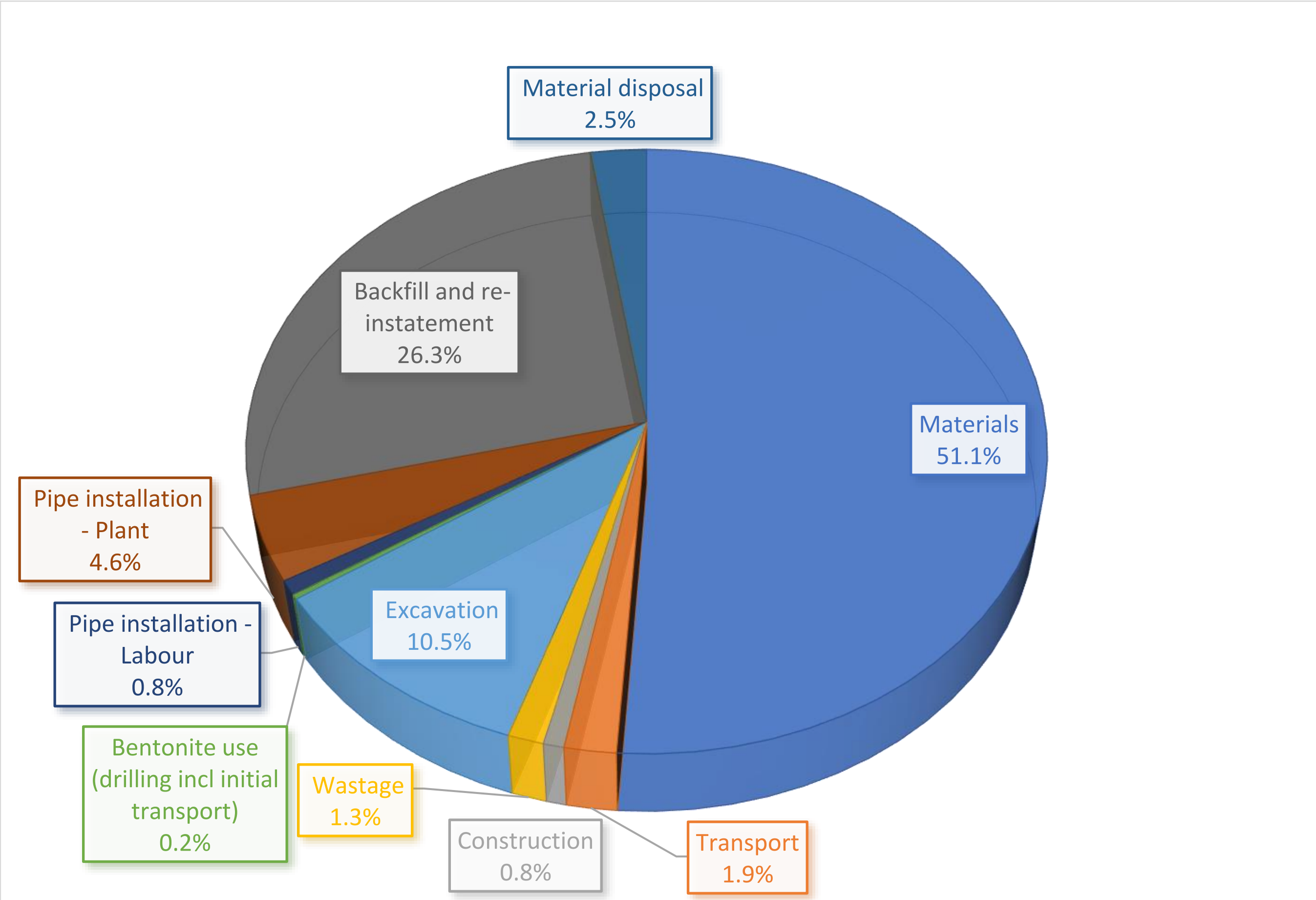


Figure 3 : Capital carbon baseline by project type

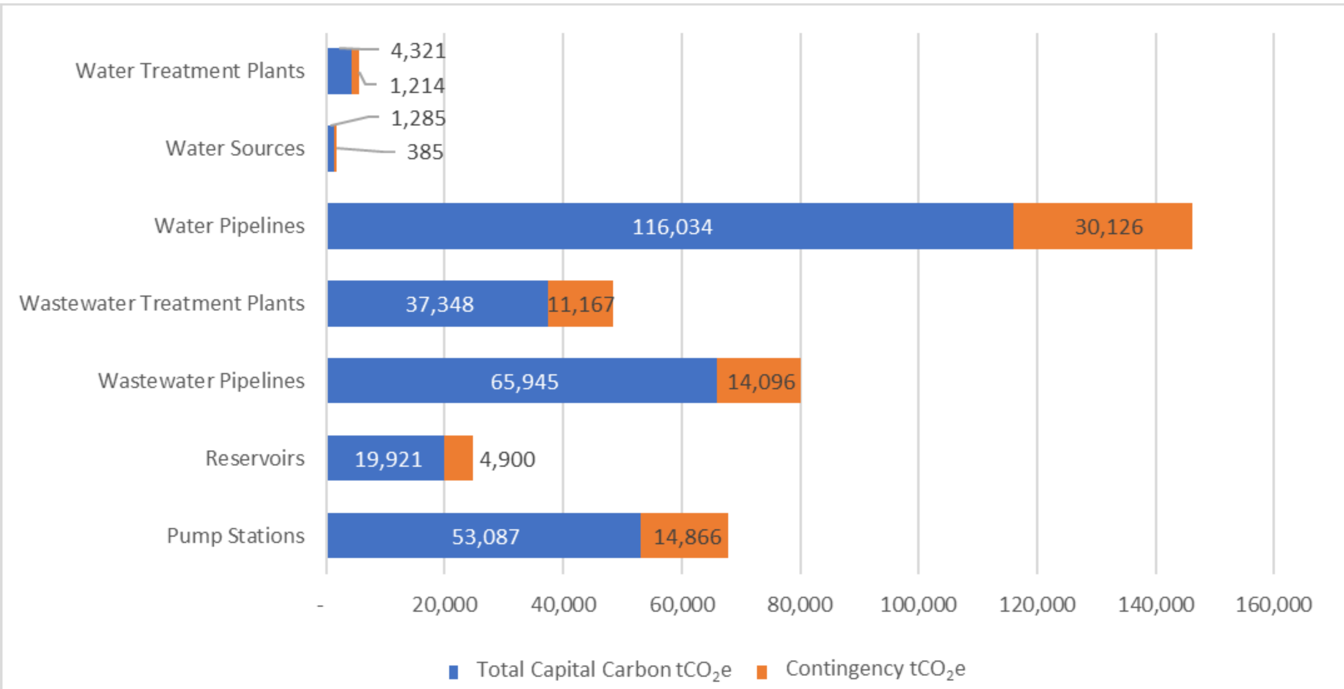


Figure 3 shows a detailed breakdown of the emissions based on operational schemes (water and wastewater distribution networks and treatment). As is expected pipelines are the largest contributor to the baseline based on their concrete and steel composition.

Further analysis of the baseline data for both operational emissions and capital carbon has shown that the projected carbon emissions for these projects are more than Watercare's expected operational emissions over the same period of time, highlighting the emphasis on identifying potential reduction opportunities across all scopes.

With baseline values described for all reporting scopes, Watercare has set reduction targets and is determining reduction pathways for achieving these as described in the following sections of this paper.

TARGETS AND PATHWAYS

REDUCTION TARGETS

Industry is encouraged to set reduction targets that are ambitious, achievable and in line with globally recognized science. For many this will include alignment with the need for net zero emissions by 2050. For organisations to integrate targets into their business strategies these targets are often shorter term and can also be business unit specific. This allows an organisation to integrate reduction plans and projects within specific planning or investment horizons which might not be possible for a longer term target.

As emission reduction is still a relatively recent business priority, many organisations are aiming to focus on emissions that they can control, consequently most published emission reduction targets relate to scope 1 and 2 (direct) emissions sources. These targets usually apply to the entire organisation, but can also include sub-targets for business units or emission sources (e.g. electricity).

It is recognized that emissions also occur on behalf of organisations, outside of their operational boundary. Therefore scope 3 (indirect or supply chain) emissions reduction targets are becoming more common. When setting a scope 3 emission reduction target, there is a consideration on whether the third-party organisation will be able to provide the data and achieve the target. Appropriate scope 3 targets can therefore evolve as the supplier relationship becomes more mature. Examples can include a commitment to reporting emissions data to the contract owner or providing emission reduction solutions as part of the supplier relationship.

Watercare has four primary emission reduction targets from short to long term:

- Reduce energy consumption by 8 GWh by 2022 (select scope 1 and 2)
- Reduce emissions from construction by 40% by 2025 (select scope 3)
- Reduce operational emissions by 50% by 2030 (all scope 1 and 2)
- Achieve net zero emissions by 2050 (all scopes)

To set targets there should be a consideration of the urgency required in reducing greenhouse gas emissions globally and a recognition that everyone needs to take action. For specific advice and support an organisation called the Science Based

Targets Initiative (SBTi) has been established. They have a focus on corporate entities however their tools, guidance and approach are relevant across many sectors. The SBTi is a partnership between Carbon Disclosure Project (CDP), the United Nations Global Compact (UNGC), World Resources Institute (WRI) and the World Wide Fund for Nature (WWF). Science-based targets show companies how much and how quickly they need to reduce their greenhouse gas (GHG) emissions to prevent the worst effects of climate change. More than 1,000 companies in 50 sectors are working with the SBTi to set science-based targets.

CARBON OFFSETTING

The primary focus for emissions management should be appropriate measurement of emissions and the implementation of strategies for reducing the volume and potency of greenhouse gas emitting activities. However, to reach net zero emissions goals there will also need to be a certain amount of carbon removals or offsets.

Removals consider the activities or assets within an organisation that sequester or absorb carbon emissions. This may include but is not limited to forestry stocks as well as planting programmes. The emission reductions from such assets can be measured however there is often a significant amount of variability from factors such as climate, age, density and species type (for forests). Specific guidance should be sought before attempting to quantify the specific rates of emissions removals from forests or other sequestering activities within an organisations operational control. Once measured these removals are considered a negative when creating a carbon footprint and can be removed from the gross contribution of emitting activities to create a net position.

Carbon offsets are another way to reduce or ultimately minimize a carbon footprint to create a carbon neutral or net zero position. Voluntary offsetting means the retirement or cancellation of units (also known as carbon credits) that meet specific requirements (Ministry for Environment, 2020b). A unit represents a tonne of carbon dioxide or equivalent GHG emissions emitted and is issued in a publicly accessible registry. These offsets are normally external to an organisation and are purchased through an accredited body.

The use of removals and offsets is going to play a significant role in the future to allow net zero targets to be met. At this current time there should be some caution in proceeding down this path as it is an area that requires complex technical understanding and should not detract from efforts to reduce emissions from occurring in the first place.

EMISSION REDUCTION PATHWAYS AND REDUCTION INITIATIVES

GLOBAL CONTEXT

Emission reduction pathways are becoming a tool to provide detailed integrated assessment modelling to develop strategies for immediate and future GHG emission reductions. This approach is being taken by many countries, and globally by the IPCC (2014). From such analysis, emission reduction actions can be prioritised.

SECTOR CONTEXT

The *Water UK Routemap* (Water UK, 2020) provides the direction for the UK water sector on what its journey to net zero by 2030 may look like. The routemap illustrates a number of possible futures of decarbonisation for the sector through three pathways and a more likely combined pathway. The three pathways are as follows:

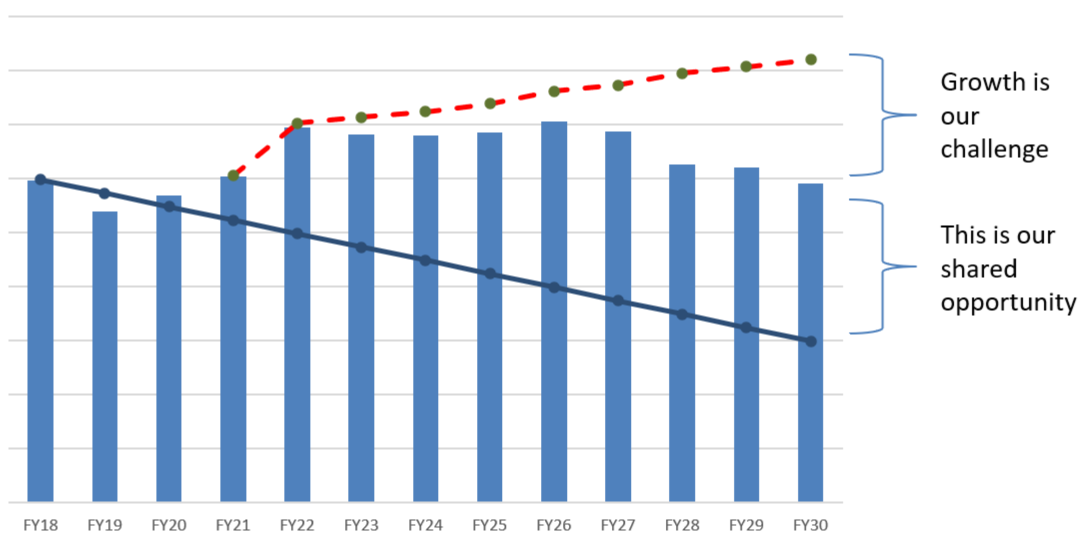
1. Demand led pathway – prioritises water efficiency, leakage management, and energy self-sufficiency. Adopting this pathway requires regulators to be fully engaged and social influences for sustainable consumption to change behaviour.
2. Technology led pathway - assumes that technological innovations are accelerated for investing more rapidly in renewables, sustainable transport systems and process technologies for capturing and managing process emissions.
3. Removals led pathway - Pathway focuses on accelerating activities which improve the natural sequestration capacity of the sector, within the companies own land and the wider community (assumes that there has been very slow progress in adopting additional reduction and renewables, in combination with increasing regulatory quality standards for the sector).

The intent of the routemap is to help water companies engage more strategically with the sector's regulators and supply chain, and Government to work together towards net zero. The routemap will also help water companies to create their own company action plans to align to the net zero sector target by 2030.

WATERCARE CONTEXT

Working with internal subject matter experts, Watercare is developing a reduction pathway to reduce operational emissions by 50% by 2030 (all scope 1 and 2). Figure 4 provides a graphical representation of a draft pathway.

Figure 4 : Draft emissions reduction pathway



The pathway includes a line which represents unconstrained growth (the red dashed line). When developing a reduction pathway, consideration needs to be given to projected growth and planned infrastructure development. Doing so highlights the challenges associated with identifying reduction initiatives required to achieve the targets. The shared opportunity identified in figure 4 is where an organisation can work internally with its teams and externally with it's supply chain to implement low carbon solutions.

Reduction initiatives within the pathway are being developed in alignment with the portfolios described in Table 2.

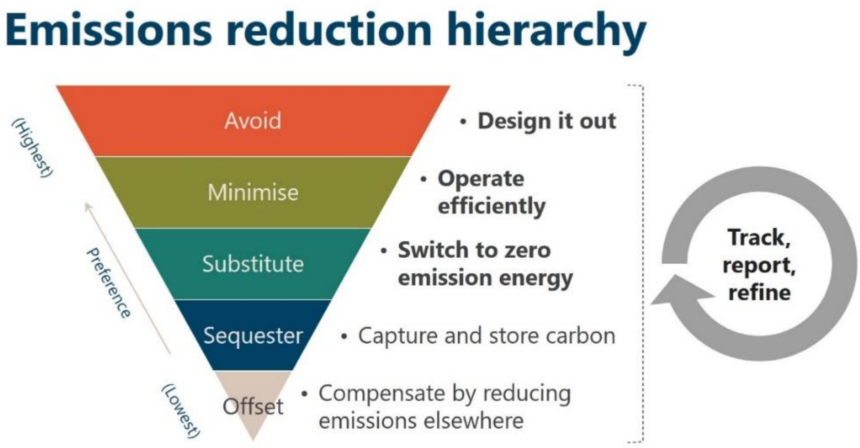
Table 2: Watercare Decarbonisation Value Streams

PORTFOLIO	OBJECTIVE/INTENT	EMISSION SOURCE
1. Low carbon infrastructure – operational and capital carbon	All new infrastructure supports operational and capital carbon reduction targets. Infrastructure is delivered in line with the 40:20:20* vision, 50% reduction by 2030 based on 2018 baseline and Net Zero emissions by 2050.	Electricity Natural gas WW process emissions Biosolids Construction carbon
2. Operating low carbon water supply and network	The water supply network is run at lowest carbon intensity. Achieved through operational control and new projects.	Electricity
3. Operating low carbon wastewater treatment – Energy and process/biological	Wastewater sites are run at lowest carbon intensity. Process related emissions are accurately measured and new innovations are trialed to support emission reduction.	Electricity Natural Gas Diesel WW process emissions Biosolids
4. Low carbon fleet	Fleet strategy aligns with targets to reduce emissions by 50% by 2030. Low emission options are actively tested as technology improves.	Petrol Diesel
5. Removing carbon	Investigate opportunities and maximise projects that sequester carbon emissions, such as tree planting.	Tree planting
6. Low carbon purchasing and supply chain	Purchasing processes assess carbon impact and reward low carbon solutions in line with other product objectives.	Varied
7. Low carbon financial support	Financial decisions support the reduction of carbon emissions through decision making and analysis	Varied

*40:20:20 is the vision of Watercare's Enterprise Model program which is to reduce capital carbon by 40%, reduce cost by 20% and increase health and safety performance by 20% by 2025.

In all portfolios above, consideration is given to adopting an emissions reduction hierarchy as outlined in Figure 5.

Figure 5: Emissions reduction hierarchy (Barwon Water, 2021)



As described in Edmond et al. (2020), Watercare are pioneering infrastructure carbon management in New Zealand, working with supply chain partners, and implementing structures similar to those outlined in the Infrastructure Carbon Review (Enzer et al., 2013) and PAS 2080 (Manidaki et al., 2016). The key concepts being applied are implementing a carbon management process across the entire supply chain including the asset owner, designer and product/material suppliers to help promote collaboration and reduce whole of life carbon and cost.

CONCLUSIONS

Climate change and increasing greenhouse gas emissions are a global challenge that will have significant impacts on the water industry. Within the New Zealand context there are specific targets that need to be considered and globally there are examples of reduction pathways that can be learnt from.

Measuring greenhouse gas emissions follows a standardized approach and there is guidance from standards and protocols to allow a water utility to understand their impact. There is an emergent field of understanding the embodied emissions from infrastructure development as well as those from operational activities. This is important as the volume of capital carbon may be as much or more than the operational carbon for a water utility.

There are a multitude of areas that an organisation can focus on to reduce emissions and there is an opportunity for both internal engagement as well as working closely with the supply chain. Population growth and other factors such as energy intensive new water supplies and increasing wastewater treatment requirements highlight a challenge for reducing emissions in the sector.

Climate change is one of the largest challenges that we face. There are methods for measurement as well as recognized approaches to act on this challenge that are available today.

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