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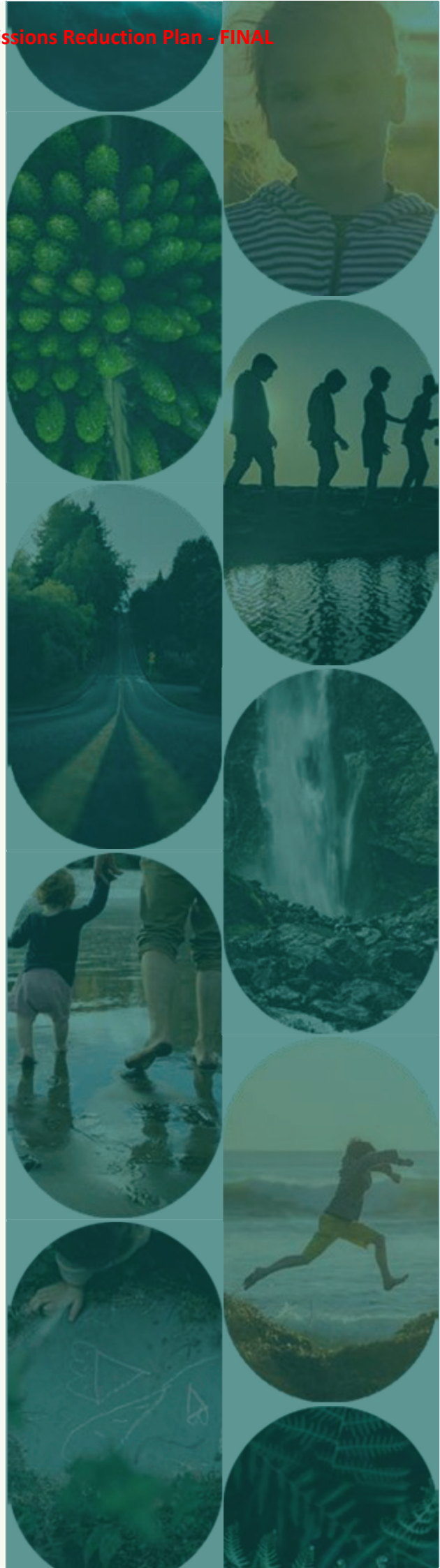

Queenstown Lakes District Council

Emissions Reduction Plan

Final Report V2

13th September 2023

Revision	Date	Revision Details	Author	Verifier	Approved
1	30th June 2023	Preliminary Draft	GC	DT	MD
2	23rd August 2023	Initial Report	GC	DT	MD
3	5th September 2023	Final Report	BB & GC	DT	MD
4	13th September 2023	Final Report V2[1]	BB & GC	DT	MD

[1] Addition of *Table 3: Science Based Targets excluding Three Waters* to *Section 2.2.2 Emission Reduction Targets*

Contents

Executive Summary

QLDC requires an Emissions Reduction Plan (ERP):

- To support its commitment to a target of a 44% reduction in organisation emissions by 2030 (against a 2019 baseline).
- To support a QLDC application to the Local Government Funding Agency for a Climate Action Loan.
- To support QLDC's commitment to Toitū 'carbonreduce' certification.

The ERP is a plan to reduce QLDC organisation emissions through to 2030. The emission reductions are achieved by fuel switching (e.g. Alpine Aqualand conversion from LPG to heat pump, diesel vehicles to BEV), improved energy efficiency (e.g. networking of BMS units to allow remote control of building heating and lighting), and behavioural change (e.g. water demand management by implementing water charging).

Three Waters assets are considered separately due to uncertainty over future ownership and control of these assets.

For non-Three Waters emissions the ERP is a pathway to 2030 savings of **1,249 tCO_2e** or **64%**, relative to the 2019 baseline. This significantly exceeds the 2030 target of a 44% reduction in emissions. See Table 1 and Figure 1.

Table 1: ERP Non 3W Emissions Analysis

	Opportunity	Descriptor	tCO_2e/y	Relative to baseline emissions
a	Actual Emissions	2019 Baseline	1,957	
b	BAU Forecast Emissions	2030	2,023	103%
c	BAU Savings (a - b)	2030 savings	-66	-3%
d	Fossil Vehicles to BEV	2030 savings	121	
e	Increased Efficiency of Buildings & Equipment	2030 savings	9	
f	Streetlights to LED	2030 savings	6	
g	Alpine Aqualand to Heat Pump	2030 savings	903	
h	Wanaka Rec Centre to Biomass Boiler	2030 savings	259	
i	Arrowtown Pool to Heat Pump	2030 savings	17	
j	Sum of Project Savings (d to i)	2030 savings	1,315	67%
k	Total Savings (c + j)	2030 savings	1,249	64%
l	ERP Residual Emissions (a – k)	2030	708	36%

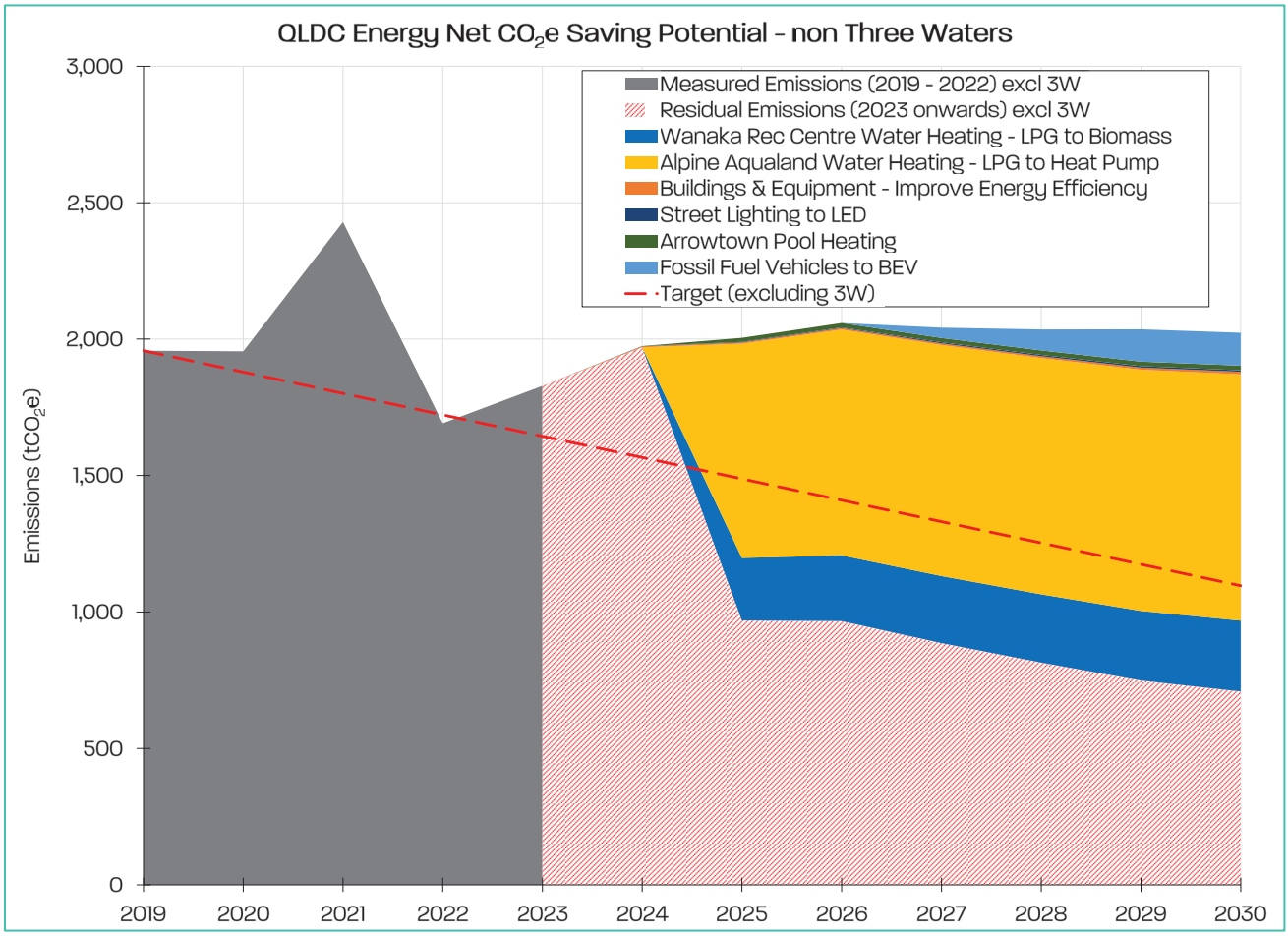

Figure 1: QLDC Non 3W Emissions Profile

For Three Waters emissions the ERP shows an increase in emissions in 2030 of 1,436 tCO_2e or 16% relative to the 2019 baseline. Population growth is the key driver for this trend.

The next steps for QLDC are to integrate the ERP into the 2024-2034 Long Term Plan to enable implementation.

1. Glossary & Abbreviations

BAU	Business As Usual
BEV	Battery Electric Vehicle (charge from the grid)
BMS	Building Management Systems
ERP	Emission Reduction Plan
ETS	Emissions Trading Scheme
GHG	Greenhouse Gases
LPG	Liquified Petroleum Gas
MfE	Ministry for the Environment
QLDC	Queenstown Lakes District Council
PPA	Power Purchase Agreement
REC	Renewable Electricity Certificate
WWTP	Wastewater Treatment Plant
3W	Three Waters (Potable Water, Wastewater, and Stormwater)

2. Background

2.1 Purpose of Report

This report documents an Emissions Reduction Plan (ERP) for QLDC. The ERP is to provide backing to QLDC's commitment to emissions reduction, to support a QLDC application to the Local Government Funding Agency for a Climate Action Loan, and to support QLDC's commitment to Toitū 'carbonreduce' certification.

This ERP outlines a pathway for emissions reductions through to 2030. It uses the earlier work[2] undertaken for The District Emissions Reduction Roadmap in 2020 as a starting point.

2.2 QLDC Organisation Emissions

The emissions scope covers category 1 direct emissions, and category 2 indirect emissions from imported energy. This includes emissions from QLDC owned and controlled buildings, vehicles, streetlights, and Three Waters assets. Landfill and embedded carbon from construction activities are excluded.

Coronet Forest, owned and managed by QLDC, was felled in 2020 and is to be fully replanted by 2025. Given the net emissions will over time be effectively zeroed, forestry emissions have been excluded from this ERP. Toitū have confirmed to QLDC that this is an acceptable approach when developing emission reduction targets.

Three Waters (3W) assets present a special case, as there is uncertainty over future ownership and control of these assets. Given this, emissions from Three Waters assets are separately identified and evaluated. Toitū have confirmed to QLDC that this is an acceptable approach when developing emission reduction targets.

The base year for QLDC emissions reduction is 2019, being the year to 30 June 2019. Emissions for 2019 and 2020 are as detailed in QLDC's report for Toitū[3]. Emissions for 2021 and 2022 are provided from a GHG inventory developed by QLDC[4] (currently unverified by Toitū). These figures are presented in Table 2 below.

Table 2: Reported QLDC Emissions

	2019 Baseline year	2020	2021 unverified	2022 unverified
Category 1 (excluding forestry removals)	9,498	8,984	8,640	10,316
Category 2	1,714	1,983	1,925	1,387
Total (with 3W)	11,212	10,968	10,565	11,703
Total (3W only)	9,255	9,012	8,135	10,011
Total (w/o 3W)	1,957	1,955	2,429	1,692

[2] 'QLDC District Emissions Reduction Roadmap' dated 26 November 2020 by Sapere & DETA Consulting
[3] Greenhouse Gas Emissions Inventory and Management Report - 30 June 2023
[4] QLDC GHG Inventory FY21 FY22 - 10 August 23

2.2.1 BAU Emissions Forecast

A 'Business as Usual' (BAU) emissions forecast out to 2030 is prepared by applying population forecasts[5] to the 2023 calculated emissions, without taking into account any reduction opportunities. But allowing for grid electricity forecast reductions.

2.2.2 Emission Reduction Targets

In the Climate and Biodiversity Plan[6], QLDC has committed to reducing GHG emissions by 44% by 2030 (against a 2019 baseline, aligned with the 1.5°C science-based target pathway outlined in the 2020 Emissions Reduction Roadmap), and achieve net-zero greenhouse gas emissions by 2050. QLDC advise that for this ERP the target is to be applied to organisation emissions excluding Three Waters emissions. The annual science-based targets to limit warming to 1.5°C and well below 2°C for QLDC excluding Three Waters are shown in Table 3.

Table 3: Science Based Targets excluding Three Waters

Target (tCO_2e)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Limit warming to well below 2°C	1,957	1,909	1,860	1,811	1,762	1,713	1,664	1,615	1,566	1,517	1,468	1,419
Limit warming to 1.5°C	1,957	1,879	1,801	1,723	1,644	1,566	1,488	1,409	1,331	1,253	1,174	1,096

The BAU forecast to 2030 and the emission reduction target for 2030 are displayed in Figure 2 for non-Three Waters and Figure 3 for Three Waters.

[5] Queenstown Lakes District Population Projections (March 2022)
[6] QLDC, 2022. Queenstown Lakes Climate and Biodiversity Plan 2022 – 2025.

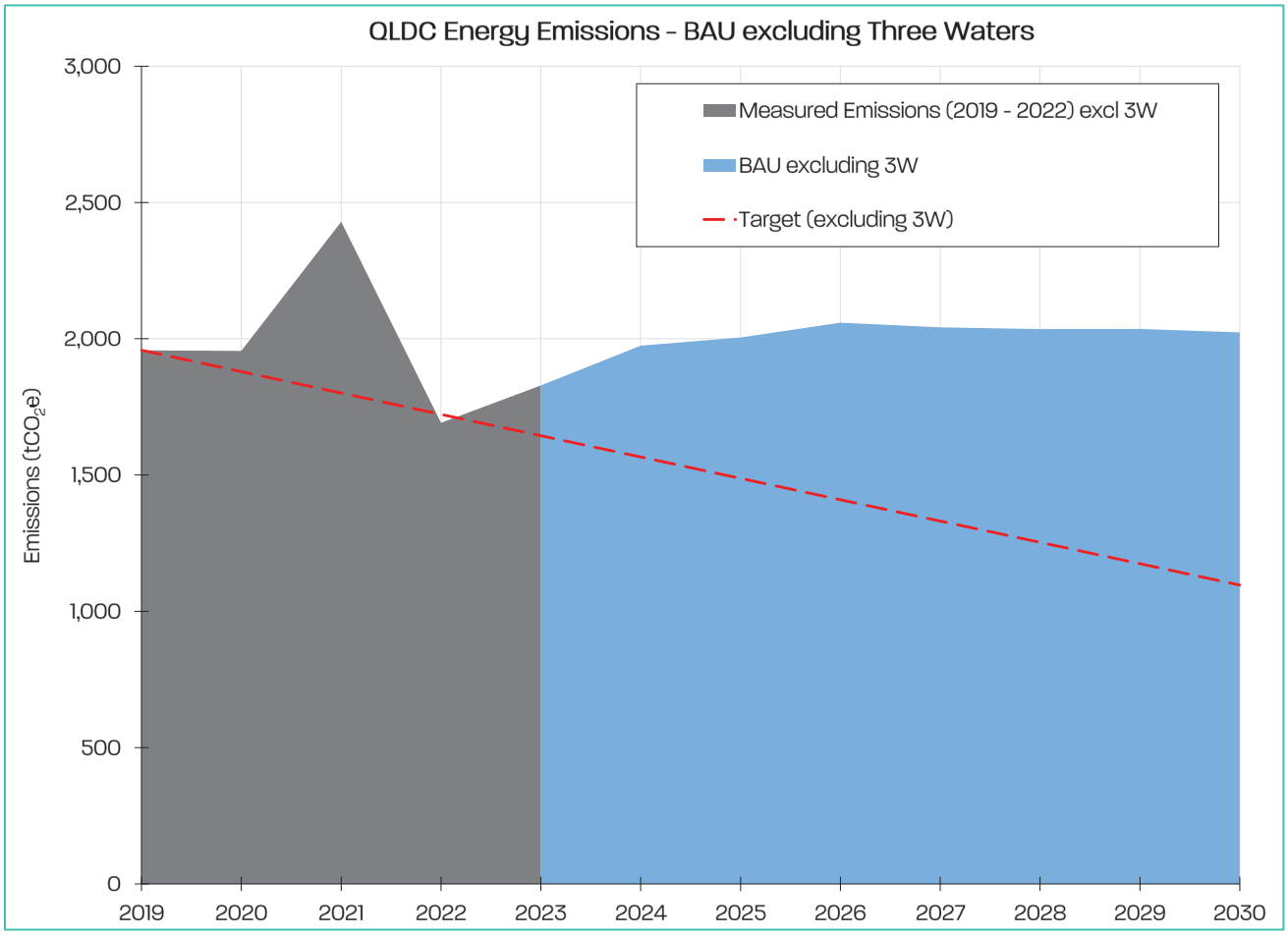

Figure 2: QLDC BAU Emissions excluding Three Waters

Note that the peak in 2021 is due to a significant increase (66%) of LPG use in 2021 on 2020. The following trough in 2020 is then amplified by a significant decrease (35%) in the electricity grid emissions factor between 2021 and 2022[7], despite electricity consumption increasing (4%).

[7] Ministry for the Environment, 2023. Measuring Emissions: A Guide for Organisations: 2023 Detailed Guide

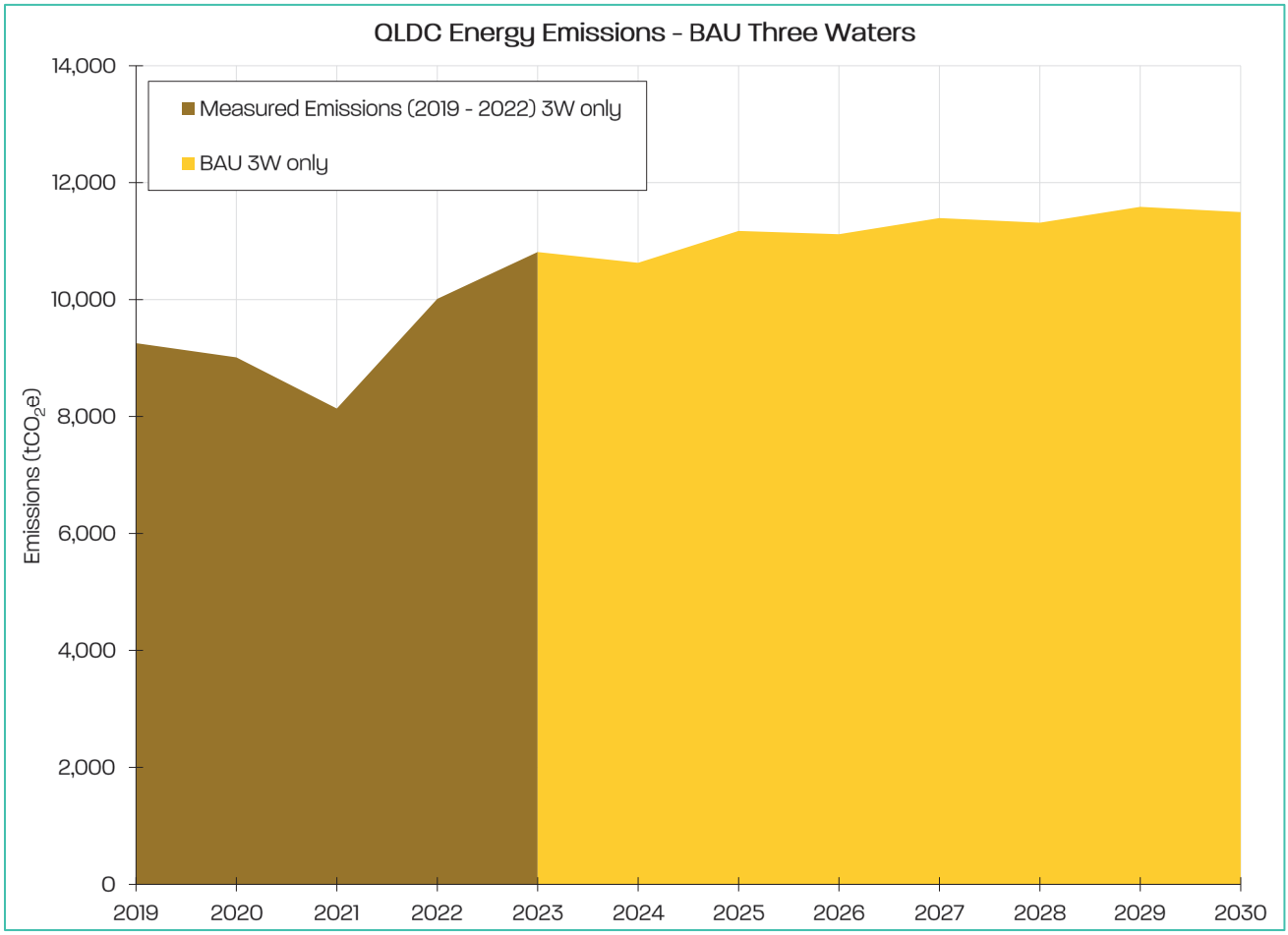

Figure 3: QLDC BAU Emissions for Three Waters

Three Waters BAU emissions increase over time in line with population forecasts.

3. Emissions Reduction Opportunities

QLDC has a number of opportunities to reduce gross emissions over the period to 2030. These include a wide range of reduction types including fuel change, equipment change, and improved operation and demand management of utility use.

3.1 General Opportunities

General opportunities are non-Three Waters opportunities.

3.1.1 Fossil Fuelled Vehicles to BEV

QLDC has been actively changing its light vehicle fleet to battery electric (BEV). 75% of the conversions have been achieved. No suitable options are currently available in New Zealand for the remaining vehicles, e.g. utes. QLDC management expect suitable BEV alternatives to be available by 2027.

For the ERP, it is assumed that one third of the remaining fossil fuel vehicles are changed in each of 2027, 2028 and 2029, achieving full fleet conversion before 2030.

At completion of the conversions, the annual emission savings are estimated to be 121 tCO_2e per year.

3.1.2 Increased efficiency of buildings & equipment

QLDC owns and manages a number of buildings and venues in the district.

Key venues will have BMS units by the end of FY 2023-24 which QLDC plans to network to allow remote control of key building functions, such as lighting and heating. This will enable tighter control of energy, and reduced wastage (e.g. - through lights not being left on when venue is not in use). For the ERP, it is assumed that implementation happens in 2024 and that there is a one-off 10% reduction in electricity use and associated emissions.

For all buildings, energy audits will identify energy efficiency opportunities which can be captured over time. For example, lighting in the Church St carpark can be converted to LED. For the ERP, it is assumed there is a year on year 2% p.a. reduction (up to a maximum of 30%) in the electricity use and associated emissions from these buildings, commencing in 2025.

In 2030 the annual emission savings are estimated to be 9 tCO_2e per year.

3.1.3 Streetlights to LED

The bulk of streetlights have been converted to LED. The remaining non-LED lights will be converted as replacement is required and as funding allows. For the ERP, it is assumed conversion is completed over 15 years, with 7% of remaining non-LED electrical load converted each year starting in 2024.

In this scenario, by 2030, the annual emission savings are estimated to be 6 tCO_2e per year.

If it was possible for funding to be brought forward to enable the completion of LED conversion by 2030, then the 2030 annual emission savings is estimated to be 8 tCO_2e per year.

3.1.4 Alpine Aqualand to Heat Pump

Alpine Aqualand currently use LPG for water heating in the pools complex. QLDC have plans[8] to replace the LPG boilers with an electrically powered heat pump. For the ERP, it is assumed the water heating conversion is completed prior to 2025, with emissions benefits accruing from that point.

Annual emission savings are estimated to be 903 tCO_2e per year. This is the most significant of the emission reduction projects.

3.1.5 Wanaka Rec Centre to biomass boiler

The Wanaka Recreation Centre currently use LPG for water heating in the pools complex. QLDC have plans[9] to replace the LPG boiler with a woodchip fired boiler. For the ERP it is assumed the water heating conversion is completed prior to 2025, with emissions benefits accruing from that point.

Annual emission savings are estimated to be 259 tCO_2e per year.

3.1.6 Arrowtown Pool to Heat Pump

The Arrowtown Pool currently uses LPG to for water heating. QLDC have plans[10] to replace the LPG boiler with an electrically powered heat pump. For the ERP it is assumed the water heating conversion is completed prior to 2025, with emissions benefits accruing from that point.

Annual emission savings are estimated to be 17 tCO_2e per year.

[8] Powell Fenwick Design Advice Memo titled 'Alpine Aqualand/Queenstown Event Centre - Decarbonisation' dated 09 Feb 2023
[9] Powell Fenwick Design Advice Memo titled 'Wanaka Aquatic Centre Decarbonisation' dated 09 Feb 2023
[10] The Building Intelligence Group Report titles 'Arrowtown Pool Investment Plan' dated 02 July 2020

3.1.7 Summary of Emissions Savings for General Opportunities

The gross emissions savings from the general opportunities outlined above are summarised in Table 4 and Figure 4 below.

Table 4: Emissions Savings for General Opportunities

Opportunity	Emissions savings by 2030 tCO_2e/y	Emission savings by 2050[11] tCO_2e/y
Fossil Vehicles to BEV	121	165
Increased efficiency of buildings & equipment	9	16
Streetlights to LED	6	6
Alpine Aqualand to Heat Pump	903	1,234
Wanaka Rec Centre to biomass boiler	259	346
Arrowtown Pool to Heat Pump	17	24
Total	1,315	1,791

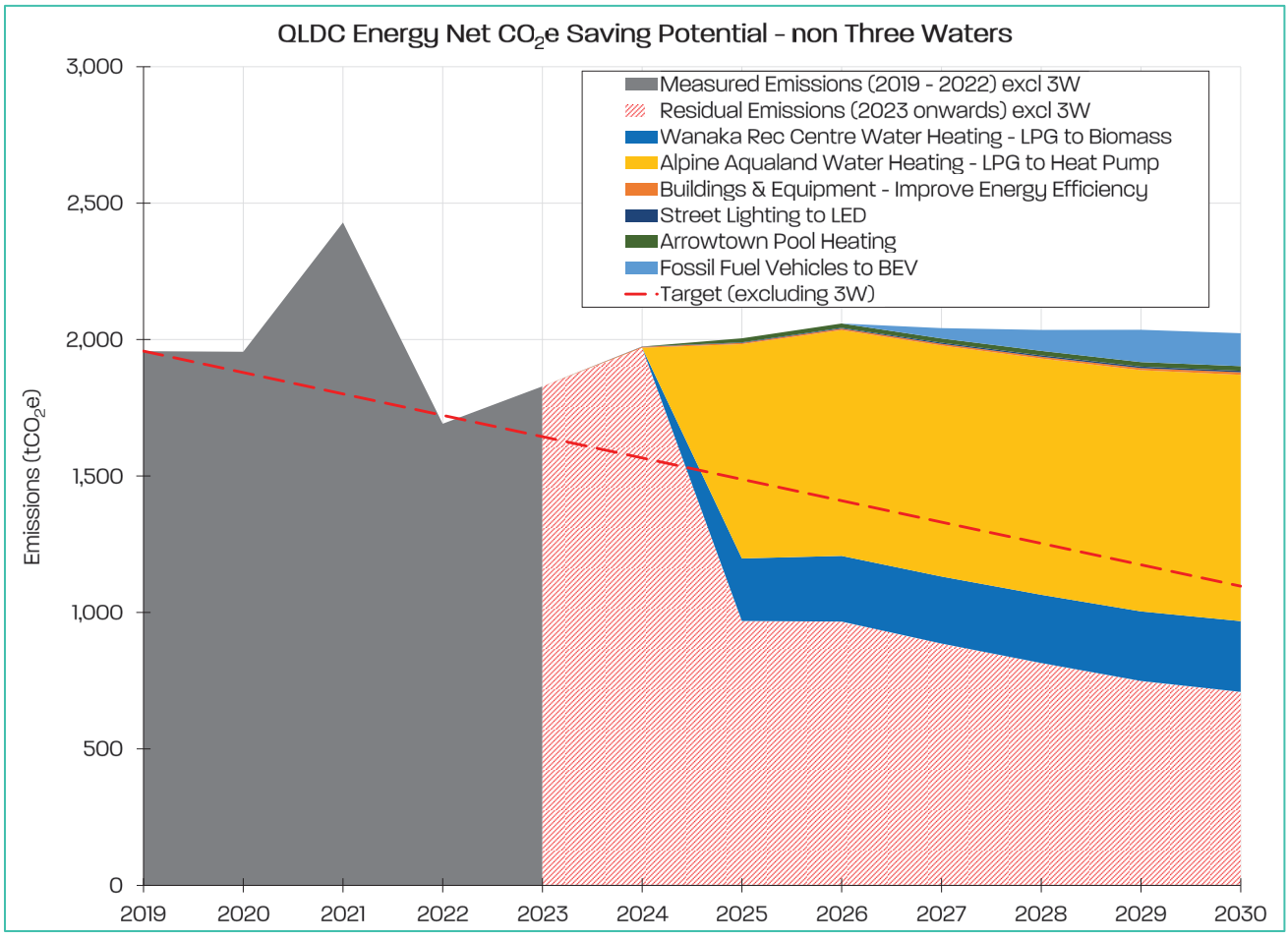

Figure 4: General Opportunities for Emissions Reduction

The general opportunities will lead to a reduction of 1,315 tCO_2e in 2030 relative to 2019, which is equivalent to a 67% reduction in 2030, significantly ahead of the target.

[11] Including adjusting for grid electricity emissions factor, as per 4.1, and BAU growth.

3.2 Three Waters Opportunities

3.2.1 Water Demand Management

QLDC have plans[12] to improve water demand management through a number of initiatives, broadly covering:

- Education and customer communication.
- Water loss reduction and water efficiency.
- Installation of water meters and volumetric pricing.

Expectations are for water demand reduction savings of 40% (on a L/per person/day consumption basis) over a 10-year period. For the ERP, it is assumed that the water demand management programme commences in 2024 with a 4% p.a. reduction in water demand through to 2033. For 2030 this gives a 28% reduction.

Emission savings are calculated using the methodology outlined in the MfE 2022 water supply emissions factor[13].

In 2030 the annual emissions savings are 159 tCO_2e per year.

3.2.2 WWTP upgrade

On 23 June 2023 it was announced[14] that the WWTP is to be upgraded, with commissioning to happen in early 2026. Supporting analysis[15] indicates the following changes to WWTP emissions (based on MfE 2020 emission factors):

- 884 tCO_2e per year savings due to decommissioning of ponds and increased effluent quality.
- 20 tCO_2e per year increase due to higher electricity consumption.
- 267 tCO_2e per year increase due to more sludge to landfill.
- A net saving of 597 tCO_2e 2026, the first year of operation.

The electricity emissions factor is adjusted each year using a forecasting model, to account for future grid decarbonisation, as described in section 4.1.

[12] Draft District Wide Water Demand Management Plan 2022, Dec 2022.
[13] Ministry for the Environment, 2023. Measuring Emissions: A Guide for Organisations: 2023 Detailed Guide
[14] QLDC, 2023. Shotover Wastewater Treatment Plant Upgrade.
[15] Detailed Design Update – Capital and Operational Carbon Baselines Report Rev D – Project Shotover Stage 3 15th March 2022

3.2.3 Emissions Savings

The emissions savings from the Three Waters opportunities outlined above are summarised in Table 5 and Figure 5.

Table 5: Emission Savings Summary for 3W

Opportunity	Emissions savings in 2030 tCO_2e per year	Emission savings in 2050 tCO_2e per year
Water Demand Management	159	334
WWTP upgrade	648	876
Total	807	1,210

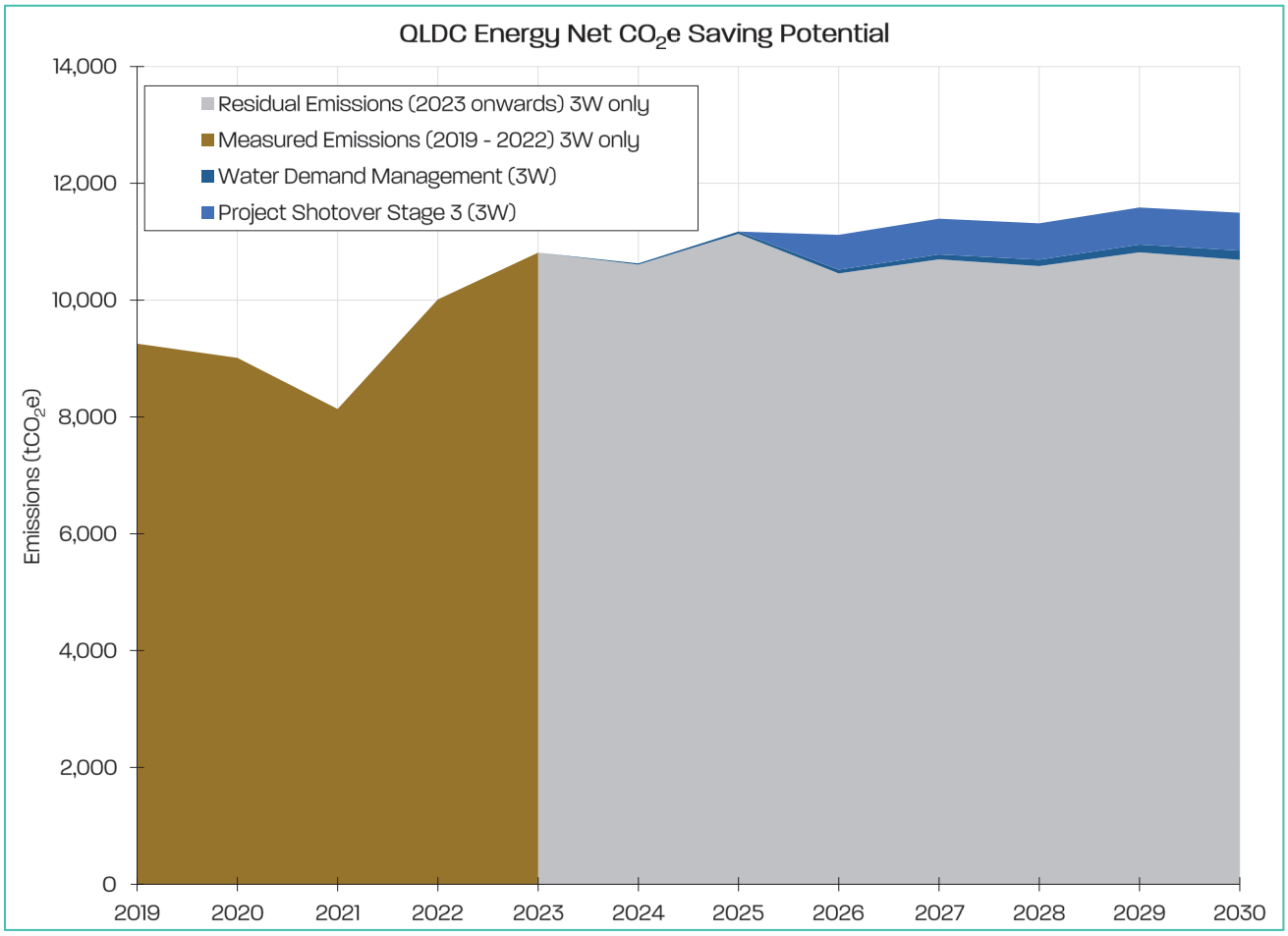

Figure 5: Three Waters Emission Reduction Opportunities

The Three Waters opportunities will lead to emissions savings of 807 tCO_2e in 2030 (equivalent to a 7% reduction relative to BAU in 2030). The emissions are 16% higher in 2030 relative to the baseline in 2019, population growth is the key driver for this.

3.3 Other opportunities

Behavioural change is likely to be a key contributor to emissions savings, with an example being water demand reduction. Other behavioural change opportunities have not been investigated due to limited information on the effects that behavioural change can have on the ERP.

3.4 Overall Emissions Reduction Pathway

Figure 6 depicts the ERP with the combination of both the general and Three Waters opportunities.

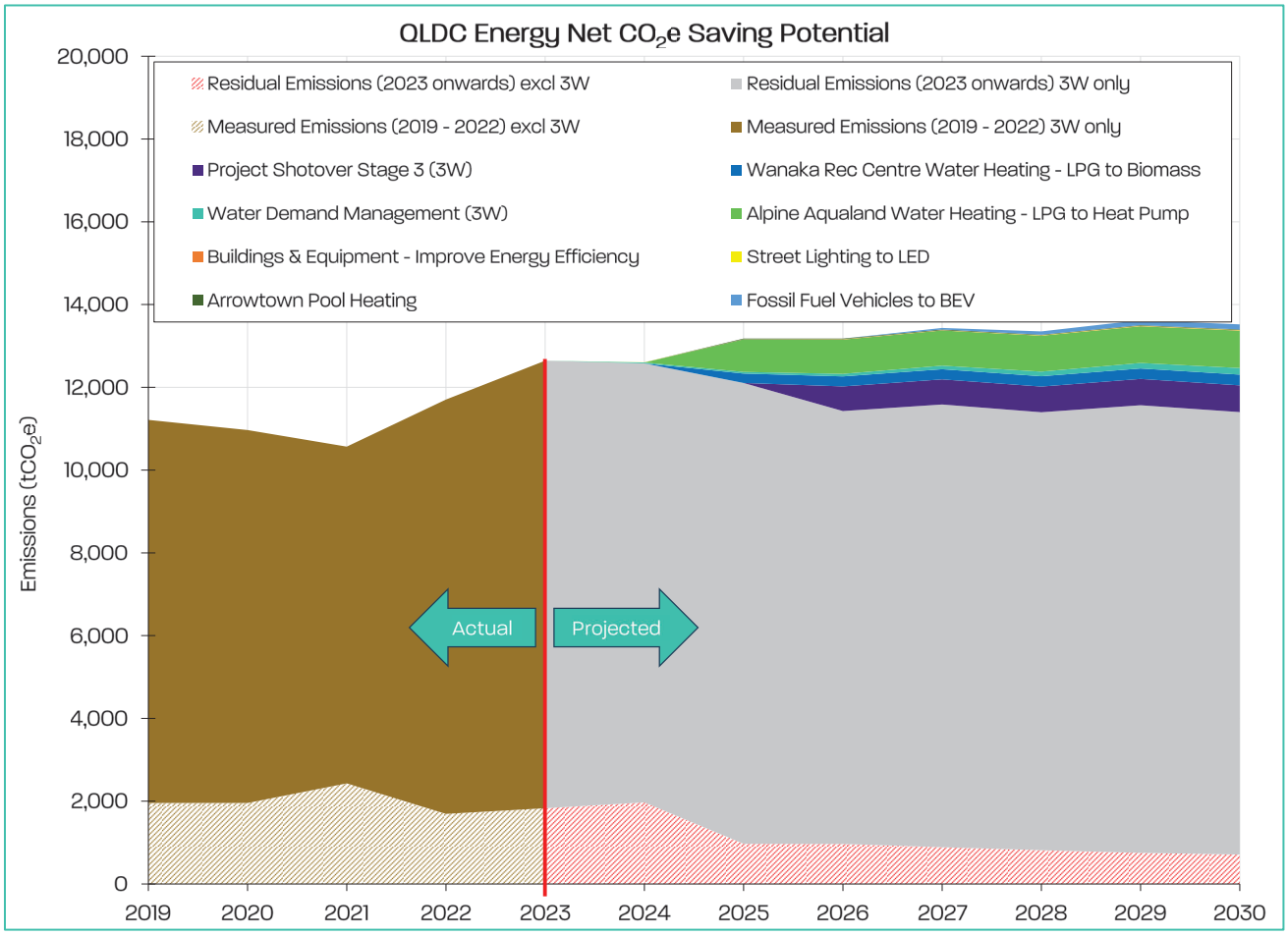

Figure 6: All Emission Reduction Opportunities

The combined opportunities will lead to a reduction of 2,121 tCO_2e in 2030, or a 16% reduction, relative to BAU.

The emissions in 2030 are 11,399 tCO_2e, an increase of 187 tCO_2e or 2% relative to the 2019 baseline.

4. Reducing Net Electricity Emissions

In 2023, electricity was a significant source of emissions at 1,401 tCO_2e. Methods to reduce these emissions include:

- Decarbonisation of the electricity grid.
- Renewable Electricity Certificates (RECs).
- Solar PV.
- Power Purchase Agreement (PPA).

4.1 Grid Decarbonisation

New Zealand has a very low-carbon electricity generation system by international standards due to the high levels of renewable generation. Despite this, because of the significant residual use of coal and gas for dry year firming, peaking, and baseload duties, along with geothermal emissions, the 5-year moving average emissions factor for electricity is currently still significant at 0.10 $kgCO_2e/kWh$.

Significant new renewable generation is being installed around the country (predominantly wind and solar), and as older thermal assets are retired, the overall emissions factor is expected to reduce further. The government is also targeting zero emissions from the electricity sector by 2035, however DETA believe this is unlikely to occur.

While there is still significant uncertainty around exactly what will happen with the net-zero emissions, modelling has been released by a range of organisations and is outlined in Figure 7. This shows the anticipated grid electricity emissions factors, based on several assumptions, particularly regarding the continued operation of NZ Aluminium Smelter.

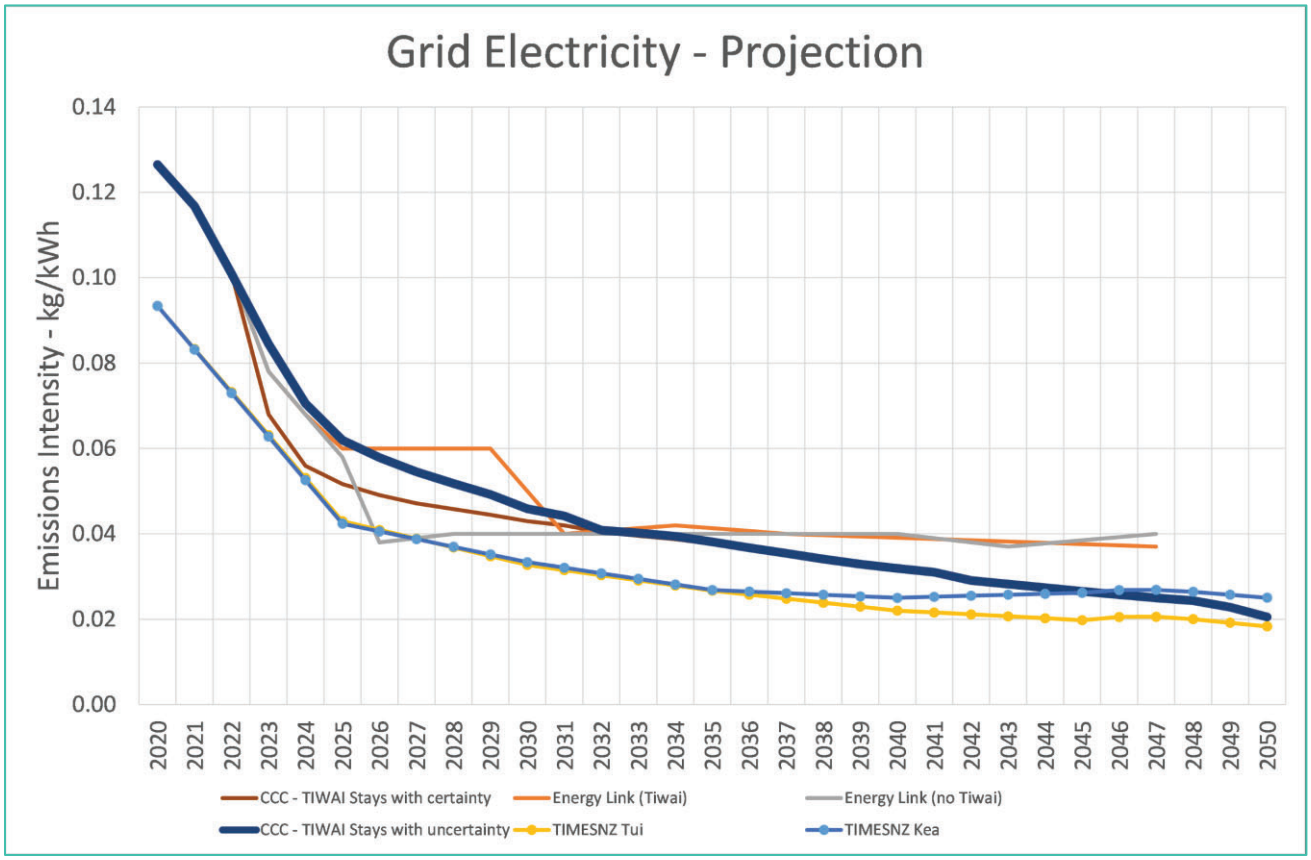

Figure 7: Grid Electricity Emission Factor Projections

For this ERP, it is assumed the pathway "CCC – Tiwai stays with uncertainty", modified with actual values to 2022, is followed. It is anticipated that this will result in a significant reduction (~50%) by 2025, slowing reductions through 2030, then minor reductions into the future. Actual figures will vary depending on rainfall, natural gas utilisation and other factors, such as the future decisions of NZ Aluminium Smelters regarding their operations at Tiwai Point.

Effectively, this is a 'do nothing' option. The grid will significantly decarbonise regardless of QLDC action, however it will take time to decarbonise and it is unlikely to reach zero carbon.

4.2 Renewable Electricity Certificates

A Renewable Energy Certificate is proof that energy has been generated from renewable sources such as hydro or wind power and assigns that renewable generation to the specific site consumption, in units of 1 MWh. Therefore, each REC represents the environmental benefits of 1MWh of renewable energy generation. When a REC is purchased, the equivalent renewable energy is removed from the overall pool and the average emissions factor for the rest of the country increases. An REC is linked to existing renewable generation assets and the generator can use the proceeds from RECs as it chooses.

The equivalent of 100% renewable electricity can be achieved by the purchase RECs. QLDC can buy RECs from current electricity suppliers for each MWh of electricity consumed. RECs are available from many NZ electricity retailers[16] at $3-4 per MWh plus set-up fees and annual membership fees.

For QLDC in 2023 with the current mix of electricity retailers, the REC cost is estimated to be $30,000 to $50,000 for 1,000 tCO_2e of savings (or $30 to $50 per tonne) with incomplete coverage. For full coverage of electricity, the cost would be more like $50,000 to $70,000.

For QLDC in 2030, the REC cost (at current rates and assuming full coverage) works out to $70,000 to $90,000 for 1,100 t CO_2e of savings. It is expected that the cost of RECs will vary over time with the ETS costs, so can be expected to be more expensive in 2030.

RECs are relatively inexpensive, fast to implement, and relatively easy to acquire, and therefore are the most flexible way to achieve renewable energy targets. However, the environmental impact is difficult to assess. Buying RECs does not guarantee that a new renewable energy project will be built (most projects offering RECs would have been built without the REC market), but the average emissions factor increases for other users in the country, which does help to drive low carbon generation due to everyone needing to decarbonise.

Key points for QLDC are:

- Can achieve 100% renewable electricity equivalent.
- No capital investment required but RECs have to be purchased for every MWh every year.
- The unit cost is expected to increase as the ETS cost increases.

[16] For the electricity retailers supplying QLDC:

- Simply Energy do not offer RECs. They have an alternative product where the emission factor in a given half hour can be applied to the electricity use in that half hour, giving a more accurate actual emissions figure.
- Meridian Energy currently charge $3/MWh + $300 set-up cost.
- Genesis Energy currently charge $4/MWh + $500 set-up cost + $500 annual membership.

4.3 Solar PV

Solar panels could potentially be installed on QLDC buildings[17], generating zero carbon electricity to offset electricity supply from the grid.

Panels could be mounted to the roofing on Alpine Aqualand, Queenstown Events Centre, and Wanaka Recreation Centre. A high-level analysis indicates potential electricity generation of 1.25 GWh/y, which equates to 7% of QLDC electricity consumption in 2023. This would remove 93 tCO_2e based on the current electricity emission factor. Table 6 outlines the electricity usage vs modelled generation via solar PV for each building.

Table 6 – Current electricity use vs Estimated generation from Solar PV on QLDC buildings.

Building	Current Electricity Consumption (kWh/y)[18]	Estimated Electricity Generation (kWh/y)[19]	Offset
Wanaka Rec Centre	585,000	464,000	79%
Alpine Aqualand	595,000	787,000[20]	47%
Queenstown Events Centre	1,085,000		

Solar PV projects typically have paybacks in the range 10 to 20 years.

Over time the electricity emission factor is going to reduce, so a solar PV project will have a diminishing emission reduction.

The solar PV installation could be managed under a PPA, with an energy developer installing and owning the equipment, and QLDC purchasing the electricity direct.

Key points for QLDC are:

- Can expect to offset less than 10% of current electricity use and electricity emissions.
- Capital investment is required which delivers unexciting investment returns.

[17] The suitability of building structures for the extra weight of the solar PV system has not been investigated at all.
[18] Figures taken from Powell Fenwick Design Advice Memos (provided by QLDC) – dated 08 Feb 2023 & 09 Feb 2023
[19] DETA have estimated these figures using methods from a previous solar PV integration study.
[20] Modelled using combined roof area of Alpine Aqualand and QEC (buildings are physically combined).

4.4 Power Purchase Agreement

A PPA can be a good way to achieve carbon reduction and renewable energy goals plus provide a hedge against electricity price volatility. It is a long-term electricity supply agreement negotiated between a power producer and a customer. The power producer is often a developer of a solar farm or a windfarm. The PPA will be agreed ahead of the construction of the renewable generation assets and is crucial component to enable the funding of the development.

A PPA can be 'sleeved' by inserting an electricity retailer as an intermediary to manage the transaction and supplier relationship, including purchasing of additional electricity from the grid when PPA electricity isn't available (i.e. when the sun isn't shining or the wind isn't blowing).

The PPA market in New Zealand is relatively immature but is developing quickly as the number new renewable energy developments rises.

Key points for QLDC are:

- Can achieve 100% renewable electricity.
- Will have a hedge against price volatility.
- Must commit to electricity purchases for the long-term, up to 20 years.
- No capital investment is required.

Appendix A: ERP Calculations

QLDC Organisation Greenhouse Gas Emissions Reduction Pathway - Scope 1 & 2 Direct Energy

Includes: population growth, electricity grid emissions intensity reduction

Business as Usual | ERP

FY starts in July. i.e. - FY2024 starts in July 2023

	Description	Units	Source	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
POPULATION															
Population projection	Total pop (avg day)	people	QLDC Demand Projection (Mar 2022)	69,988	68,707	63,931	66,532	71,921	76,628	79,825	83,777	85,430	87,082	88,680	90,276
% of previous year									107%	104%	105%	102%	102%	102%	102%
BASE UNITS															
Road transport	Petrol	L	QLDC advice			6,302	4,088	4,637	4,941	5,147	5,401	5,508	5,615	5,718	5,820
Road transport	Diesel	L	QLDC advice			64,032	51,394	32,990	35,149	36,616	38,428	39,187	39,945	40,677	41,409
LPG	LPG	t	QLDC advice			386	284	330	352	367	385	392	400	407	415
Wastewater	Wastewater	Theo. People	"Wastewater Treatment Calcs FY2019-FY2022" data used by Toitu, provided by Kirsty				50,940	55,066	58,670	61,118	64,143	65,409	66,674	67,897	69,119
Potable Water (volume)	Drinking Water	m^3	QLDC advice	13,156,052	12,915,222	12,017,455	12,506,428	13,519,305	12,017,455	12,518,845	13,138,585	13,397,874	13,656,944	13,907,458	14,157,753
Potable Water (electricity)	Electricity	GWh	DETA Calculation on QLDC advice; electricity usage from PW pumping	5.52	5.42	5.04	5.24	5.67	5.42	5.04	5.24	5.67	6.04	6.29	6.60
Wastewater (electricity)	Electricity	GWh	QLDC advice; electricity usage from WW pumping and agitation	4.69	4.61	4.29	4.46	4.82	5.14	5.35	5.62	5.73	5.84	5.95	6.05
Electricity (stationary) - TOTAL	Electricity	GWh	QLDC advice			17.9	17.7	19.4	20.6	21.5	22.6	23.0	23.4	23.9	24.3
Electricity (excl. 3w)	Electricity	GWh	QLDC advice			8.6	8.0	8.9	10.1	11.1	11.7	11.6	11.6	11.6	11.6
EMISSIONS FACTORS															
Road transport	Petrol	tCO2e/L	MfE Measuring emissions a guide for organisations 2023	0.00246	0.00246	0.00246	0.00246	0.00246	0.00246	0.00246	0.00246	0.00246	0.00246	0.00246	0.00246
Road transport	Diesel	tCO2e/L	MfE Measuring emissions a guide for organisations 2023	0.00271	0.00271	0.00271	0.00271	0.00271	0.00271	0.00271	0.00271	0.00271	0.00271	0.00271	0.00271
Electricity (stationary)	Electricity	tCO2e/GWh	CCC - TIWAI Stays with uncertainty	**110.0**	**120.0**	**115.0**	**74.2**	72.4	70.5	62.0	57.9	54.5	51.8	49.2	45.9
LPG	LPG	tCO2e/t	MfE Measuring emissions a guide for organisations 2023	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97
Potable Water (pumping)	Drinking Water	$tCO2e/m^3$	MfE Measuring emissions a guide for organisations 2023	0.0000369	0.0000369	0.0000369	0.0000369	0.0000369	0.0000369	0.0000369	0.0000369	0.0000369	0.0000369	0.0000369	0.0000369
QLDC CARBON EMISSIONS (GROSS)															
Fleet vehicles	Petrol	tCO2e	DETA Calculation			16	10	11	12	13	13	14	14	14	14
Fleet vehicles	Diesel	tCO2e	DETA Calculation			174	139	89	95	99	104	106	108	110	112
Electricity (excl. 3w)	Electricity	tCO2e	DETA Calculation			988	595	642	711	688	677	633	599	573	534
LPG	LPG	tCO2e	DETA Calculation			1,148	843	981	1,045	1,089	1,143	1,165	1,188	1,210	1,231
Wastewater	Wastewater Sludge	tCO2e	"Wastewater Treatment Calcs FY2019-FY2022" data used by Toitu, provided by Kirsty	8,253	7,983	7,199	9,219	9,966	9,822	10,381	10,309	10,586	10,508	10,780	10,697
Wastewater	Electricity	tCO2e	DETA Calculation. 2019-2022 extrapolated backwards	516	553	493	331	349	362	332	325	312	302	293	278
Potable Water	Electricity	tCO2e	DETA Calculation. 2019-2022 extrapolated backwards	485	477	443	461	499	443	462	485	494	504	513	522
Refrigerants	Leakage	tCO2e	Toitu Audits and GHG Inventories			104	105	104	111	116	122	124	126	129	131
TOTAL		**tCO2e**	**2019 - 2022 data from Toitu audit: Scope 1-2**	**11,212**	**10,968**	**10,565**	**11,703**	**12,642**	12,603	13,179	13,177	13,435	13,350	13,622	13,520
TOTAL (excl. 3 waters)		**tCO2e**		**1,957**	**1,955**	**2,429**	**1,692**	**1,828**	**1,975**	**2,004**	**2,059**	**2,042**	**2,035**	**2,036**	**2,023**
TOTAL (3 waters only)		**tCO2e**		**9,255**	**9,012**	**8,135**	**10,011**	**10,813**	**10,628**	**11,175**	**11,119**	**11,393**	**11,314**	**11,586**	**11,497**

MfE Emission Factors

Toitu Numbers

Based on consumption data in GHG Inventories

QLDC Organisation Greenhouse Gas Emissions Reduction Pathway - Scope 1 & 2 Direct Energy

Includes: population growth, electricity grid emissions intensity reduction

Business as Usual | ERP

FY starts in July.
i.e. - FY2024 starts in July 2023

	Description	Units	Source	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Reduction Opportunities															
1 Fossil Fuel Vehicles to BEV															
Assumptions:															
Incremental vehicle conversion per year from 2027. Complete conversion over 3 years															
Assuming existing is diesel, since higher fuel use vs petrol															
Private vehicle emissions - Diesel	0.268	kgCO2/km	MfE Measuring emissions a guide for organisations 2023: Default <3000 cc												
Private vehicle emissions - Electric	0.020	kgCO2/km	MfE Measuring emissions a guide for organisations 2023: Default <3000 cc												
Diesel fuel emissions	2.71	kgCO2/L	MfE, 2023												
Diesel GCV	10.58	kWh/L	Energy Handbook												
Diesel fuel emissions	0.26	kgCO2/kWh	Calculated												
Electricity emissions	0.0742	kgCO2/kWh	MfE, 2023 (based on latest figure available - 2022)												
Diesel	1.05	kWh/km	Energy input required per km travelled												
EV	0.27	kWh/km	Energy input required per km travelled												
			Diesel and Petrol Vehicles												
			Proposed tCO2e	-	-	189	149	101	107	112	117	120	122	124	127
			Proposed L	-	-	70,334	55,482	37,627	40,090	41,762	43,830	44,695	45,559	46,395	47,230
Conversion to BEV	100%		Uptake %	0%	0%	0%	0%	0%	0%	0%	0%	33%	67%	100%	100%
Start	2027		Savings L	-	-	-	-	-	-	-	-	14,898	30,373	46,395	47,230
End	2030		Savings kWh fuel	-	-	-	-	-	-	-	-	157,624	321,343	490,856	499,690
			Savings tCO2	-	-	-	-	-	-	-	-	40	81	124	127
			Distance travelled km	-	-	-	-	-	-	-	-	150,650	307,127	469,141	477,584
			EV electricity input kWh	-	-	-	-	-	-	-	-	40,607	82,784	126,453	128,729
			Elec input to BEV GWh	-	-	-	-	-	-	-	-	0.041	0.083	0.126	0.129
			Elec emissions factor tCO2e/GWh	110	120	115	74	72	71	62	58	55	52	49	46
			Elec emissions tCO2e	-	-	-	-	-	-	-	-	2	4	6	6
			NET carbon savings	-	-	-	-	-	-	-	-	38	77	118	121
2 Buildings & Equipment - Improve Energy Efficiency															
Assumptions:															
10% savings in electrical consumption in 2024 with initial networking of BMS's across venues.															
2%pa thereafter from improved electrical efficiency of all buildings.															
Buildings with BMS only															
10% savings in 2024, then 2%pa p to 30% maximum			Existing elec tCO2	-	-	988	595	32	35	36	38	38	39	40	41
			Savings %	0%	0%	0%	0%	0%	10%	12%	14%	16%	18%	20%	22%
			Savings tCO2	-	-	-	-	-	3	4	5	6	7	8	9
Conversion	30%		Remaining emissions tCO2	-	-	988	595	32	31	32	32	32	32	32	32
Start	2024														
End	-														

QLDC Organisation Greenhouse Gas Emissions Reduction Pathway - Scope 1 & 2 Direct Energy

Includes: population growth, electricity grid emissions intensity reduction

Business as Usual | ERP

FY starts in July.
i.e. - FY2024 starts in July 2023

		Description	Units	Source	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
3	**Alpine Aqualand Water Heating - LPG to Heat Pump**															
	Convert from LPG-fired water heating systems (e.g. gas boilers) to hot water heat pumps - heat recovery from wastewater															
	Assumptions:															
	LPG heating efficiency is 85%															
	HP heating efficiency is 400% - sourced from Powell Fenwick report															
	Commissioned June 2024															
	LPG energy density	**13.65**	MWh/t													
				Existing LPG CO2					753	802	836	877	894	912	928	945
				Existing LPG t					254	270	281	295	301	307	313	318
	Heat Pump Efficiency	400%		Existing LPG MWh					3,461	3,687	3,841	4,032	4,111	4,191	4,267	4,344
	Conversion	100%		Savings					0%	0%	100%	100%	100%	100%	100%	100%
	Start	2025		Savings LPG CO2					-	-	836	877	894	912	928	945
				Savings LPG t					-	-	281	295	301	307	313	318
				Savings LPG MWh					-	-	3,841	4,032	4,111	4,191	4,267	4,344
				Load Shift												
				LPG Efficiency					1	85%	85%	85%	85%	85%	85%	85%
				Load shift heating delivered (MWh)					-	-	3,265	3,427	3,494	3,562	3,627	3,693
				HWHP efficiency					400%	400%	400%	400%	400%	400%	400%	400%
				Load shift electrical input (MWh)					-	-	816	857	874	890	907	923
				Load shift elec emissions factor (tCO2/MWh)	0.1100	0.1200	0.1150	0.0742	0.0724	0.0705	0.0620	0.0579	0.0545	0.0518	0.0492	0.0459
				Load shift elec emissions (tCO2e)					-	-	51	50	48	46	45	42
				LPG Emissions Savings (tCO2e)					-	-	836	877	894	912	928	945
				Elec Emissions Increase (tCO2e)					-	-	51	50	48	46	45	42
				NET SAVINGS (tCO2e)					**-**	**-**	**785**	**827**	**847**	**866**	**884**	**903**

QLDC Organisation Greenhouse Gas Emissions Reduction Pathway - Scope 1 & 2 Direct Energy

Includes: population growth, electricity grid emissions intensity reduction

Business as Usual | ERP

FY starts in July.
i.e. - FY2024 starts in July 2023

		Description	Units	Source	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
4	**Wanaka Rec Centre Water Heating - LPG to Biomass**															
	Convert from LPG-fired water heating systems (e.g. gas boilers) to biomass boiler															
	Assumptions:															
	LPG heating efficiency is 85%															
	Biomass boiler heating efficiency is 92%															
	Assume medium quality wood chip used - 35% MC. Energy density of 3.9 kWh/kg (ref below)															
	https://www.mbie.govt.nz/dmsdocument/125-industrial-bioenergy-demand-methodology-2016-pdf															
	Commissioned June 2024															
	LPG energy density	**13.65**	MWh/t													
	Biomass Energy Density	3.9	kWh/kg													
	Biomass Emissions Factor (Mfe)	0.01496	kgCO2e/kg	Existing LPG CO2					210	224	233	245	250	254	259	264
		0.00384	tCO2e/MWh	Existing LPG t					71	75	79	82	84	86	87	89
	Efficiency	92%		Existing LPG MWh					966	1,029	1,072	1,125	1,147	1,170	1,191	1,212
	Conversion	100%		Savings					0%	0%	100%	100%	100%	100%	100%	100%
	Start	2025		Savings LPG CO2					-	-	233	245	250	254	259	264
				Savings LPG t					-	-	79	82	84	86	87	89
				Savings LPG MWh					-	-	1,072	1,125	1,147	1,170	1,191	1,212
				Load Shift												
				LPG efficiency					85%	85%	85%	85%	85%	85%	85%	85%
				Load shift heating delivered (MWh)					-	-	911	956	975	994	1,012	1,031
				Biomass boiler efficiency					92%	92%	92%	92%	92%	92%	92%	92%
				Load shift biomass energy input (MWh)					-	-	990	1,040	1,060	1,081	1,100	1,120
				Load shift biomass emissions factor (tCO2/MWh)					0.0038	0.0038	0.0038	0.0038	0.0038	0.0038	0.0038	0.0038
				Load shift biomass emissions (tCO2e)					-	-	4	4	4	4	4	4
				LPG Emissions Savings (tCO2e)					-	-	233	245	250	254	259	264
				Elec Emissions Increase (tCO2e)					-	-	4	4	4	4	4	4
				NET SAVINGS (tCO2e)					**-**	**-**	**229**	**241**	**246**	**250**	**255**	**259**

QLDC Organisation Greenhouse Gas Emissions Reduction Pathway - Scope 1 & 2 Direct Energy

Includes: population growth, electricity grid emissions intensity reduction

Business as Usual | ERP

FY starts in July.
i.e. - FY2024 starts in July 2023

		Description	Units	Source	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
7	**Water Demand Management**															
	Water reduction projects - electrical savings from reduced pumping through comprehensive metering															
	Assumptions:															
	Ongoing metering installs in 2026 and 2027. Savings fully captured after 2027.															
	Savings	40%		Water Consumption (L/p/d)	515	515	515	515	515	515	515	515	515	515	515	515
	Start	2024		Water Consumption (m^3/y)	13,156,052	12,915,222	12,017,455	12,506,428	13,519,305	14,404,172	15,005,140	15,747,963	16,058,748	16,369,270	16,669,538	16,969,543
	End	2034		Savings %	0%	0%	0%	0%	0%	4%	7%	11%	15%	18%	22%	25%
				Total savings from metering projects (m^3/y)	0	0	0	0	0	523,788	1,091,283	1,717,960	2,335,818	2,976,231	3,636,990	4,319,520
				Emissions Savings (tCO2e)	-	-	-	-	-	19	40	63	86	110	134	159
8	**Street Lighting to LED**															
	Upgrade street light bulbs for potential savings - changing incandescent to LED															
	Assumptions:															
	From data, indicates that there is a 19.4% reduction in power consumption switching from old bulbs to LED (ref to calc in data spreadsheet)															
	Complete replacement of bulbs to LED in 15 years															
	Lights on 12 hrs per day 365 days per year															
	2023 total wattage	339641	W	Lighting elec consumption (kWh)	-	-	-	-	1,487,626	1,487,626	1,468,386	1,449,644	1,431,380	1,413,576	1,396,215	1,379,280
	2023 power consumption	1487626	kWh	Savings %						1.3%	2.6%	3.9%	5.2%	6.5%	7.8%	9.1%
	Power consumption reduction	19.4%		Savings from bulb upgrades (kWh)	-	-	-	-	-	**19,240**	**37,982**	**56,246**	**74,050**	**91,411**	**108,346**	**124,871**
	Implementation period	15	yrs													
	Average savings per year	1.29%		Elec emissions factor (tCO2/GWh)	-	-	-	-	72	71	62	58	55	52	49	46
	Start	2024		Current lighting elec emissions (tCO2e)	-	-	-	-	108	105	91	84	78	73	69	63
	End	2039		Savings (tCO2e)	-	-	-	-	-	1	2	3	4	5	5	6
				Proposed remaining emissions (tCO2e)	-	-	-	-	108	104	89	81	74	68	63	58

QLDC Organisation Greenhouse Gas Emissions Reduction Pathway - Scope 1 & 2 Direct Energy

Includes: population growth, electricity grid emissions intensity reduction

Business as Usual | ERP

FY starts in July.
i.e. - FY2024 starts in July 2023

		Description	Units	Source	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
9	**Arrowtown Pool Water Heating - LPG to Heat Pump**															
	Convert from LPG-fired water heating systems (e.g. gas boilers) to hot water heat pumps															
	Assumptions:															
	LPG heating efficiency is 85%															
	HP heating efficiency is 250% for a commercial pool hot water heat pump (which will be running at lower temps vs DHW sytems)															
				LPG energy density	13.65	MWh/t										
									2022 figure used here							
				Existing LPG CO2					17	16	16	17	17	18	18	18
	LPG Efficiency	85%		Existing LPG t					6	5	5	6	6	6	6	6
	Heat Pump Efficiency	250%		Existing LPG MWh					76	72	75	78	80	81	83	84
	Conversion	100%		Savings					0%	0%	100%	100%	100%	100%	100%	100%
	Start	2025		Savings LPG CO2					-	-	16	17	17	18	18	18
				Savings LPG t					-	-	5	6	6	6	6	6
				Savings LPG MWh					-	-	75	78	80	81	83	84
				Load Shift												
				LPG Efficiency					85%	85%	85%	85%	85%	85%	85%	85%
				Load shift heating delivered (MWh)					-	-	63	66	68	69	70	72
				HWHP efficiency					250%	250%	250%	250%	250%	250%	250%	250%
				Load shift electrical input (MWh)					-	-	25	27	27	28	28	29
				Load shift elec emissions factor (tCO2/MWh)	0.1100	0.1200	0.1150	0.0742	0.0724	0.0705	0.0620	0.0579	0.0545	0.0518	0.0492	0.0459
				Load shift elec tCO2					-	-	2	2	1	1	1	1
				LPG Savings tCO2e					-	-	16	17	17	18	18	18
				Elec Increase tCO2e					-	-	2	2	1	1	1	1
				NET SAVINGS t CO2e					**-**	**-**	**15**	**15**	**16**	**16**	**17**	17
10	**Project Shotover Stage 3**															
	Upgrade of Shotover WWTP															
	Assumptions:															
	Assumed annual emission reduction as per BECA report and adjusted for population growth. Scope 2 reduction adjusted based on projected electricity emission factor.															
	Electricity Emissions Factor	0.0742	$kgCO_2e/kWh$	MfE, 2023 (based on latest figure available - 2022)												
	Unit Conversion	0.000001	GWh/kWh													
	Scope 1 Change	-884	tCO2e	Scope 1 (tCO_2e) - Decrease		-	-	-	-	-	-	- 884	- 901	- 919	- 936	- 953
	Scope 2 Change	350,404	kWh	Scope 2 (kWh)		-	-	-	-	-	-	350,404	357,320	364,229	370,910	377,585
	Scope 3 Change	267	tCO2e	Scope 2 (tCO_2e) - Increase		-	-	-	-	-	-	20	19	19	18	17
				Scope 3 (tCO_2e) - Increase		-	-	-	-	-	-	267	272	278	283	288
				Total Reduction		**-**	**-**	**-**	**-**	**-**	**-**	**597**	**610**	**622**	**635**	648
	Conversion	100%														
	Installed	2025														

QLDC Organisation Greenhouse Gas Emissions Reduction Pathway - Scope 1 & 2 Direct Energy

Includes: population growth, electricity grid emissions intensity reduction

Business as Usual | ERP

FY starts in July.
i.e. - FY2024 starts in July 2023

	Description	Units	Source	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Opportunities - Carbon Savings Summary (tCO2e)															
		1	Fossil Fuel Vehicles to BEV	-	0	0	0	0	0	0	0	38	77	118	121
		2	Buildings & Equipment - Improve Energy Efficiency	-	0	0	0	0	3	4	5	6	7	8	9
		3	Alpine Aqualand Water Heating - LPG to Heat Pump	-	0	0	0	0	0	785	827	847	866	884	903
		4	Wanaka Rec Centre Water Heating - LPG to Biomass	-	0	0	0	0	0	229	241	246	250	255	259
		5	Solar PV	-	0	0	0	0	0	0	0	0	0	0	0
		6	Behavioural Changes	-	0	0	0	0	0	0	0	0	0	0	0
		7	Water Demand Management	-	-	-	-	-	19	40	63	86	110	134	159
		8	Street Lighting to LED	-	0	0	0	0	1	2	3	4	5	5	6
		9	Arrowtown Pool Water Heating - LPG to Heat Pump	-	0	0	0	0	0	15	15	16	16	17	17
		10	Project Shotover Stage 3	-	0	0	0	0	0	0	597	610	622	635	648
			total		0	0	0	0	24	1076	1752	1852	1953	2056	2121
			tot w/o 3waters												1315
			% saving w/o 3waters												67%
			% saving of 3waters												7%
			% saving inc 3waters												16%
Renewable Energy Certificates															
			total electricity use. GWh					19.36	20.65	22.37	23.53	24.06	24.58	25.05	25.51
			elec tCO2e					1,401	1,456	1,386	1,362	1,312	1,273	1,233	1,170