Energy Audit Update

Whakatāne District Council

Final Copy
July 2022

1 Executive Summary

Whakatane District Council's largest facilities were audited in June 2018 for energy cost saving opportunities. In December 2021, Whakatane District Council (WDC) elected to update the energy audit with a focus on the next tier of large energy using facilities. Each of its 193 electricity, natural gas, and LPG accounts were included in the audit. The energy audit update identified energy savings at larger accounts and focused on facilities that were not a part of the 2018 audit. These facilities include Museum and Research Centre, Whakatane Holiday Park, Murupara Swimming Baths, War Memorial Hall, Ohope Oxidation Ponds, and Whakatane Oxidation Ponds, which emit 196,000 kgCO2e per year attributed to energy.

Annual reductions in carbon emissions of 100,500 kgCO2e and energy cost savings of $108,000 a year have been identified with investment paybacks varying from 0 years to 31 years. Many of these options are achievable by adopting formal energy efficiency practices, increasing maintenance, and investing in technology upgrades.

Energy costs were $1,473,559 (electricity, natural gas, and LPG) in the 12 months to June 2021. Electricity usage was 7,357,746 kWh and gas usage was 554,305 kWh in the 12 months to June 2021. Carbon emissions attributed to the Whakatane District Council's energy consumption were 981,846 kgCO_2e in the 12 months to June 2021.

Compared to the energy audit in 2018, energy cost has decreased by $260,808 per year (electricity and natural gas). Electricity use has increased by 124,198 kWh compared to 2018 and natural gas has reduced by 554,305 kWh per year since 2018. Carbon emissions from electricity and natural gas have also decreased from 2018 levels, by 263,114 kg CO_2e per year.

One of the Whakatāne District Council's primary drivers for commissioning this report was to understand the impact on its carbon emissions that are influenced by energy use and what opportunities exist to reduce carbon emissions that contribute to climate change. The cost of offsetting carbon emissions was explored through purchasing carbon credits. At a carbon price of $77 per tonne CO_2e, it would cost the Council $75,602 to offset its energy related emissions, for the 12 months to June 2021. The report includes a pie chart (refer to Figure 5-3) illustrating the percentage of carbon emissions from each facility. Section 7 also includes a model of expected and actual carbon emissions per month for each of the main facilities.

Shown below in Table 1-1 is a summary of energy cost saving opportunities, which are listed in order from the shortest payback period to longest. Also included is an estimated cost of implementation, as well as annual carbon savings for each opportunity.

Table 1-1 - Summary of energy and carbon saving opportunities identified

Section Reference and Description		Estimate Cost	Energy reductions [kWh/year]	Carbon Savings [$kgCO_2e/yr$]	Net Cost* savings [$/year]	Simple Payback [years]
9.2.3	Combine ICPs for TOU and NHH account at Whakatane Oxidation Ponds	$0	0	0	$9,700	-
9.3.2	Change Ohope Oxidation Ponds electricity account from NHH to TOU	$0	0	0	$12,300	-
8.2	Reduce capacity of transformers on accounts with excess capacity	$0	0	0	$67,300	-
10	Continue with council-wide energy management programme	$0	147,500	19,600	$4,500	-
9.3.4	Improve aerator control at Ohope oxidation ponds	TBD	13,100	1,400	2,600	-
8.1	Review electricity account type and lines structure	$4,200	0	0	$12,300	0.3
9.1.2	Install VSD on circulation pump at Murupara Swimming Baths, decrease speed of pump, and decrease it further outside of normal operating hours	$7,000	22,900	2,500	$4,600	1.5
9.1.4	Install pool cover for 33m pool at Murupara Swimming Baths	$31,900	35,500	3,900	$7,100	4.5
9.5.1	Replace gas califont water heating with hot water heat pumps at Holiday Park *	$88,000	65,000	55,600	9,400	9.4
9.4.3	Replace natural gas boilers with hot water heat pump for space heating at Museum and Research Centre *	$40,000	53,300	12,800	1,500	26.2

Section Reference and Description		Estimate Cost	Energy reductions [kWh/year]	Carbon Savings [$kgCO_2e$/yr]	Net Cost* savings [$/year]	Simple Payback [years]
9.6.1	Replace natural gas space heating at the War Memorial Hall with combination of heat pumps and radiant heaters *	$40,000	13,500	4,400	1,200	31.3
	TOTAL	**$211,000**	**363,700**	**100,500**	**$108,000**	

* Projects to be explored in detail in a separate feasibility study.

Estimated costs are based on budget prices received by suppliers. Further investigation of some energy saving opportunities is required where suggested in the report.

Note, not all project calculations are mutually exclusive. For example, energy savings achieved from installing occupancy sensors for lighting would change depending on if the lights were upgraded to LEDs or not.

Energy savings were calculated using the following rates:

- Electrical energy savings are calculated at average yearly rates for TOU accounts of 20.1 c/kWh, which are from contract prices from March 2022 to February 2023. However, fixed prices for electricity use vary at different times of day and year.

- After- hours electricity savings are calculated at a rate of 17.4 c/kWh, which is from contract prices from March 2022 to February 2023, for electricity use during after-hours periods.

- Peak load electricity savings are included and are based on the tariff charges currently in place with the lines company, Horizon. Peak load electricity savings are calculated at a rate of $65.48 per kW per year for peak load reductions.

- Natural gas savings are calculated at 7.3c/kWh at the Memorial Hall, which is the marginal price of natural gas currently purchased at this facility.

- LPG savings are calculated at 15.8 c/kWh at the Holiday Park, which is the marginal cost of LPG purchased for the site.

2 Glossary

CDD – Cooling Degree Days

ETS – Emissions Trading Scheme

EUI – Energy Use Index

GXP – Grid Exit Point

HDD – Heating Degree Days

HVAC – Heating Ventilation and Air-conditioning

kgCO_2e – equivalent kilograms of carbon dioxide

NHH – Non-half hourly

RH – Relative humidity

TOU – Time of Use

3 Contents

4 Introduction

Georgina Fletcher, GM Community Experience, Whakatāne District Council, commissioned Energy Management Solutions Ltd (Emsol) in November 2021 to carry out an updated Type Two Energy Audit of its council facilities. The Whakatāne District Council's Civic Centre is located on Commerce Street, Whakatāne in the Eastern Bay of Plenty. Carl Newby and Gordon Allan from Emsol surveyed the facilities, analysed energy saving opportunities and completed this report. Site maps for facilities are included for reference; refer to Appendix 12.2 - Site Maps.

The objective of the energy audit was to identify the sources of energy provided for the sites, the quantity of energy supplied, and what the energy is used for, with a focus on sites that were not audited in detail in 2018. Furthermore, the Whakatane District Council expressed a desire to understand its carbon emissions associated with energy use with a goal to minimise its contribution to climate change. During the process of collecting this data, areas of potential energy and carbon savings were identified. Potential saving quantities and the cost of implementing these savings were calculated; the results of these calculations are presented in this report.

A desk-top audit of energy use and tariff analysis of electricity contracts was undertaken in December 2021; these were based on energy supply records for the period from July 2020 to June 2021. Emsol personnel carried out surveys of facilities for the energy audit as described in Table 4-1 below.

Table 4-1 - Facilities Surveyed during audit

Date	Facilities Surveyed
7th July 2021	Ohope Oxidation Ponds
18th November 2021	Holiday Park
25th March 2022	War Memorial Hall, Whakatane Oxidation Ponds, Murupara Swimming Baths

The following people assisted with providing information for the audit:

- Gail Teichmann, Manager – Property and Facility Assets, Whakatāne District Council
- Jim Finlay, Team Leader Capital Works, Whakatāne District Council
- Dean Finlay, Places and Open Spaces Asset Officer, Whakatāne District Council
- Andrew Smith, Manager Aquatics and Recreation, Whakatāne District Council
- Sarah Dark, Business Development Manager, Mercury Energy Ltd.
- Benjamin Whitaker, Sales Administrator Large Commercial, Mercury Energy Ltd.
- Shannon, Corporate Account Specialist, Genesis Energy Ltd.

Other Staff members from Council facilities also provided useful information on operation practices and ideas for improving energy efficiency.

5 Overview of Requirements for Energy

At the Whakatāne District Council, energy is required to provide services to the district, as well as for office buildings. The largest users of energy were covered in detail in the 2018 energy audit. The largest energy using facilities that were not previously audited are:

- Water pump stations
- Water treatment and oxidation ponds
- Museum and Research Centre
- War Memorial Hall

Most energy used is electricity; natural gas is used at a small number of facilities. The Whakatāne District Council has 186 separate electricity accounts and five accounts for natural gas, and the Whakatāne Holiday Hark uses LPG. A breakdown of electricity accounts is presented in Figure 5-1 and a breakdown of natural gas use is presented in Figure 5-2.

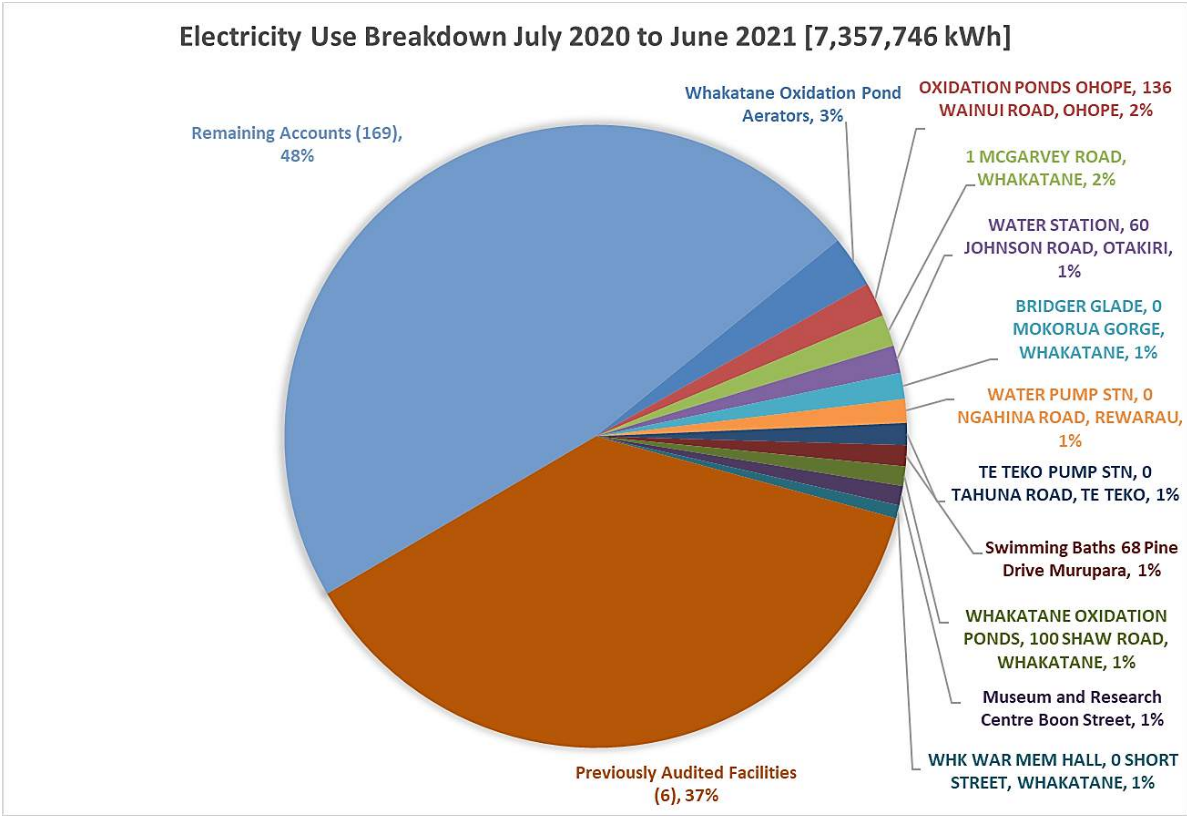


Figure 5-1 - Pie chart showing breakdown of electricity used by Whakatāne District Council accounts, year to June 2021

The Aquatic Centre is the largest gas account, using 382,661 kWh of gas in the 12 months to June 2021, which is 61% less compared to usage during the 2018 audit. The Aquatic Centre has used approximately 70% of the total gas used by the five active accounts from July 2020 to June 2021.

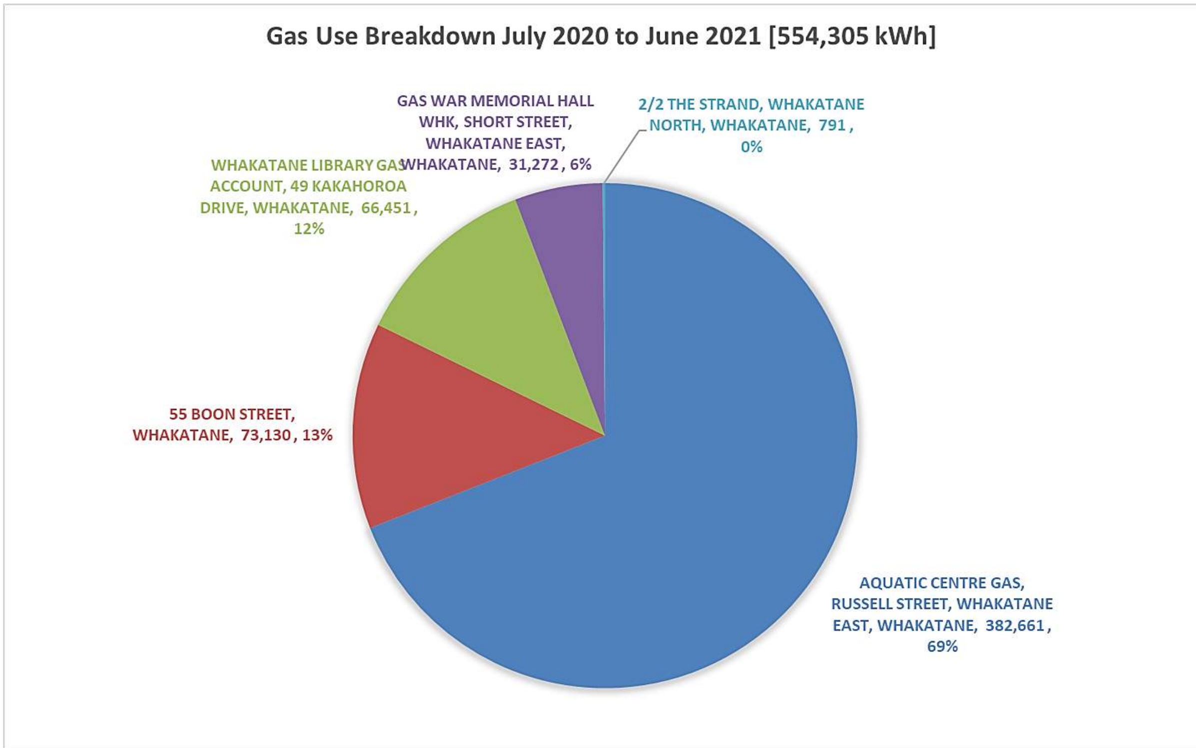


Figure 5-2 Pie chart showing breakdown of natural gas use at the Whakatāne District Council, year to June 2021

Figure 5-3 below shows a breakdown of carbon emissions by facility at the Whakatāne District Council. These emissions are those associated with electricity, natural gas, and LPG consumption. The Holiday Park has the highest carbon emissions for the Council at 8% (of the facilities that have not already been audited in 2018). For all accounts, the Aquatic Centre has the most emissions at 23% of the total for the Council. While the holiday park does not use a lot of electricity, it does use a significant amount of LPG. The 11 largest accounts that have not been previously audited contribute 29% of the Council's total emissions.

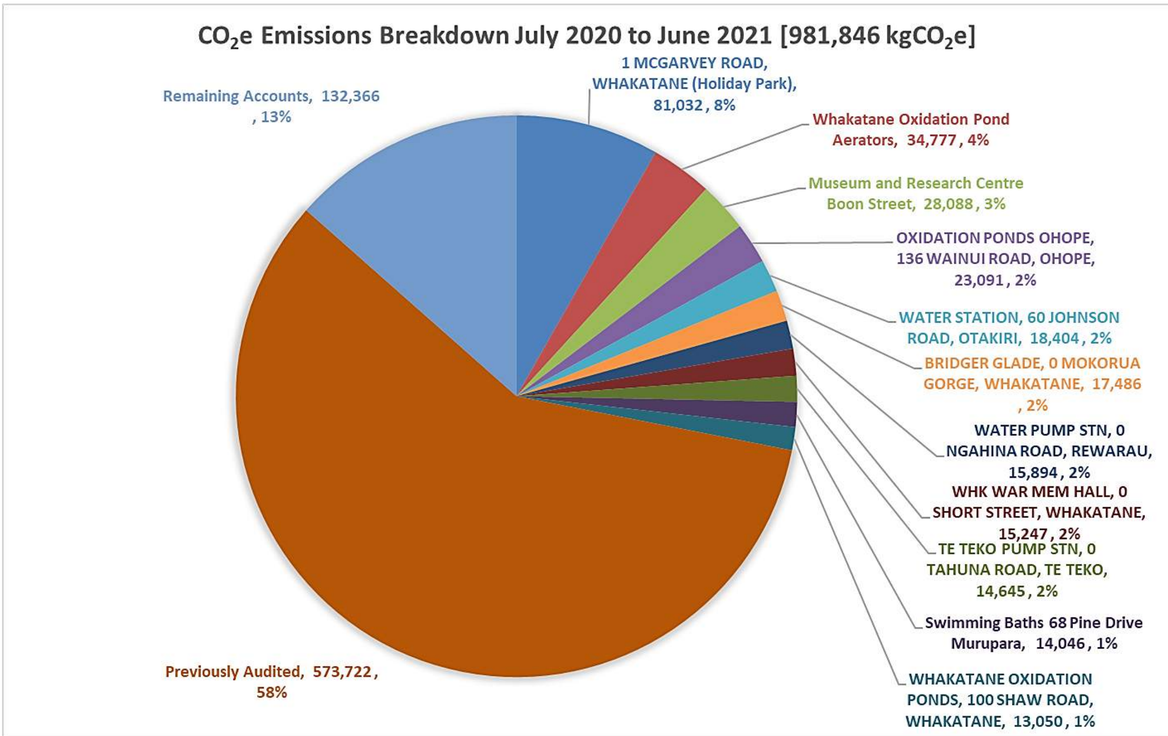


Figure 5-3 - Pie chart showing breakdown of CO_2 emissions attributed to energy use by facility

Ten sites with the most carbon emissions are presented in Table 5-1 below, excluding six accounts that were audited in 2018 (Civic Centre, Aquatic Centre, Water Treatment Plant, Braemar and Paul Road pump stations, and the Library).

Table 5-1 – Ten of highest 16 electricity accounts at Whakatāne District Council, July 2020 to June 2021

Description	Annual Consumption (kWh)	Energy Related Carbon Emissions (kg of CO_2e)
1 MCGARVEY ROAD, WHAKATANE	296,155	81,032
Whakatane Oxidation Ponds	435,979	47,827
Museum and Research Centre Boon Street	191,176	28,088
OXIDATION PONDS OHOPE, 136 WAINUI ROAD, OHOPE	210,490	23,091
WATER STATION, 60 JOHNSON ROAD, OTAKIRI	167,766	18,404
BRIDGER GLADE, 0 MOKORUA GORGE, WHAKATANE	159,400	17,486
WATER PUMP STN, 0 NGAHINA ROAD, REWARAU	144,884	15,894
WHK WAR MEM HALL, 0 SHORT STREET, WHAKATANE	111,252	15,247
TE TEKO PUMP STN, 0 TAHUNA ROAD, TE TEKO	133,498	14,645
Swimming Baths 68 Pine Drive Murupara	128,038	14,046

6 Historic Energy Costs and Use

6.1 Gross Energy Costs

During the July 2020 to June 2021 year, Whakatāne District Council's energy costs totalled $1,473,559. The total energy use during the same period was 8,016,126 kWh. A breakdown of Whakatāne District Council's energy consumption by fuel type is shown below in Table 6-1.

Table 6-1 - Energy use and costs for July 2020 to June 2021

Fuel Type	**Cost**	**Energy** [kWh]	**Gross Cost**[i] [c/kWh]	**Carbon Emissions (kg of CO_2e)**
Electricity	$1,416,815	7,357,746	19.3	807,145
Natural Gas	$39,485	554,305	7.1	114,741
LPG	$17,259	104,075	16.6	59,961
Total	$1,473,559	8,016,126	18.4	**981,846**

Electricity is a high-grade form of energy that is able to be easily converted into useful work, without many of the efficiency limitations associated with other fuels. Due to electricity's high-grade form, the price per unit of energy [c/kWh] is usually higher compared to other fuel sources.

Approximately 80% of New Zealand's electricity is generated using renewable sources. As a result, the carbon emissions per kWh associated with electricity use is lower than fossil fuels which produce carbon dioxide as a by-product of combustion. The latest publication from the Ministry for Environment (MfE) specifies that CO_2 emissions for electricity are 0.1077 $kgCO_2e/kWh$ for electricity, 0.207 $kgCO_2e/kWh$ for natural gas and 3.03 kg CO_2e/kg for LPG (approximately 0.576 kgCO2e/kWh). Natural gas and LPG have higher CO_2 emissions per kWh. However, because a higher proportion of Whakatāne District Council's energy is from electricity than natural gas or LPG, the highest total CO_2 emissions are from electricity use.

Whakatāne District Council's most expensive energy source is electricity, with an average gross cost during July 2020 to June 2021 of 19.3 c/kWh. Natural Gas was Whakatāne District Council's cheapest source of energy; its average gross cost was 7.1 c/kWh. Natural gas is a lower-grade form of energy which can be used for direct heating only.

[i] Includes both variable charges, and all fixed charges that do not vary with energy use such as monthly administration fees and other fixed energy charges

6.2 Electricity

6.2.1 Monthly Consumption

6.2.1.1 Holiday Park

Shown below in Figure 6-1 is Whakatāne District Council's monthly electricity consumption at the Holiday Park and average monthly 9am temperature at Whakatāne Airport. There is a weak trend showing increased electricity consumption in months of decreased ambient temperatures. Electricity use was highest in August 2020 and lowest in Jan 2021.

The relationship between electricity use and ambient temperature is discussed further in Section 6.4.1.1.

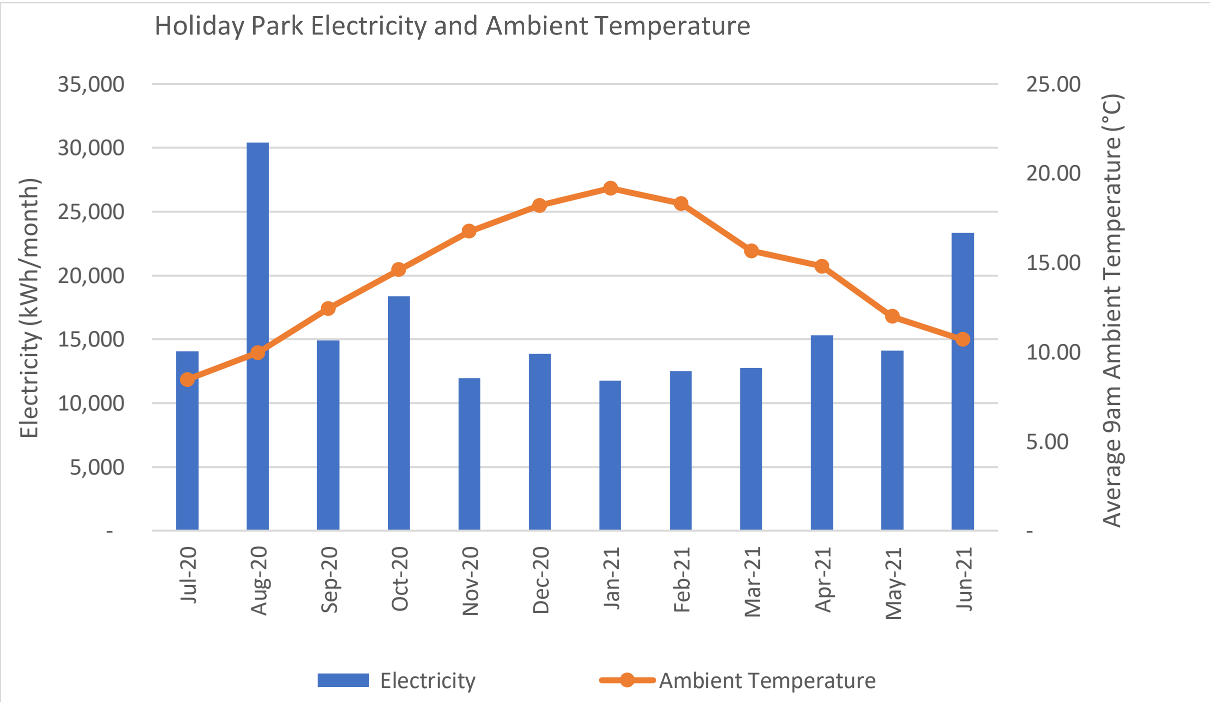


Figure 6-1 - Electricity usage at the Holiday Park for the period July 2020 to June 2021

6.2.1.2 Murupara Swimming Baths

Shown below in Figure 6-2 is Whakatāne District Council's monthly electricity consumption at the Murupara Swimming Baths and average monthly 9am temperature at Whakatāne Airport. The pool is typically open from October to March, which coincides with when the majority of electricity is used. When the pool is closed, minimal electricity is used. When the pool is in use, electricity is relatively constant and generally between 20,000 kWh and 25,000 kWh each month. When the pool is not in use, electricity use drops to 200 kWh per month, or less.

The relationship between ambient temperature and electricity use is discussed further in Section 6.4.2.1.

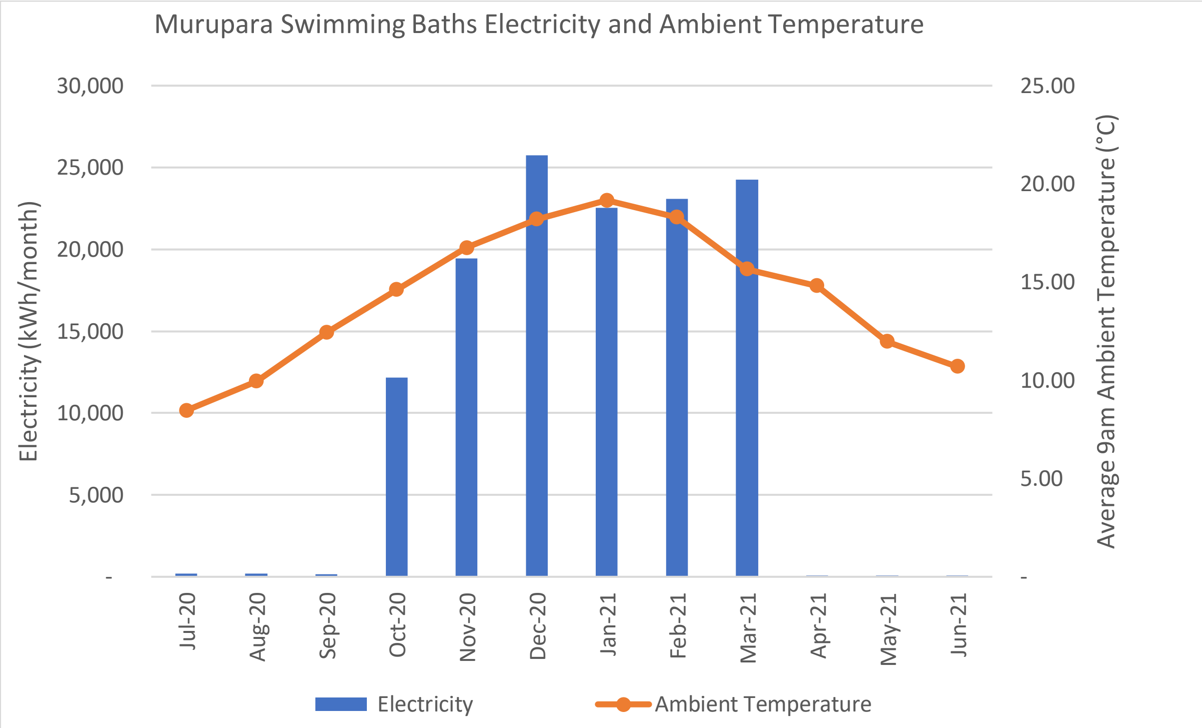


Figure 6-2 - Electricity usage at the Murupara Swimming Baths for the period July 2020 to June 2021

6.2.1.3 War Memorial Hall

Shown below in Figure 6-3 is Whakatāne District Council's monthly electricity consumption at the War Memorial Hall and average monthly 9am temperature at Whakatāne Airport. There appears to be a weak relationship between electricity and ambient temperature, with winter months on average using more electricity and July and Aug being the highest usage months. The difference between summer and winter months' electricity use is not that pronounced; this is because gas is also used for central heating.

The relationship between electricity use and ambient temperature is discussed further in Section 6.4.3.1.

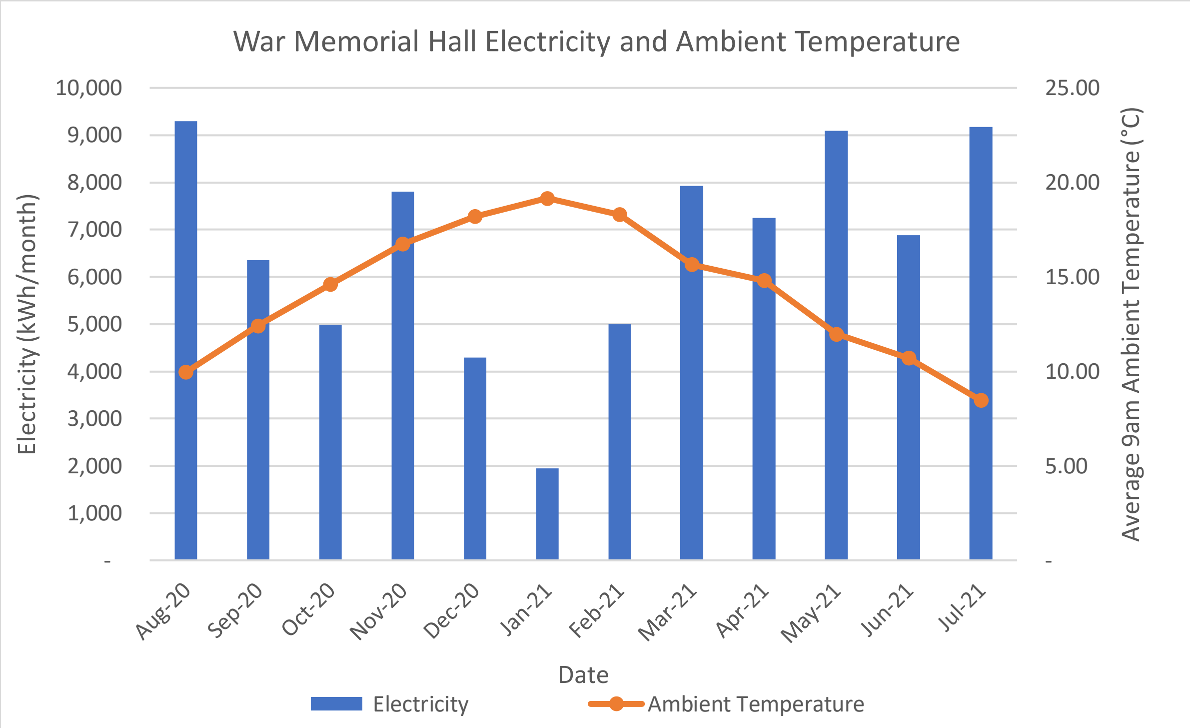


Figure 6-3 - Electricity usage at the War Memorial Hall for the period July 2020 to June 2021

6.2.1.4 Whakatane Oxidation Pond

Shown below in Figure 6-4 is Whakatāne District Council's monthly electricity consumption at the Oxidation Pond and monthly volumes of effluent. The oxidation ponds have two electricity accounts, one NHH and one TOU, the aerators are on the TOU account. The TOU account uses between 20,000 kWh and 32,000 kWh each month and the NHH account uses between 6,000 kWh and 18,000 kWh.

The relationship between effluent and electricity use is discussed further in Section 6.4.4.1.

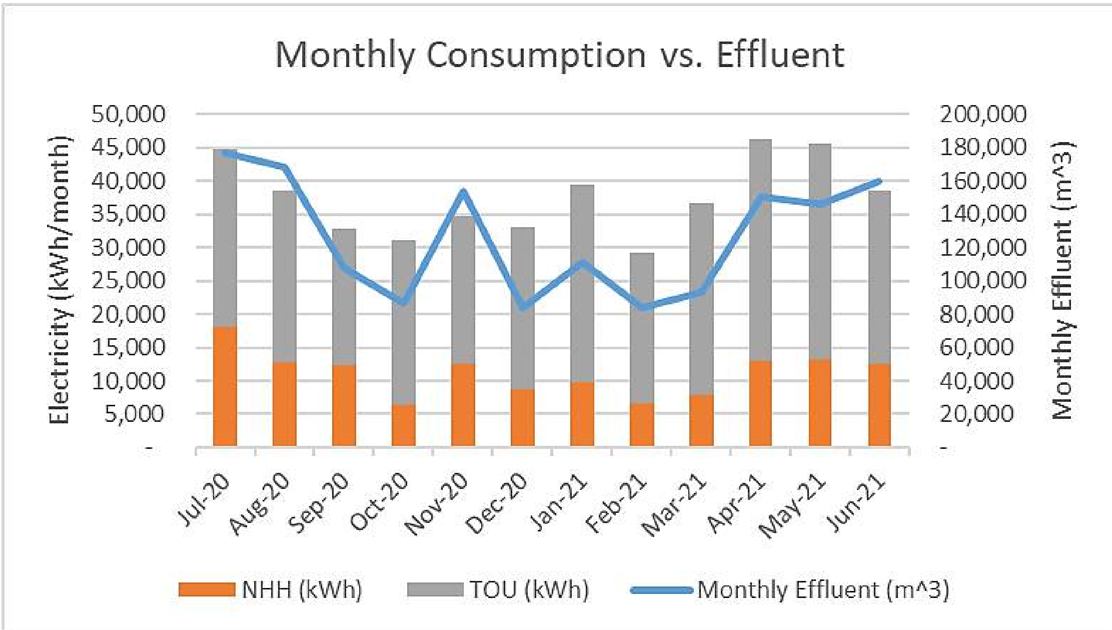


Figure 6-4 Electricity usage at the Whakatane Oxidation Ponds and Effluent for the period July 2020 to June 2021

6.2.1.5 Ohope Oxidation Ponds

Shown below in Figure 6-5 is Whakatāne District Council's monthly electricity consumption at the Ohope Oxidation Ponds and monthly effluent. Electricity use is relatively constant aside from a few months that have higher use. The relationship between ambient temperature and electricity use is discussed further in Section 6.4.5.1.

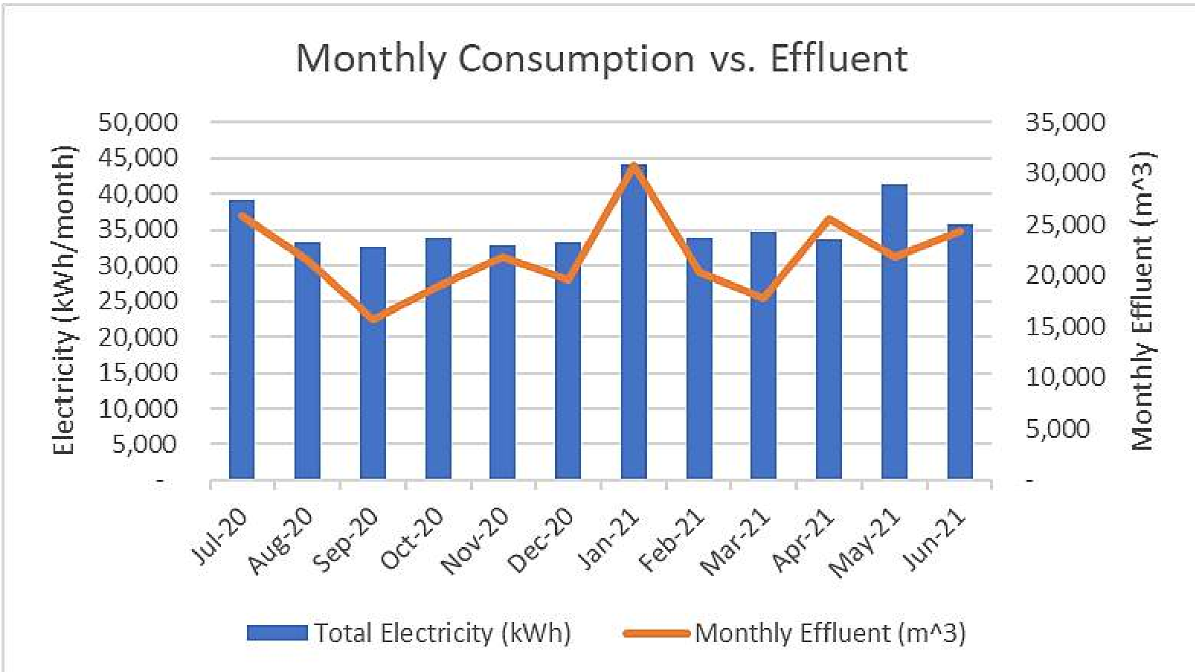


Figure 6-5 Electricity usage at the Ohope Oxidation Ponds and Effluent for the period July 2020 to June 2021

6.2.2 Daily Load Profiles

6.2.2.1 Murupara Swimming Baths

The Murupara Swimming Baths' electricity use over a single operating day is shown below in Figure 6-6; Thursday the 7th of January 2021 was arbitrarily selected to represent a typical summer day's electricity use. The graph was generated using time of use (TOU) data supplied by Mercury.

The graph shows a peak load of 75.8 kVA, which occurred at 18:30 hours. This peak is due to the second of two heat pumps switching on to assist with heating. The electricity load was at its minimum of 8.42 kVA at 03:00 hours, when no heat pumps were running

There is a difference between the kW load and kVA load throughout the day, this indicates that there is some opportunity to improve the power factor during this period (refer to Section 8.6 for further details). The power factor varied from 0.84 to 1.00 throughout the day and was 0.84 at peak load. The power factor should be kept at 0.95 or greater.

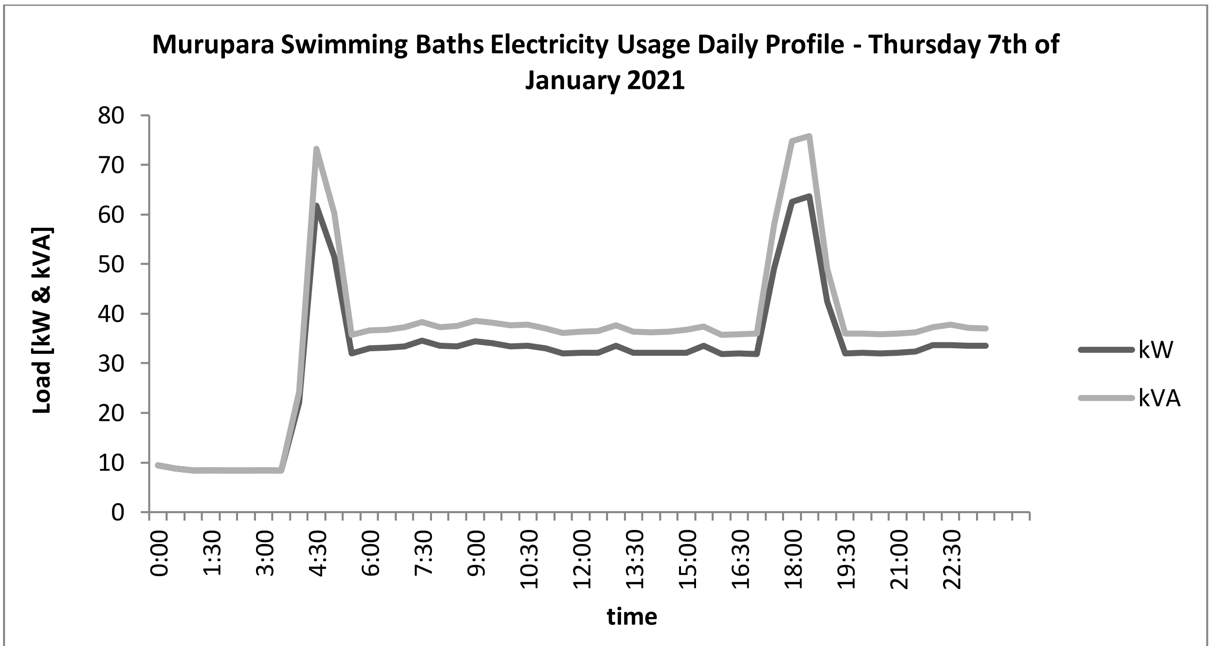


Figure 6-6 - On-season daily electricity profile for Thursday the 7th of January 2021.

Shown below in Figure 6-7 is the daily electricity usage profile for Saturday the 5th of June 2021, this day was arbitrarily selected to represent a typical off-season electricity use profile. Electrical load was zero for much of the day, aside from four periods of 1-2 kW demand. This is lower than the summer peak because the pools are not operating in winter months. The minimum load was 0 kVA which occurred several times through the day.

Also shown in Figure 6-7 is the kW load, the discrepancy between the kW load and kVA load indicates the power factor is less than 1. The power factor for the period below was 1.00 for the entire day.

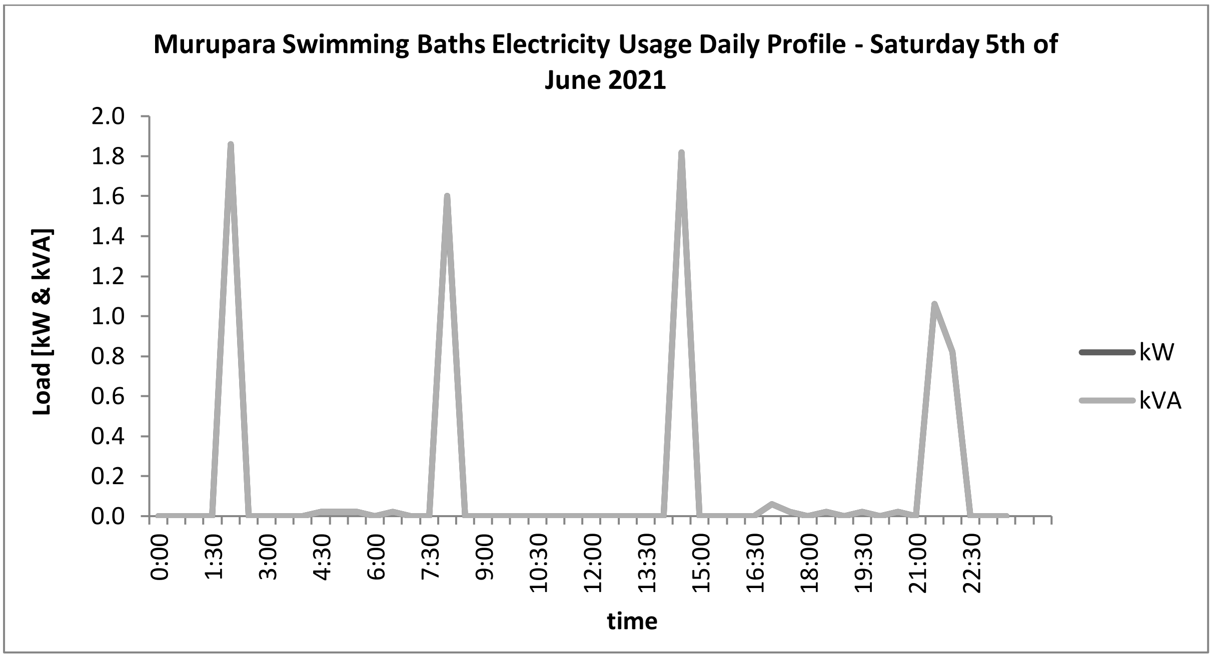


Figure 6-7 – Off-season daily electricity usage profile for Saturday the 5th June 2021.

6.2.2.2 Whakatane Oxidation Ponds

The Oxidation Ponds' electricity use over a single working day is shown below in Figure 6-6 for the TOU account only; Monday the 15th of February 2021 was arbitrarily selected to represent a typical summer day's electricity use. The graph was generated using half hour time of use (TOU) data supplied by Mercury.

The graph shows a peak load of 49.7 kVA, which occurred at 01:00 hours. The electricity load was at its minimum of 34.7 kVA at 16:30 hours. The electrical load is steady through the morning until demand decreases at 10:30, by 11:30 demand is steady for the rest of the day at approximately 35 kVA.

There is a large difference between the kW load and kVA load throughout the day. This indicates that there is an opportunity to improve the power factor during this period (refer to Section 8.6 for further details). The power factor varied from 0.72 to 0.75 throughout the day and was 0.73 at peak load. Power factor should generally be kept at 0.95 or greater.

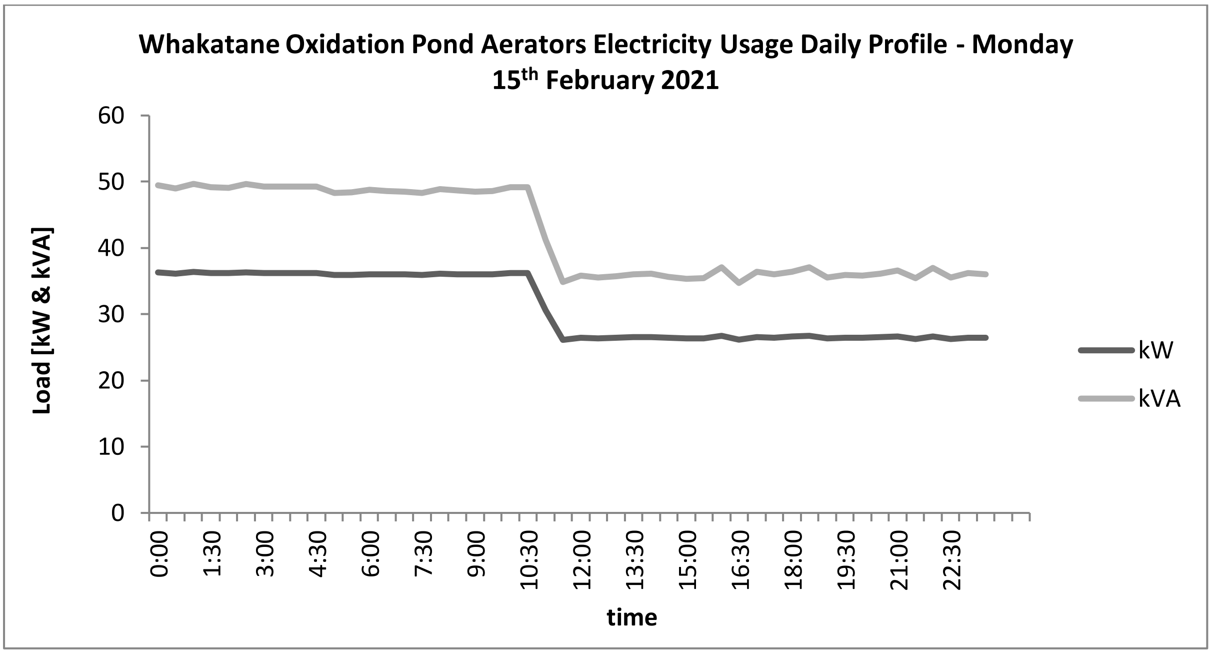


Figure 6-8 - Daily electricity profile for Monday the 15th of February 2021.

Shown below in Figure 6-7 is the daily electricity usage profile for Thursday the 17th of July 2020, this day was arbitrarily selected to represent a typical winter electricity use profile. Electrical load was steady through the day, averaging 50.6 kVA. The peak load was 53.6 kVA, which occurred at 05:30. The minimum load was 47.9 kVA which occurred at 17:00.

Power factor ranged between 0.71 and 0.75 throughout the day and was 0.72 at peak load.

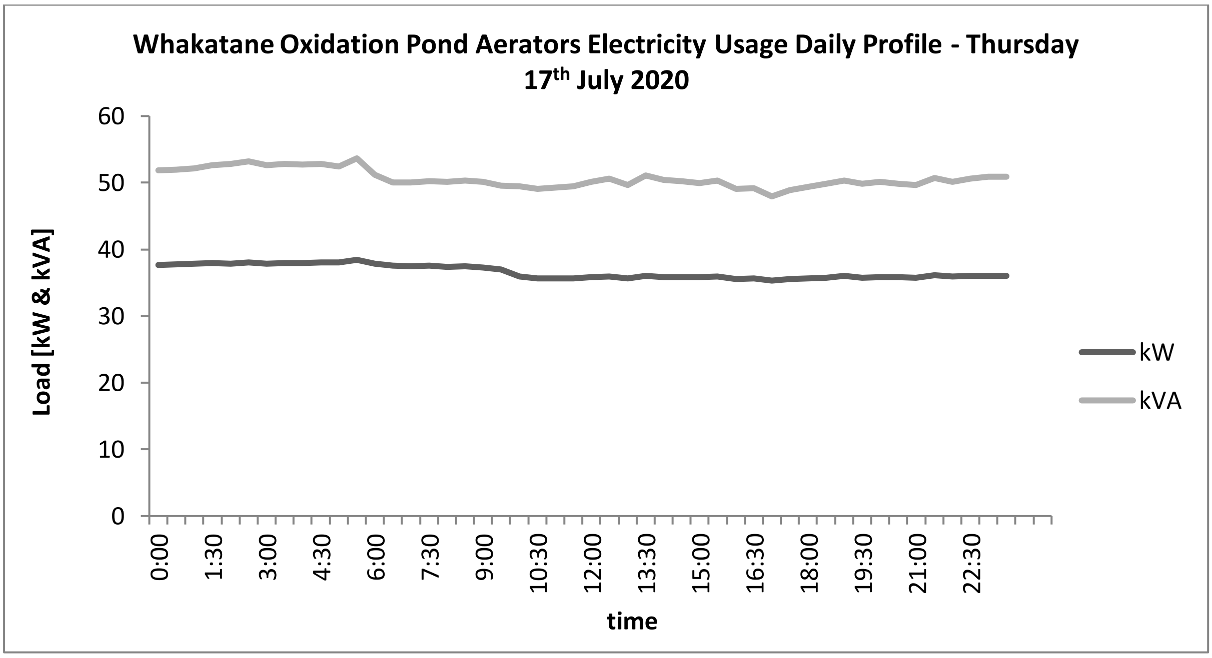


Figure 6-9 – Daily electricity usage profile for Thursday the 17th July 2020.

6.2.2.3 Whakatane Oxidation Ponds (NHH account)

The Oxidation Ponds' electricity use over a single production day is shown below in Figure 6-10; Monday the 15th of February 2021 was arbitrarily selected to represent a typical summer day's electricity use. The graph was generated using smart meter readings for the NHH account, data supplied by Genesis.

The graph shows a peak load of 40.2 kW, which occurred at 23:00 hours. The electricity load was at its minimum of 0.2 kW until 14:00 hours. The electrical demand is stepped, rising two times during the day.

As the TOU data was derived from smart meter readings only kW readings were recorded, there is no data on power factor.

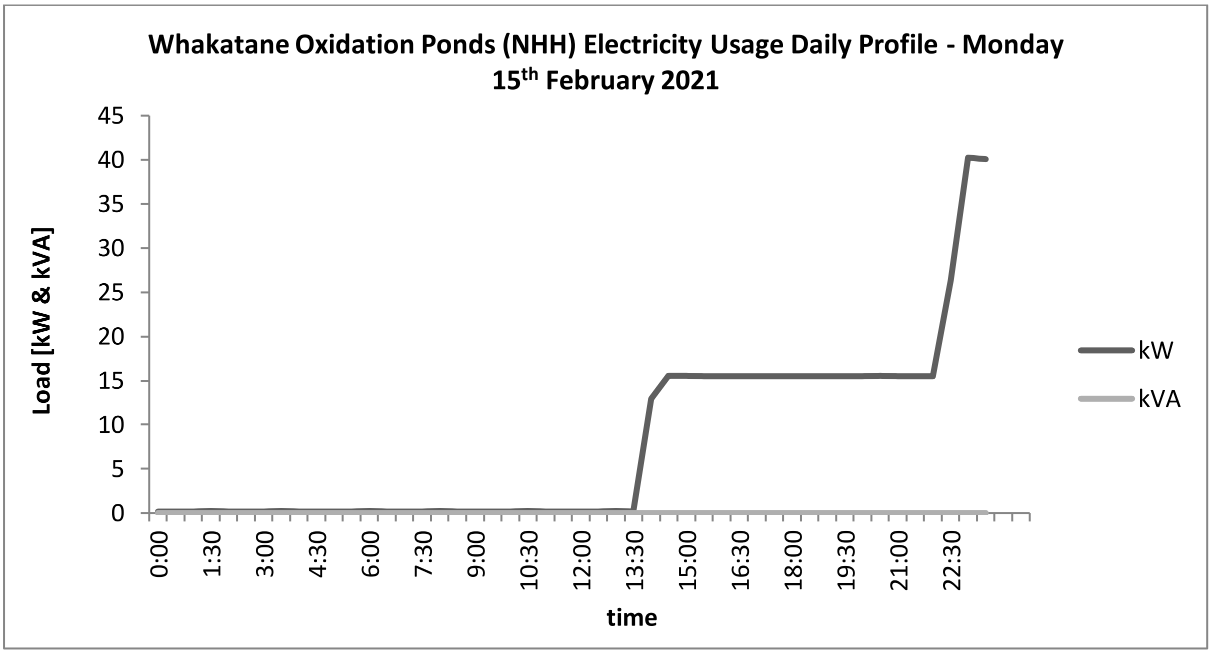


Figure 6-10 - On-season daily electricity profile for Monday the 15th February 2021.

Shown below in Figure 6-11 is the daily electricity usage profile for Friday the 24th of July 2020, this day was arbitrarily selected to represent a typical winter electricity use profile. Electrical load was lowest for the hour 15:30 to 16:30 and remained elevated for most of the day at approximately 40 kW. The peak load was 42 kW, which occurred at 12:30. The minimum load was 0 kW which occurred at 15:30. The pattern of electricity use operates between three modes, approximately 0 kW, 15 kW, and 40 kW.

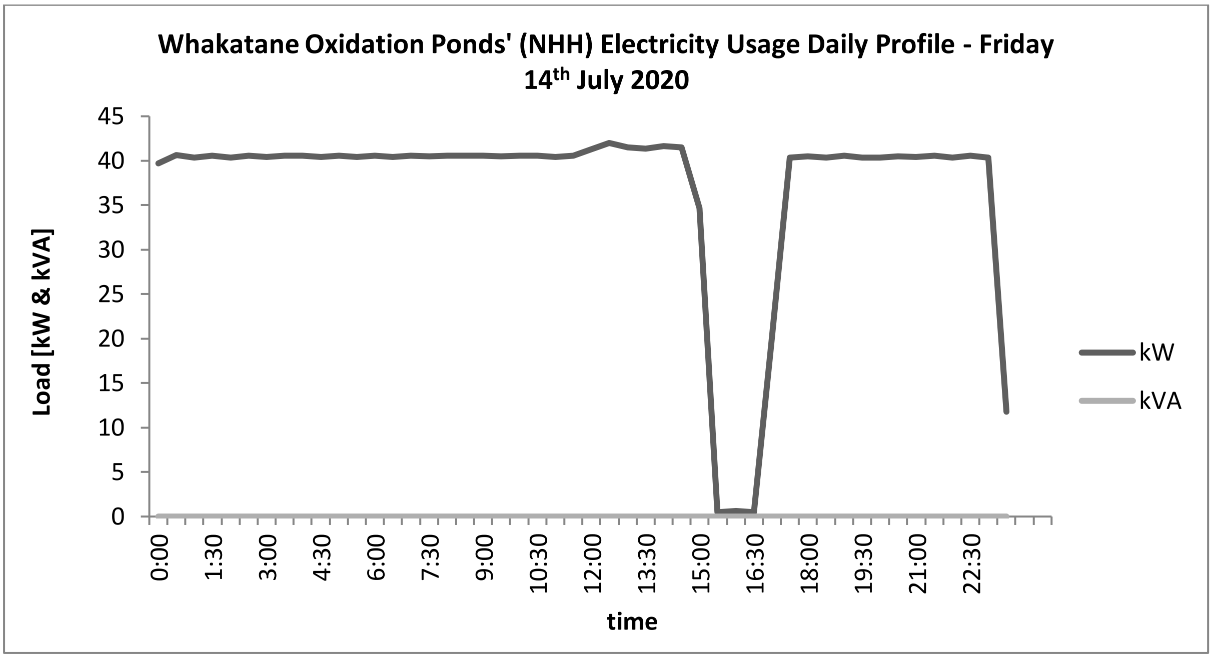


Figure 6-11 – Winter daily electricity usage profile for Friday the 14th July 2020.

6.2.2.4 Ohope Oxidation Ponds

The Oxidation Ponds' electricity use over a single production day is shown below in Figure 6-12; Monday the 25th of October 2021 was arbitrarily selected to represent a typical day's electricity use. The graph was generated using smart meter readings for the NHH account, data supplied by Genesis.

The graph shows a peak load of 45.3 kW, which occurred at 15:30 hours. The electricity load was at its minimum of 0.6 kW at 01:00 hours. The electrical operates in three modes, <1kW, approximately 16.5 kW, and 45 kW. Demand for each half hour depends on how often each of these modes was active.

As the TOU data was derived from smart meter readings only kW readings were recorded, there is no data on power factor. For Ohope Oxidation Ponds, smart meter readings are only available from 6 - 31 October 2021.

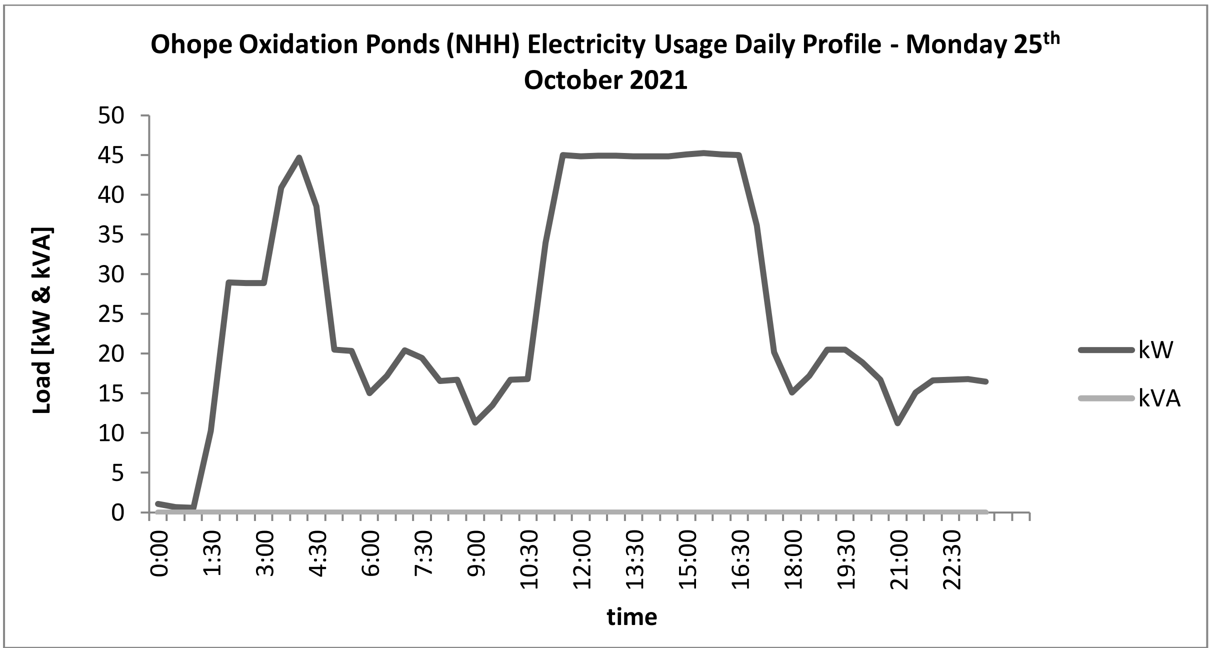


Figure 6-12 - Daily electricity profile for Monday the 25th October 2021.

6.2.3 Weekly Load Profiles

6.2.3.1 Murupara Swimming Baths

Figure 6-13 shows the on-season weekly electricity profile for the week starting Monday the 4th of January 2021. The graph shows that the week's peak load of 76.5 kVA occurred at 7:00 hours on Tuesday the 5th. The minimum observed load during the period was 7.7 kVA, this occurred on Friday at 12:30 hours.

Peak load occurs at irregular times of the day, but more frequently around opening and closing times, 6:00, 10:00, and 18:00. Opening times may require more pool heating, as ambient temperature is lower. The load profile for each day typically varies between 37 kVA and 72 kVA with an irregular pattern.

The average power factor for the period was 0.90, while the range was 0.84 to 1.00. It can be seen from the graph that the power factor tended to drop the most during high load periods, as shown by the difference between the kVA load and corresponding kW load.

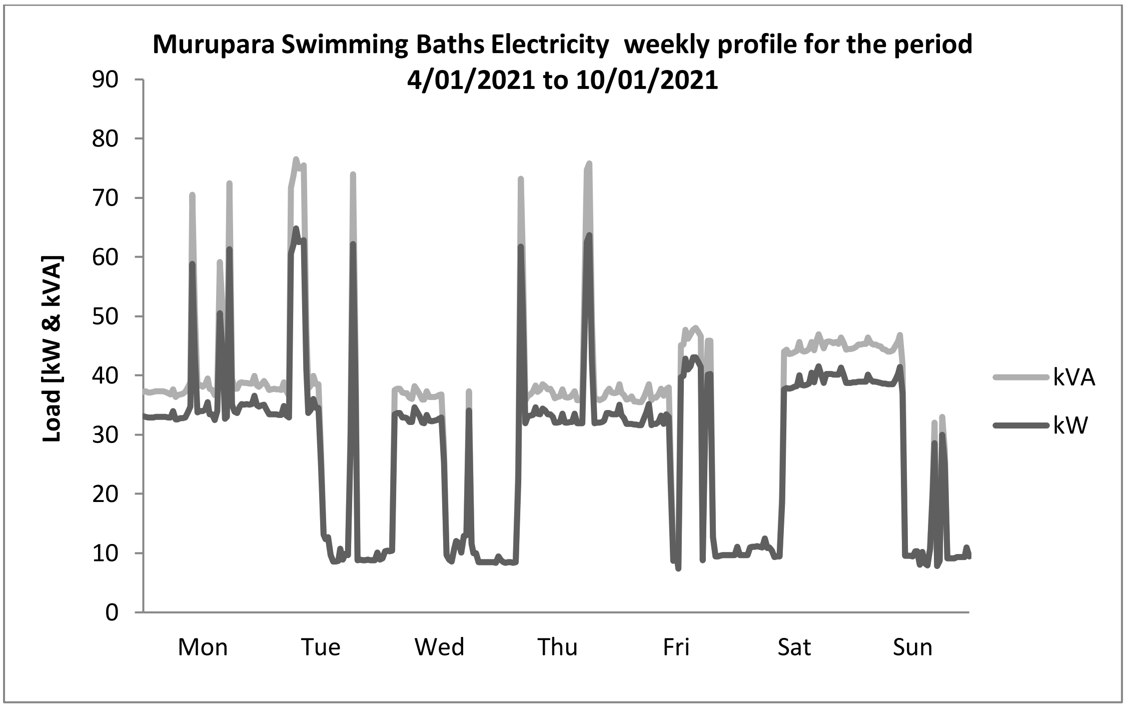


Figure 6-13 - Summer weekly electricity usage profile

Below in Figure 6-14 is the off-season electricity profile for the week starting Monday the 20th of June 2021. The graph shows that the week's peak load of approximately 2 kVA occurred several times during the week, at regular intervals, approximately 7 hours apart. Following the peaks, demand dropped to zero for approximately 7 hours.

The power factor during the sample week in the off-peak season stayed at 1.00 for the entire week.

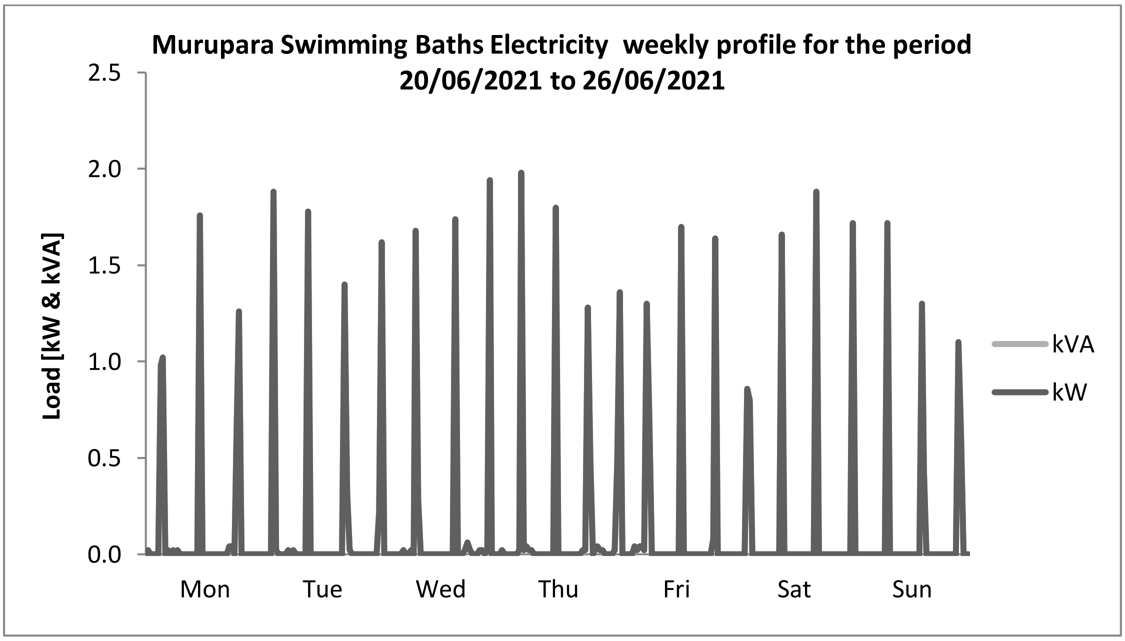


Figure 6-14 – Winter weekly electricity usage profile

6.2.3.2 Whakatane Oxidation Ponds

Figure 6-15 shows the summer weekly electricity profile for the week starting Monday the 15th of February 2021. Electricity use is for the TOU account (aerators) only. The graph shows that the week's peak load of 51.4 kVA occurred at 19:30 hours on Sunday the 21st. The minimum observed load during the period was 33 kVA, this occurred on Wednesday at 16:00 hours.

There are predominantly two modes of energy use during the week: high demand approaching 50 kVA and lower demand at approximately 35 kVA. High demand periods are from Friday through to Monday morning. Higher demand may be attributed to an influx of population over weekends.

The average power factor for the period was 0.74, while the range was 0.71 to 0.77.

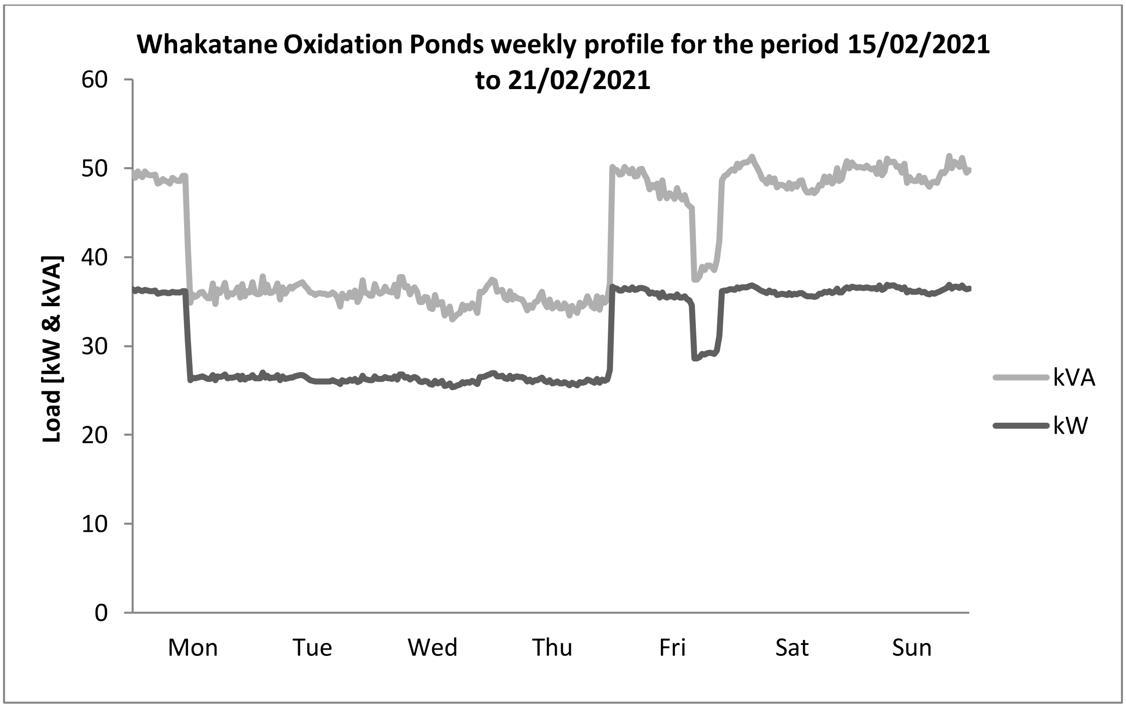


Figure 6-15 - Summer weekly electricity usage profile

Below in Figure 6-16 is the off-season electricity profile for the week starting Monday the 13th of July 2020. The graph shows that the week's peak load of 54.6 kVA occurred at about 01:30 hours on Monday the 13th, while the minimum load of 34.7 kVA occurred at 15:30 hours on Wednesday.

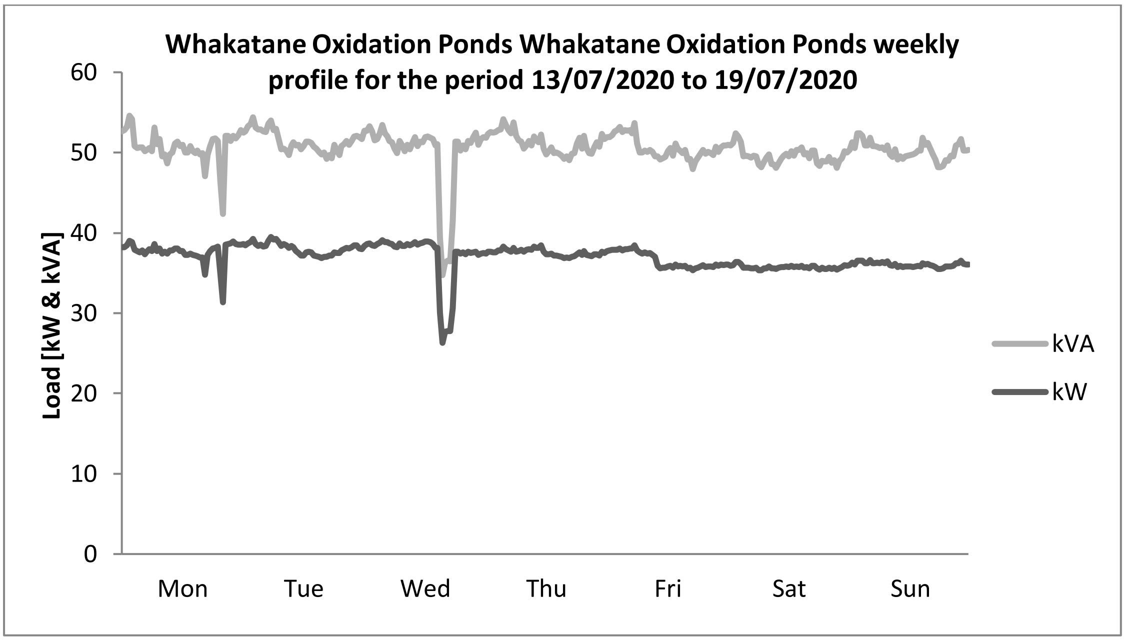


Figure 6-16 –Whakatane Oxidation Ponds off-season weekly electricity usage profile

6.2.3.3 Whakatane Oxidation Ponds (NHH)

Figure 6-17 shows the on-season weekly electricity profile for the week starting Monday the 15 of February 2020. The graph shows that the week's peak load of 40.5 kW occurred at 0:30 hours on Tuesday the 16th. The minimum observed load during the period was 0.2 kW, this occurred for 16 hours from 11:30 on Thursday and for 23 hours from Saturday at 19:00.

Demand alternates between three modes at approximately 0.2 kW, 15.4 kW and 40 kW. The pattern of electricity use is independent from days of the week. As the TOU data was derived from smart meter readings only kW readings were recorded, there is no data on power factor.

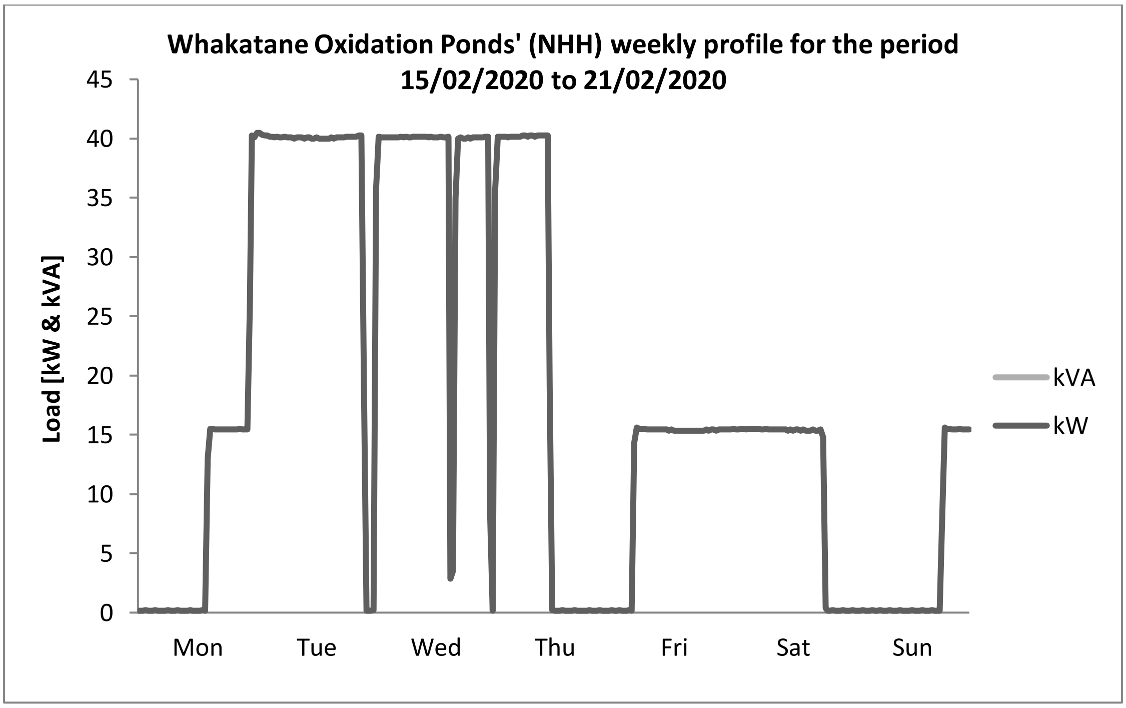


Figure 6-17 – Whakatane Oxidation Ponds' NHH summer weekly electricity usage profile

Below in Figure 6-18 is the off-season electricity profile for the week starting Monday the 15th of July 2020. The graph shows that the week's peak load of 41.2 kW occurred at about 11:30 hours on Sunday the 21st, while the minimum load of 0.2 kW occurred for much of Friday and Saturday. The electricity use profile follows a recurring pattern of high and low load levels, similar to the summer period but the frequency at which these switch is lower.

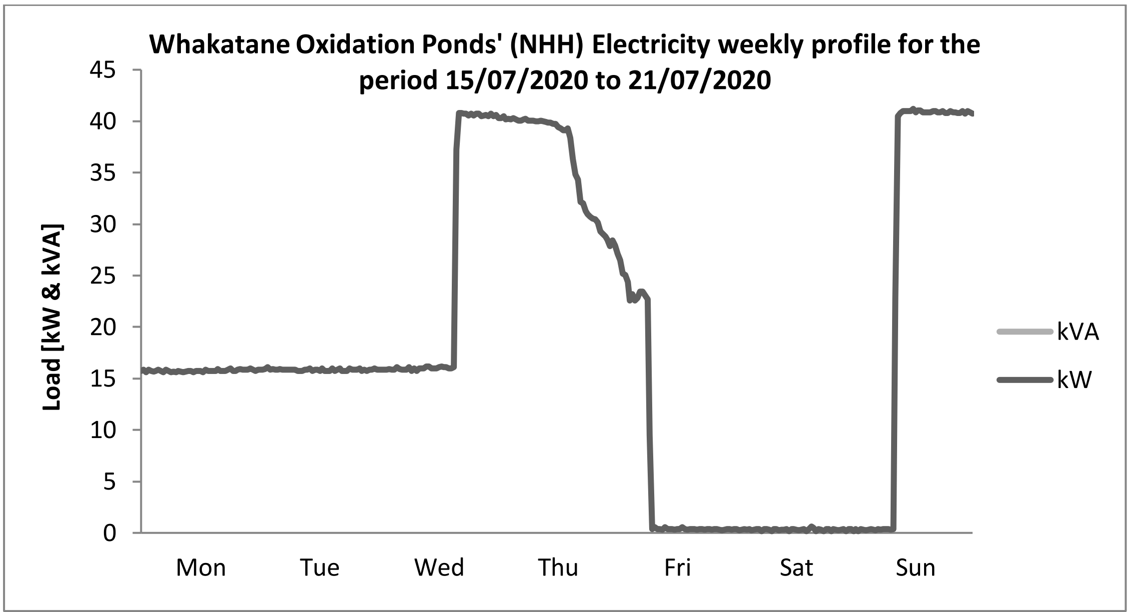


Figure 6-18 – Whakatane Oxidation Ponds' NHH winter weekly electricity usage profile

6.2.3.4 Ohope Oxidation Ponds

Figure 6-19 shows the weekly electricity profile for the week starting Monday the 25 of October 2021. The graph shows that the week's peak load of 46.3 kW occurred at 16:00 hours on Tuesday the 26th. The minimum observed load during the period was 0.5 kW, this occurred at 01:30 hours on Tuesday.

Demand alternates between three modes at approximately 0.5 kW, 16.5 kW and 45 kW. Electricity use increases from Friday afternoon and continues through to Sunday night. As the TOU data was derived from smart meter readings, only kW readings were recorded. There is no data on power factor. For Ohope Oxidation Ponds, smart meter readings are only available from 6 - 31 October 2021.

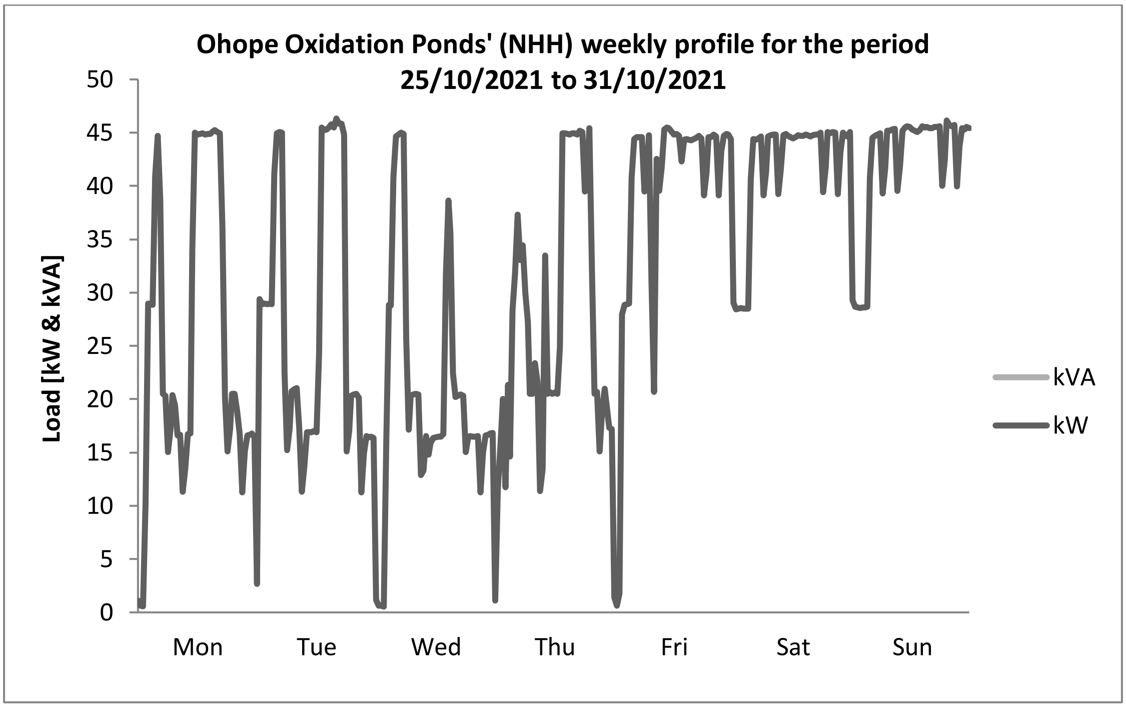


Figure 6-19 – Ohope Oxidation Ponds' NHH weekly electricity usage profile

6.2.4 Load Distribution

6.2.4.1 Whakatane Oxidation Ponds

The Whakatane Oxidation Ponds have two accounts, one TOU and one NHH. The TOU account type is N3R and the NHH account type is NMD, refer to section 8.3 for a description of account types. Only the NMD (NHH) account is charged based on maximum demand.

The frequency load distribution curve shown in Figure 6-20 illustrates the number of hours per year that a given load or greater occurs for the Whakatane Oxidation Ponds' NMD account. The load duration curve shows three primary modes of operation at approximately 40 kW, 15 kW, and <1 kW. The relatively small 'tail' on the left of the curve indicates that there is little opportunity to improve load control.

The importance of controlling peak loads and the potential cost savings associated with controlling peak loads are discussed further in Section 8.5.

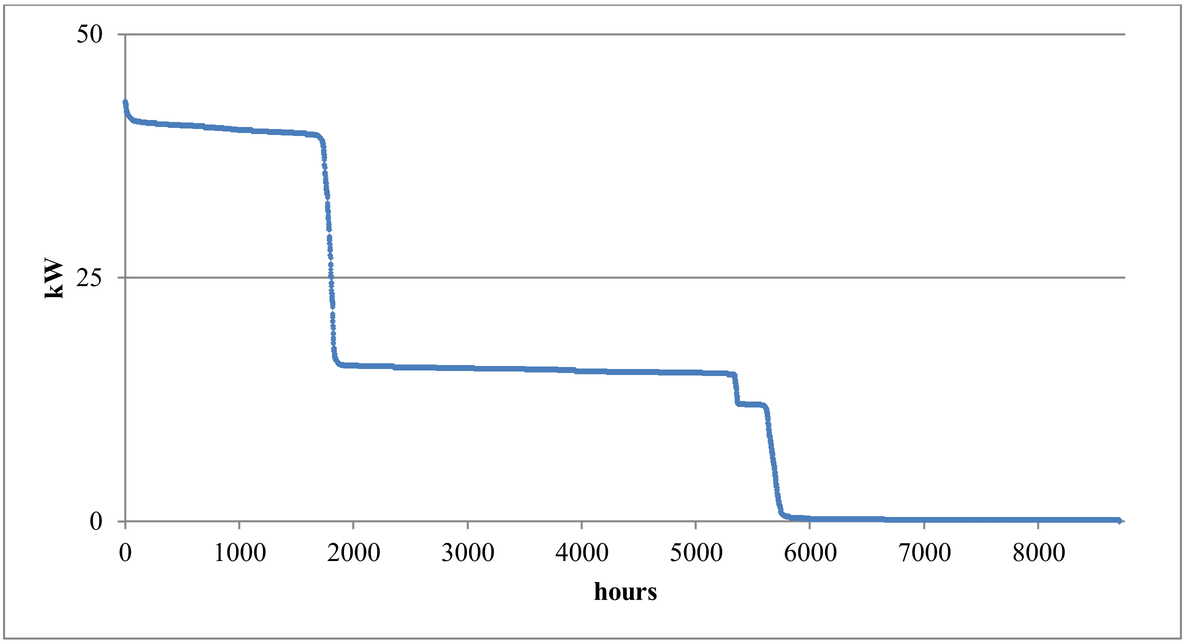


Figure 6-20 – Whakatane Oxidation Ponds annual electricity frequency distribution July 2020 to June 2021

6.2.4.2 Murupara Swimming Baths

The frequency load distribution curve shown in Figure 6-21 illustrates the number of hours per year that a given load or greater occurs at the Murupara Swimming Baths.

Loads at the swimming baths varied between 79 kVA and 9 kVA during normal operations when the pool was open. Unlike typical office buildings, there is not a clear bimodal distribution between operating hours and after hours use. This indicates that equipment, such as circulation pumps, are on while the pool is not in use. Ideally, pumps could be slowed down outside of regular hours to save on electricity.

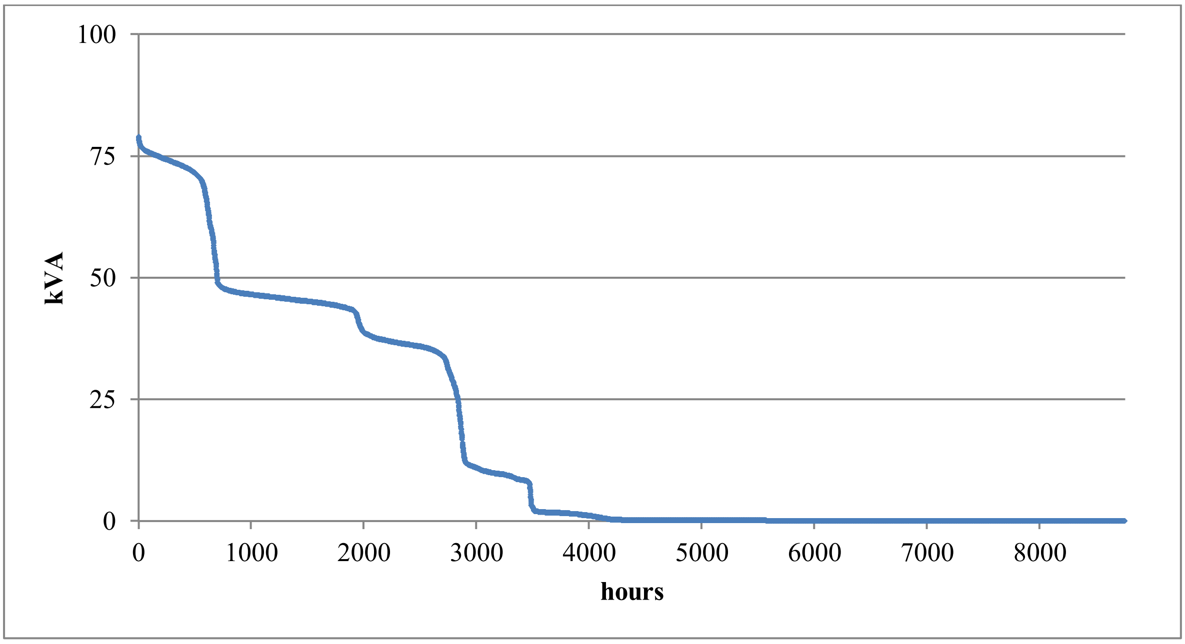


Figure 6-21 – Murupara Swimming Baths annual electricity frequency distribution July 2020 to June 2021

6.3 Natural Gas and LPG

6.3.1 Monthly Consumption

Whakatāne District Council's natural gas consumption for the year ending June 2021 was 554,305 kWh, less than half of the consumption compared to the audit in 2018. The Council's LPG consumption for the year ending June 2021 was 104,075 kWh. During this period natural gas was supplied by Genesis Energy to the Whakatāne District Council and LPG was supplied by Rockgas. There are five active accounts with natural gas use and one account with LPG use as shown in Table 6-2 and Table 6-3. The Aquatic Centre uses 69% of the Council's gas use while the three other accounts range between 0% and 13% of use.

Table 6-2 Natural gas use at WDC from Jul 2020 to June 2021

Location/Account	Consumption (kWh/year)	Total Charge (excl GST)	Gross Cost (c/kWh)
Aquatic Centre gas, Russell Street, Whakatane east, Whakatane	382,661	$24,168.45	6.3
55 Boon Street, Whakatane	73,130	$5,514.89	7.5
Whakatane library gas account, 49 Kakahoroa drive, Whakatane	66,451	$4,419.97	6.7
gas War Memorial Hall whk, short street, Whakatane east, Whakatane	31,272	$4,849.79	15.5
2/2 the Strand, Whakatane north, Whakatane	791	$532.06	67.3
Total	**554,305**	**$39,485**	**7.1**

Table 6-3 LPG use at WDC from Jul 2020 to June 2021

Location/Account	Consumption (kWh/year)	Total Charge (excl GST)	Gross Cost (c/kWh)
Whakatane Holiday Park	104,075	$17,259	16.6

Table 6-4 below shows the variable and fixed gas costs associated with these five accounts. Daily fixed charges range between 240 cents/day at 2/2 The Strand to 1,120 cents/day at the Aquatic Centre and War Memorial Hall. Charges range from 4.258 cents/kWh at 2/2 The Strand to 7.32 cents/kWh at the Whakatāne District Council Library. Variable charges represent the marginal cost of one more kWh of gas used or saved. This marginal cost is therefore what is used for energy saving calculations, except when a saving is significant enough to be able to change to a different daily fixed cost. Fixed costs are associated with the capacity of supply needed.

Table 6-4 Natural gas variable and fixed cost components

Location/Account	Variable Gas Cost (Cents/kWh)	Fixed Gas Cost (Cents/day)
AQUATIC CENTRE GAS, RUSSELL STREET, WHAKATANE EAST, WHAKATANE	7.14	1120
55 BOON STREET, WHAKATANE	7.32	240

WHAKATANE LIBRARY GAS ACCOUNT, 49 KAKAHOROA DRIVE, WHAKATANE	7.32	240
GAS WAR MEMORIAL HALL WHK, SHORT STREET, WHAKATANE EAST, WHAKATANE	7.14	1120
2/2 THE STRAND, WHAKATANE NORTH, WHAKATANE	4.258	188.45

Figure 6-22 below shows average daily gas use at the War Memorial Hall for each month in the period from July 2020 to June 2021, as well as average 9am ambient temperature for the same months. Average daily gas data is used because time of use data is not available and the length of time between meter readings varied between 20 day and 38 days.

Natural gas is used primarily as heating. April 2021 had the highest average daily natural gas consumption.

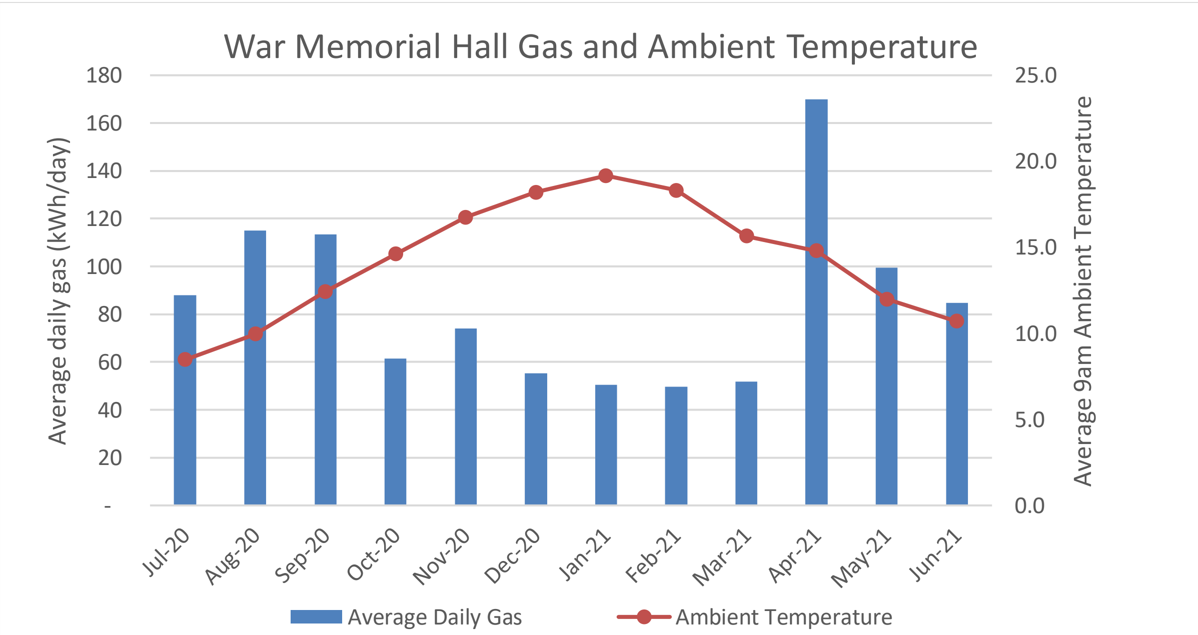


Figure 6-22 War Memorial Hall average daily gas use and average ambient temperature for July 2020 to June 2021

Figure 6-23 below shows monthly gas use for the Whakatāne District Council's account at 2/2 The Strand. This is a small gas account with just 791 kWh used for the year and costing $532. This account has a high gross cost for gas at 68 c/kWh, due to fixed monthly costs making up a high proportion of the invoiced amount. **Approximately $380 could be saved each year by using bottled LPG instead**, or using an alternative for gas-using appliances.

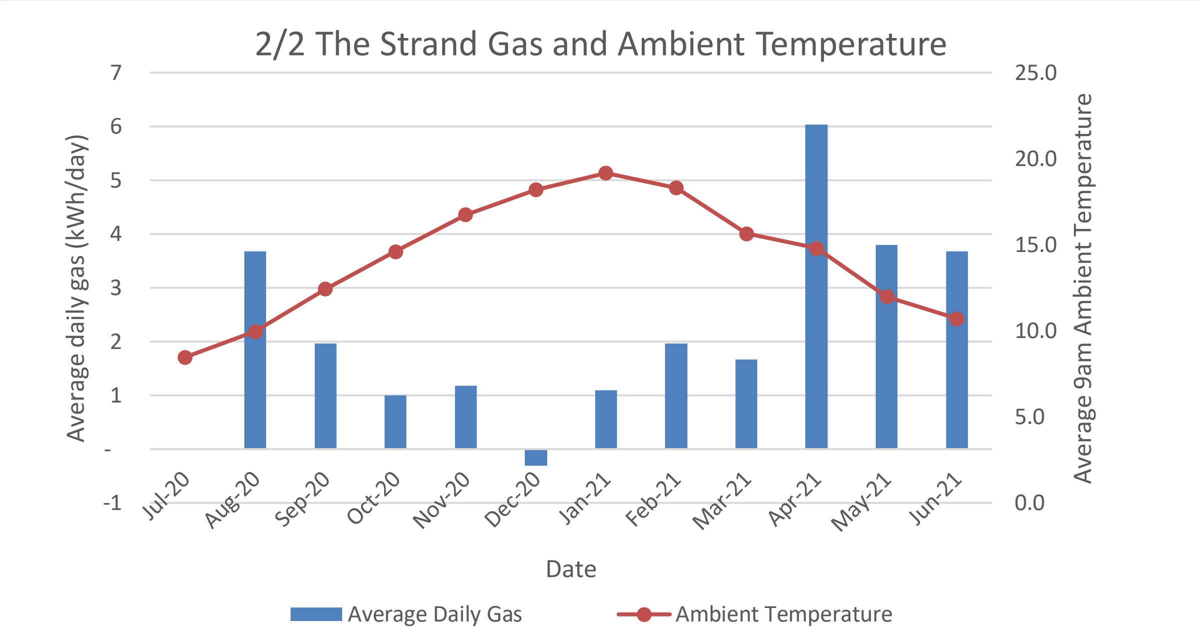


Figure 6-23 Monthly gas use at 2/2 The Strand from July 2020 to June 2021

6.4 Energy Use Index

The energy use index (EUI) is a measure of how energy efficient a building or site is relative to a particular metric. The EUI is calculated by dividing the energy use for a particular building or site by the chosen metric over a fixed period of time. When compared to results of other similar buildings or sites, the EUI provides an indication of how it is performing in terms of energy use for its particular metric. The metric used varies depending on the site and the nature of its activities. For Office buildings the metric used is usually net lettable area in m^2.

6.4.1 Holiday Park

The Holiday Park's EUI for the year ended June 2021 was 15 $kWh/m^2/year$. This EUI is electricity and LPG, as both are used at the Holiday Park. The Whakatane Holiday Park uses more electricity than usual, in Emsol's experience a large holiday park typically uses 10.5 $kWh/m^2/yr$ and a small holiday park uses 8.6 $kWh/m^2/yr$. However, the Whakatane holiday park does have a small pool, which will require extra electricity for pumps and motors.

It is important that energy use is monitored regularly and targets set, to determine both why energy use has changed over time and to ensure consistency whilst collecting data. While EUIs above provide useful indicators of performance, a properly designed and implemented monitoring and targeting solution can result in improved energy efficiency performance over time.

6.4.1.1 Electricity EUI Analysis

Shown below in Figure 6-24 is a comparison of monthly electricity energy use and heating degree days (HDD) for the Holiday Park. Heating degree days are a measure of the demand for heating and are relative to a reference temperature. In this case 16°C has been used; this means a day where the average temperature was 15°C had one heating degree day of heating demand.

The plotted data points show the raw data, while the linear trend line represents a 'line of best fit', showing the trend of the data. The equation of the trend line; y=40.363x + 12,738 informs the reader that:

- The Holiday Park's variable component of electricity use is 40.4 kWh/HDD
- The electricity base load at the site is 12,738 kWh/month

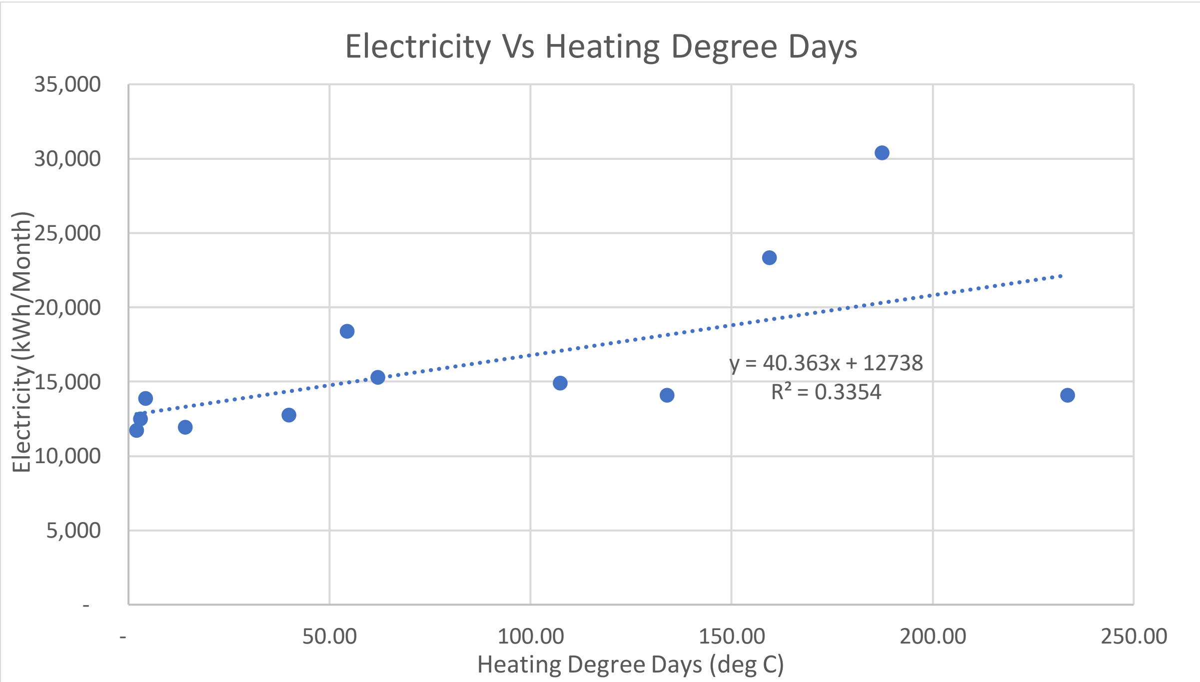


Figure 6-24 – Monthly electricity use versus heating degree days for the Holiday Park, year to June 2021

The trend line has an R^2 correlation of 0.3354, this means that 33.54% of the variation in the electricity use at the Holiday Park can be attributed to changes in heating degree days. The low correlation indicates that heating degree days is not the only factor for fluctuations in electricity use. For instance, another factor could be the number of guests that stay.

The baseload is illustrated by the point where the line of best fit intercepts the vertical axis of the graph. Baseload refers to the monthly energy usage that is not attributable to the level of heating required, and therefore represents the current minimum level of energy consumption. Electricity use not associated with heating the building contributes to this baseload, e.g., computers, lighting, appliances etc. The Holiday Park's monthly electricity baseload of 12,738 kWh represents a monthly cost of approximately $2,458[ii].

6.4.2 Murupara Swimming Baths

The Murupara Swimming Baths' EUI for the year ending July 2021 was 2.6 GJ/m^2/year[iii]; here the m^2 refers to square meters of pool area. The Murupara Swimming Baths has one 33-metre-long pool and a toddler pool. Both pools are outdoors, and total surface area is approximately 456m^2. This EUI is for electricity only. Table 6-5 below compares the EUI at the Murupara Swimming Baths with the Whakatane Aquatic Centre, as well as with a benchmark from EECA's energy efficiency guide for swimming pools.

Table 6-5 –EUI data for the Murupara Swimming Baths compared to benchmarks

Site	**EUI** [kWh/m^2/year]	**EUI** [GJ/m^2/year]	**Indoor/outdoor pool**
Murupara Swimming Baths	733	2.6	Outdoor
Whakatāne District Council Aquatic Centre	3,976	14.3	Indoor and outdoor
Benchmark for indoor pools and facilities in New Zealand	2,550	9.2	indoor

This shows that the Murupara Swimming Baths' EUI is better than the New Zealand benchmark for indoor pools and the WDC Aquatic Centre. The Aquatic Centre has an outdoor pool and indoor pools, which differs from the benchmark, the annual EUI uses the average pool surface area in use throughout the year.

Another major factor contributing to the difference is the fact that the Murupara Swimming Baths are only open for approximately four months, and these four months are the warmest of the year.

According to the International Centre for Energy and Environmental Technology (IECU), indoor pools consume approximately three times more energy than an outdoor pool of the same size. One contributing factor is that indoor pools often spend 50% of their energy for space heating and dehumidifying air.

Figure 6-25 below shows energy use indices for indoor pools with different heating technologies. This shows heat pump systems use between 3GJ/m^2/year and 8GJ/m^2/year, whereas gas boiler systems use between 10GJ/m^2/year and 15GJ/m^2/year. The Murupara Swimming Baths use heat pump technology, which is highly efficient.

Opportunities for energy savings at the Murupara Swimming Baths are in Section 9.1.

[ii] Based on a gross electricity cost of 19.3 c/kWh
[iii] Pro-rated figure as the Murupara pools are only open in warmer months.

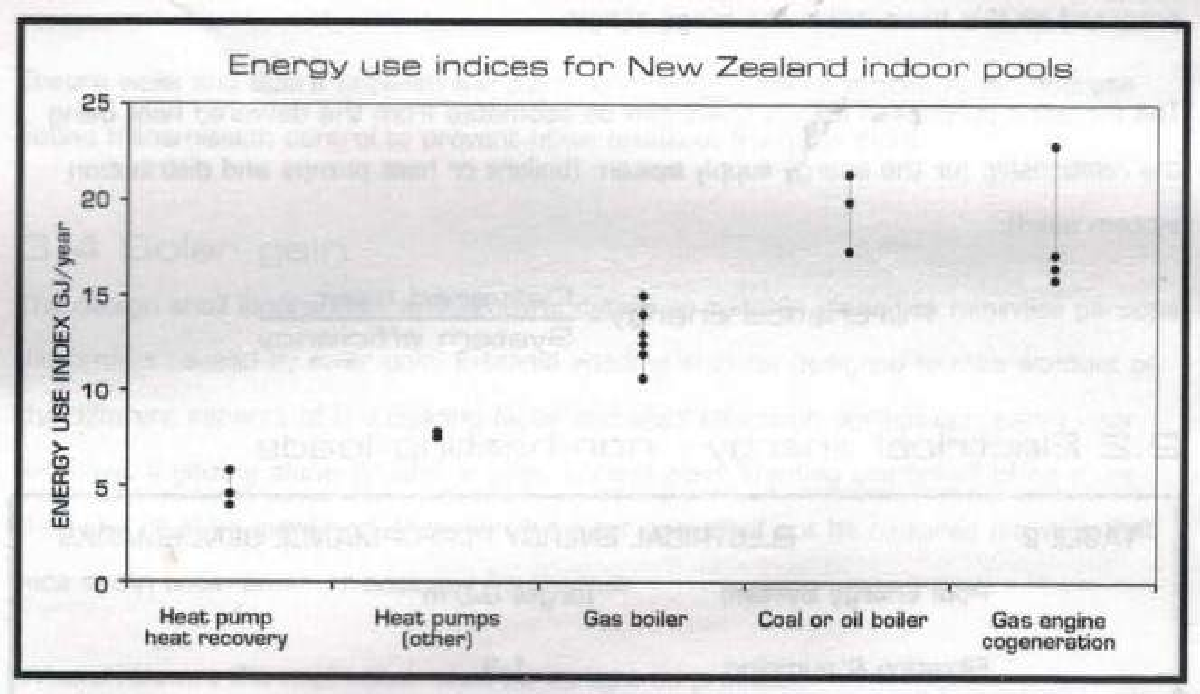


Figure 6-25 - Benchmark energy use for indoor swimming pools

6.4.2.1 *Electricity EUI Analysis*

Shown below in Figure 6-26 is a comparison of average daily temperature and electricity use for the Murupara Swimming Baths.

The plotted data points show the raw data, while the linear trend line represents a 'line of best fit', showing the trend of the data. This has been split into two parts as the energy pattern is different depending on if the pools are open or not. The pool is generally in use from October to March.

The equation of the blue trend line for when the outdoor pool is in use; y=-10.932x + 990.38 informs the reader that:

- The Murupara Swimming Baths variable component of energy use is -10.932 kWh/°C. For every degree C that the average daily temperature increases, the pool will use approximately 11 kWh less.
- The energy base load at the site is 990.38 kWh/day

The equation of the orange trend line for when the pool is not in use; y=-0.0995x + 3.72 informs the reader that:

- The Murupara Swimming Baths variable component of energy use is approximately 0.1 kWh/°C.
- The trend line suggests the energy base load at the site is 3.72 kWh/day

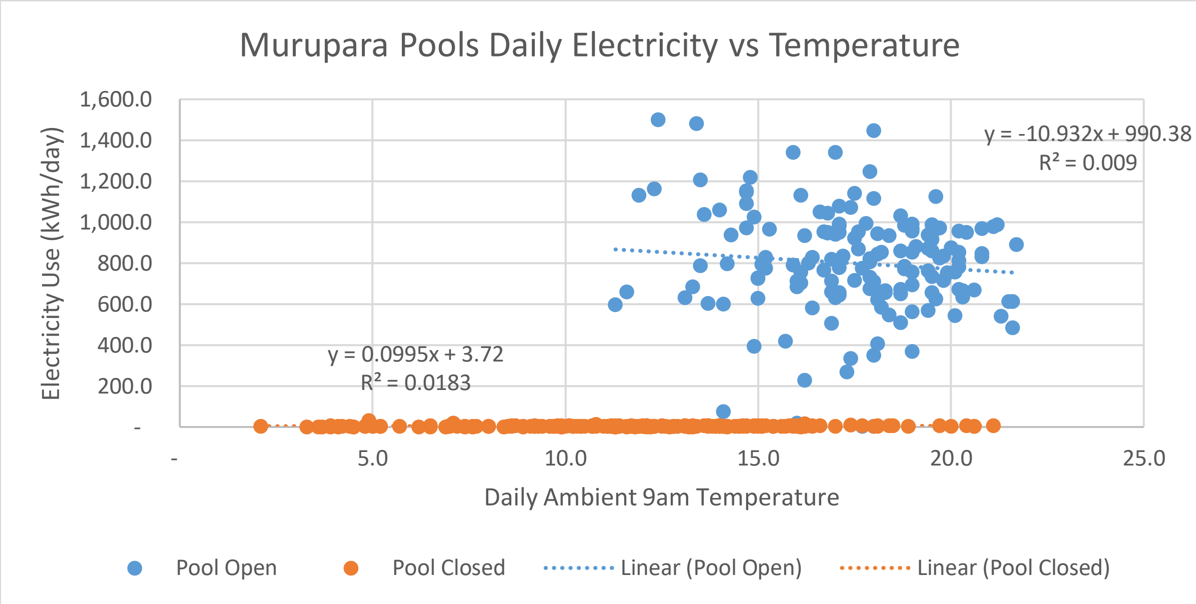


Figure 6-26 – Monthly total electricity use versus heating degree days for the Murupara Swimming Baths, year to June 2021

The trend line when the outdoor pool is in use has an R^2 correlation of 0.009, this means that there is very little correlation of the variation in the energy use at the and average ambient temperature. The high baseload and relatively small variable load results in a flat trend line relative to ambient temperature, which decreases the correlation between the two variables. This means the demand for heating has only a small influence on electricity used, which indicates potentially poor process control.

The trend line indicates that when the outdoor pool is in use, warmer days use less electricity on average. A day with ambient temperature of 22C would use approximately 750 kWh/day. Conversely, a cooler day with ambient temperature of 11C would use 870 kWh/day. This reiterates that while electricity use does vary with requirements for heating, other factors such as the strength of the sun throughout the day, and the amount of wind could also be responsible for influencing electricity use.

6.4.3 War Memorial Hall

The War Memorial Hall's EUI for the year ended June 2021 was 48 kWh/m²/year using net lettable area. This EUI is for electricity and gas, as both are used at the War Memorial Hall. Table 6-7 below compares the EUI at the hall with benchmarks for similar buildings.

Table 6-6 –Commercial building EUI benchmark data

Table 6-7 - EUIs for common building types

Building Type	Energy Use Index - (kWh/m² of NLA)		
	Low	Typical	High
Banks (electricity only)	130	230	330
Hospitals	200	440	600
Hotels (large)	180	330	670
Libraries	120	162	200
Offices (with HVAC)	200	280	400
Office (naturally ventilated)	100	210	300
Office(Tenant Electricity only)	60	150	200
Polytechnics	90	160	200

The War Memorial Hall's EUI (48 kWh/m^2/year) is lower than the Civic Centre's EUI (144 kWh/m^2/year). When compared to EUI benchmarks for buildings, the Whakatāne District Council's War Memorial Hall is low, this is because the building is occupied less frequently compared to polytechnics or offices. The majority of the building is heated by a gas boiler.

It is important that energy use is monitored regularly and targets set, to determine both why energy use changes over time and to ensure consistency whilst collecting data. Note that while the data shown above provides useful indicators of performance; a properly designed and implemented monitoring and targeting solution can result in improved energy efficiency performance over time. Refer to Sections 6.4.3.1 and 6.4.3.2 for models that could be used to monitor ongoing energy use.

6.4.3.1 Electricity EUI Analysis

Shown below in Figure 6-24 is a comparison of monthly electricity energy use and heating degree days (HDD) for the War Memorial Hall. Heating degree days are a measure of the demand for heating on a building and a relative to a reference temperature; in this case 16°C has been used.

The plotted data points show the raw data, while the linear trend line represents a 'line of best fit', showing the trend of the data. The equation of the trend line; y=19.965x + 4,999.4 informs the reader that:

- The War Memorial Hall's variable component of electricity use is 19.965 kWh/HDD
- The electricity base load at the site is 4,999 kWh/month

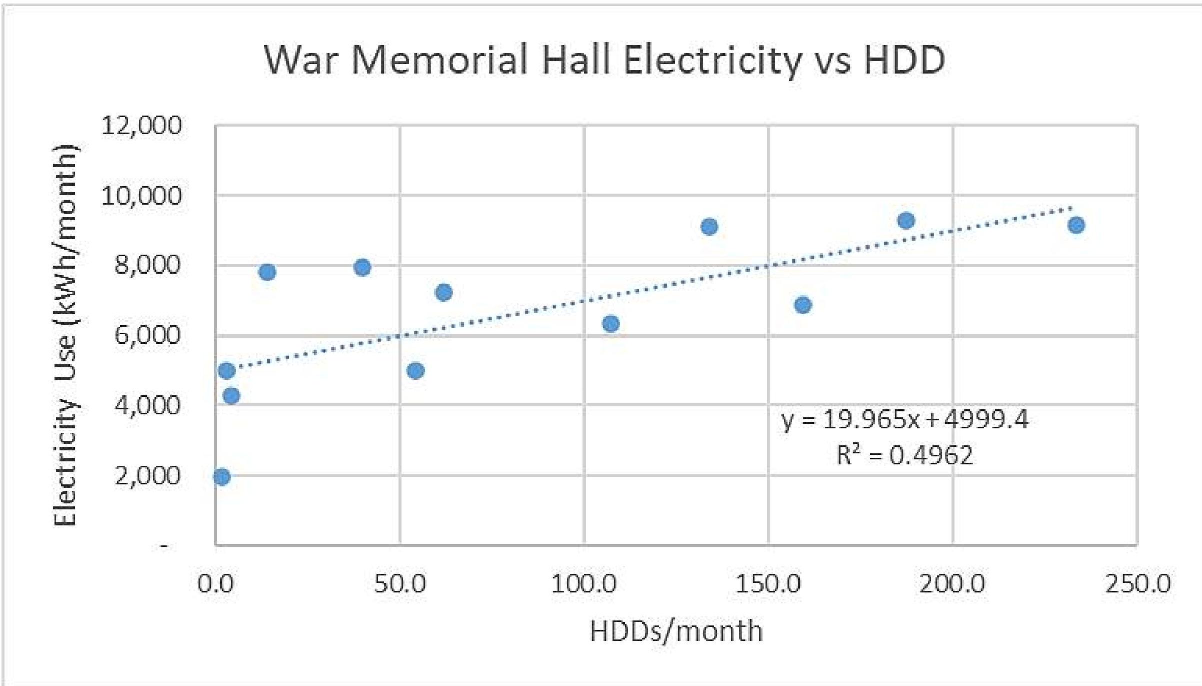


Figure 6-27 – Monthly electricity use versus heating degree days for the War Memorial Hall, year to June 2021

The trend line has an R^2 correlation of 0.4962, this means that 49.6% of the variation in the electricity use at the War Memorial Hall can be attributed to changes in heating degree days. This correlation is moderate and indicates that there are other factors that influence electricity use at the hall.

The baseload is illustrated by the point where the line of best fit intercepts the vertical axis of the graph. Baseload refers to the monthly energy usage that is not attributable to the level of heating required, and therefore represents the current minimum level of energy consumption. Electricity use not associated with heating the building contributes to this baseload, e.g., computers, lighting, and appliances. The War Memorial Hall's monthly electricity baseload of 4,999 kWh represents a monthly cost of approximately $935[iv].

[iv] At the War Memorial Hall's gross cost of electricity, 18.7 c/kWh

6.4.3.2 Thermal Energy EUI Analysis

Shown below in Figure 6-28 is a comparison of gas energy use and heating degree days for the War Memorial Hall. Plotted data points show raw data, while the linear trend line represents a 'line of best fit', showing the trend of the data. The equation of the trend line; y=6.413x + 2034.6 informs the reader that:

- The War Memorial Hall's variable component of gas energy use is 6.413 kWh/HDD
- The gas base load at the site is 2,034.6 kWh/month

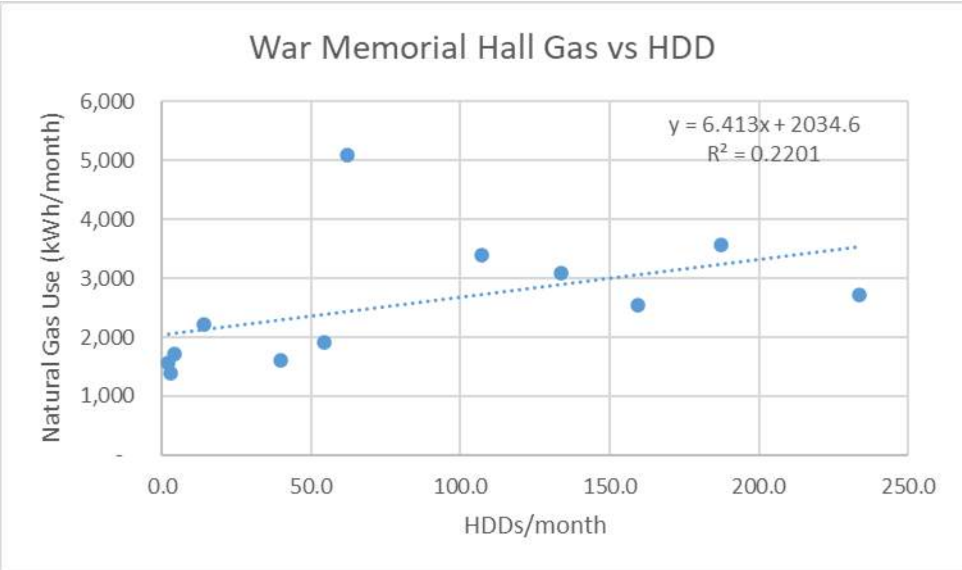


Figure 6-28 - Monthly electricity use versus heating degree days for the War Memorial Hall, year to June 2021

The trend line has a R^2 correlation of 0.2201, this means that 22% of the variation in the gas energy use at the War Memorial Hall can be attributed to changes in heating requirements. The correlation is low and indicates that factors other than ambient temperature influence gas use. An outlier exists in the data; however, usage was determined from actual meter readings and there is no reason to exclude the data point for the month of April 2021 (62 HDD, 5,100 kWh). Aside from unreliable gas use data, scatter in the data can also indicate poor heating control or additional factors such as occupancy influencing gas use. Accuracy of gas data can be improved by taking monthly readings of the meter at the end of each month.

The baseload is illustrated by the point where the line of best fit intercepts the vertical axis of the graph. Base load refers to the monthly energy usage that is not attributable to heating degree days, and therefore represents the current minimum level of energy consumption. The War Memorial Hall's monthly gas baseload of 2,034 kWh represents a monthly cost of approximately $145[v].

6.4.4 Whakatāne Oxidation Ponds

6.4.4.1 Electricity EUI Analysis

Shown below in Figure 6-29 is a comparison of monthly electricity use and effluent water volume for the Whakatāne Oxidation Ponds. Electricity is the combination of the ponds' two electricity accounts (NHH and TOU). The plotted data points show the raw data, while the linear trend line represents a 'line of best fit', showing the trend of the data.

The equation of the trend line; y=0.1198x + 26,657 informs the reader that:

- The Whakatāne Oxidation Ponds' variable component of electricity use is 0.1198 kWh/m^3
- The electricity baseload is 26,657 kWh/month.

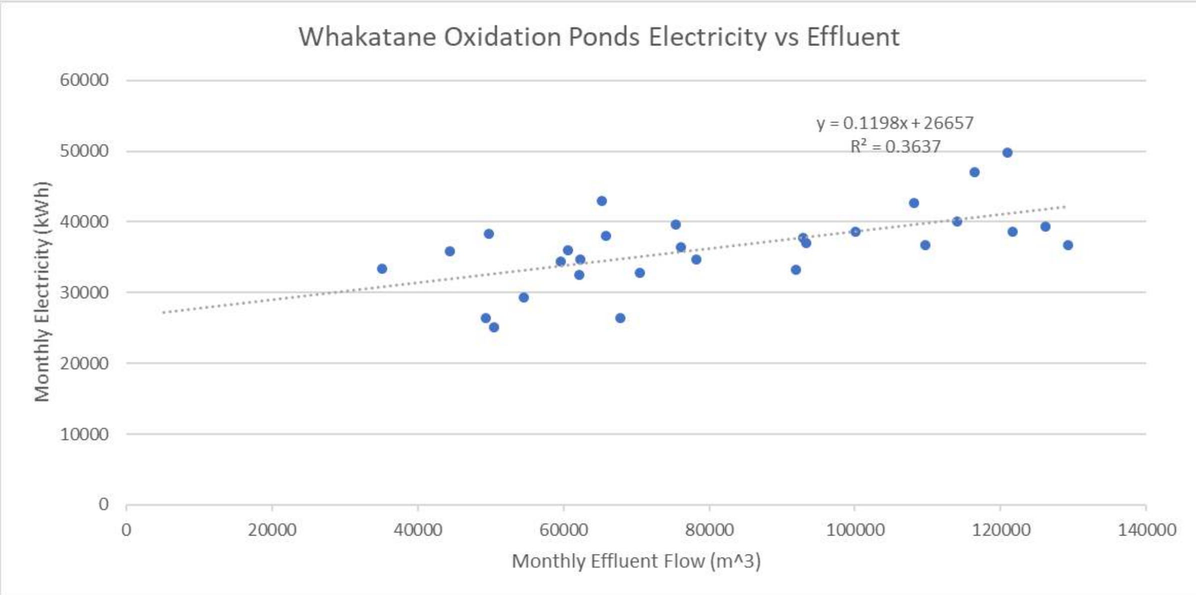


Figure 6-29 – Monthly electricity use versus effluent water volume for Feb 2018 to June 2020 at the Whakatāne Oxidation Ponds

The trend line has an R^2 correlation of 0.3637, this means that 36.37% of the variation in the electricity used by the Whakatāne Oxidation Ponds is due to changes in the volume of effluent pumped. This correlation is weak and suggests that 63.6% of electricity used is not influenced by the volume of effluent. This may be due to aerators that are running on a set schedule, regardless of the volume of effluent that is pumped.

[v] Based on the War Memorial Hall's marginal gas cost of 7.14 c/kWh

6.4.5 Ohope Oxidation Ponds

6.4.5.1 Electricity EUI Analysis

Shown below in Figure 6-30 is a comparison of daily electricity energy use and water volume for the Ohope Oxidation Ponds. The plotted data points show the raw data, while the linear trend line represents a 'line of best fit', showing the trend of the data.

The equation of the trend line; y=0.3044x + 10,377 informs the reader that:

- The Ohope Oxidation Ponds station's variable component of electricity use is 0.3044 kWh/m^3
- The electricity baseload at the site is 10,377 kWh/month

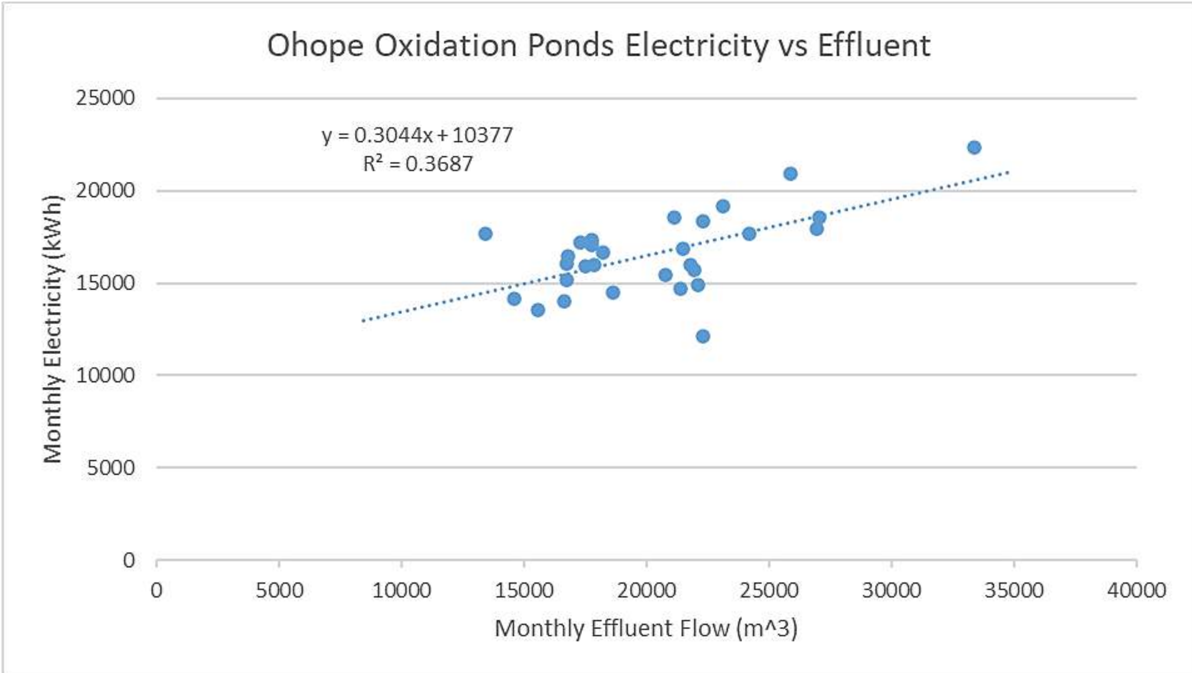


Figure 6-30 – Monthly electricity use versus effluent volume for February 2018 to June 2020

The trend line has an R^2 correlation of 0.3687, this means that 36.87% of the variation in the electricity used by the Ohope Oxidation Pond is due to changes in the volume of effluent pumped. This correlation is relatively weak and means that there are other factors that influence energy use. The proportionally high baseload contributes to the low R^2 value.

The baseload is illustrated by the point where the line of best fit intercepts the vertical axis of the graph. Baseload refers to the daily energy usage that is not attributable to the volume of effluent pumped, and therefore represents the current minimum level of energy consumption. This is made up of loads such as fixed speed and duration motors and pumps, lighting, VSD losses, control and metering equipment etc.

6.4.6 Oxidation Pond Comparisons

The patterns of energy use for the two oxidation ponds established in Sections 6.4.4 to 6.4.5 can be used to compare the relative efficiencies of each plant. This is useful to understand if a plant is operating particularly poorly or efficiently and what reasons might be behind the performance.

Table 6-8 - Relative efficiencies of two oxidation ponds

Site	EUI (kWh/m^3)
Whakatane Oxidation Ponds (NHH & TOU)	0.296
Ohope Oxidation Ponds	0.833

Table 6-8 Shows that the Whakatane Oxidation Ponds use nearly two thirds less electricity compared to the Ohope Oxidation Ponds. The Whakatane Oxidation Pond aerators are controlled to dissolved oxygen levels and switch off in high wind. For the Ohope Oxidation Pond, control is time-based only. Ohope ponds also have UV treatment, which is more energy intensive however does not account for the difference in EUIs.

7 Carbon Inventory and Net Carbon Zero

Whakatāne District Council has a publicly stated goal of achieving net zero carbon emissions by 2030, excluding its biogenic methane and nitrous oxide emissions. Emsol has developed a broad strategy for Council to achieve this goal for its stationary energy. This is shown in detail in Appendix 12.4, the key steps are:

- Continue with energy efficiency for electric loads and begin tracking carbon offset liability (see more in Section 7.1.1)
- Fuel switch natural gas for efficient electric technology
- Invest in renewable generation (solar, wind)
- Purchase carbon credits (or generate offsets) as required as the national grid is decarbonised.

Council measures its carbon emissions by completing an annual carbon inventory. This is audited annually by Toitu.

7.1 Annual Carbon Inventory

Whakatāne District Council first compiled its carbon inventory using data from its July 2017 to June 2018 financial year, at which point its total emissions were 3,571 tonnes CO_2e/year. Energy related emissions were the second largest, behind biogenic methane and nitrous oxide from its oxidation ponds. Council's goal of net carbon zero by 2030 excludes methane and nitrous oxide (WWTP sewage in Figure 7-1 below). Energy related emissions are therefore the largest component in its carbon inventory required to meet the carbon neutral target. In its most recent carbon inventory (July 2020 to June 2021), total emissions were 3,357 tonnes CO_2e/year. Figure 7-1 below shows that electricity and natural gas were the second and fourth largest sources of emissions respectively.

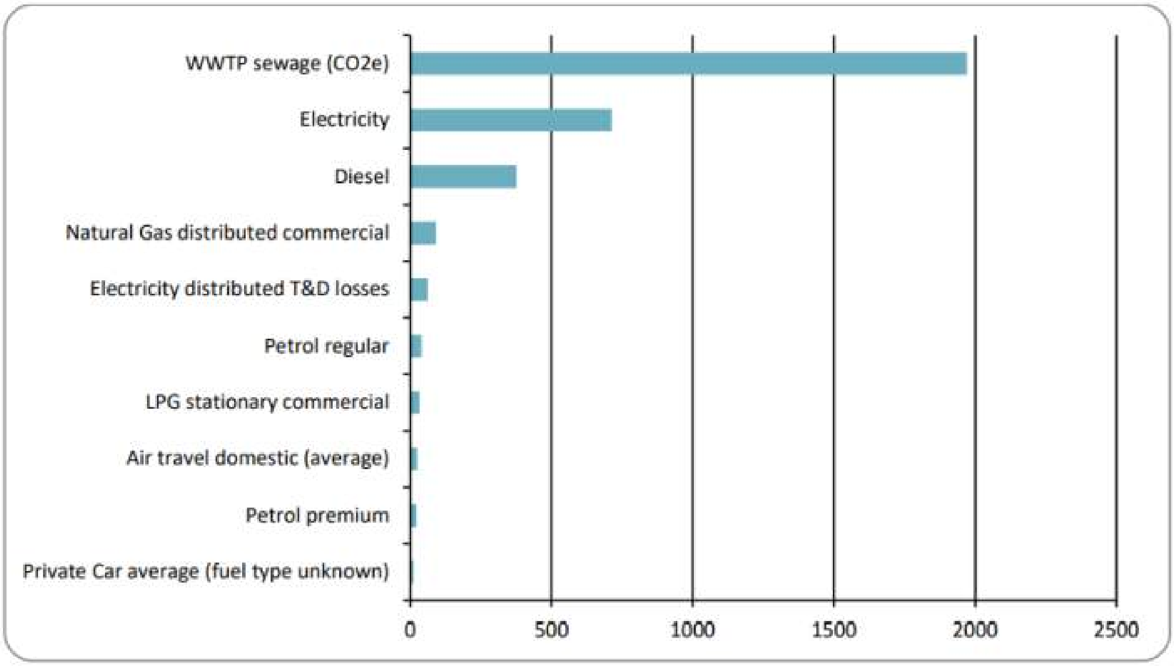


Figure 7-1 July 2020 to Jun 2021 carbon inventory for Whakatāne District Council

Council produces its carbon inventory annually in line with its July to June financial year. Its inventory is verified by Toitu. Figure 7-2 below shows the progress council has made towards its net zero target.

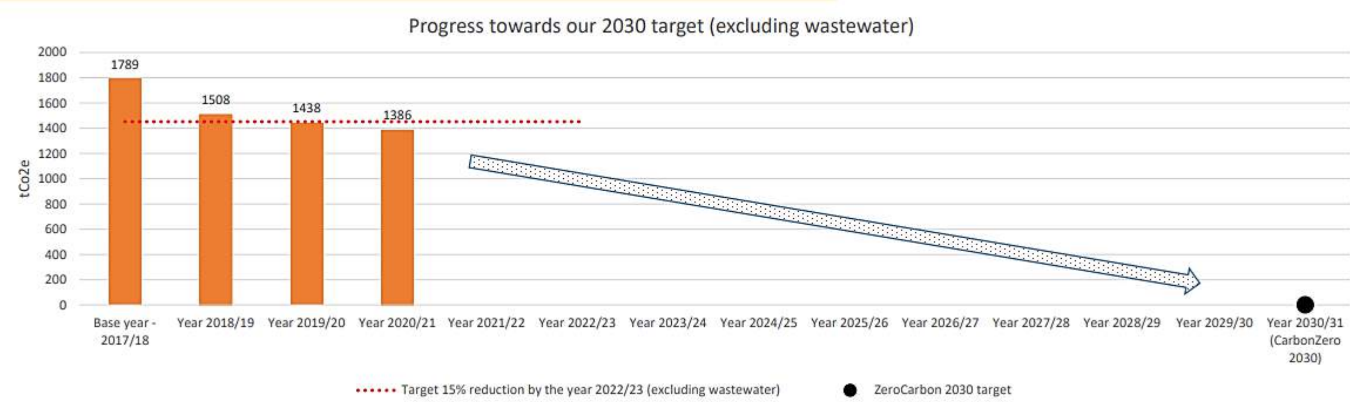


Figure 7-2 -Council progress towards net zero

7.1.1 Carbon Offsets

Carbon offsets can be generated where a participant undertakes an activity that can be verified to reduce greenhouse gases in the atmosphere. Once verified, these units can be traded in international carbon markets. Emitters can offset their own carbon emissions by purchasing credits from market participants that hold credits. This is seen as the final step for Council to achieve its net zero target, and will be necessary to offset any emissions associated with the use of electricity. Over time the national grid emissions are expected to reduce, however this will take some time as thermal generation is phased out or switched to biofuel.

In the meantime, it is useful for Council to understand its carbon offset liability. This will help with its budgeting as 2030 approaches, as well as drive some investment decisions. At the time of writing this report, the cost of an NZU was $77/tonne. Council's total emissions in the 2020/21 year (excluding WWTP emissions) were 1,386 tonnes CO_2e/year. This equates to a carbon liability (the amount that would be needed to purchase offsets) of $106,722 per year.

In terms of stationary energy, annual emissions are 982 tonnes CO_2/year. This equates to a carbon offset liability of $75,600.

7.2 Decarbonisation Roadmap

A decarbonisation roadmap is a strategic plan to reduce carbon emissions over the medium and long term. It needs to coincide with other strategic documents, in particular, any replacement strategies for significant assets. This is the most cost-effective time to decarbonise.

A decarbonisation roadmap typically focuses on demand reduction first, followed by fuel switching. It is important to follow this order, since demand reduction is likely to reduce the capital requirements when it comes time to fuel switch.

Long-term low carbon transition pathway					
Stage	Actions		Year	Remaining Emissions	
	Baseline Emissions		2017-2018		100%
1	*Energy Demand Reduction*	Implement energy audit recommendations and energy management programme	2018-2022	20%	80%
2	*Fuel Switching*	Phase out natural gas and LPG with efficient electric technology	2022-2025	33%	67%
3	*Energy Demand Reduction*	Expand energy management to next tier of facilities, continue to improve efficiency	2022-2027	50%	50%
4	*Energy Demand Reduction*	Renewable generation (Solar, wind)	2023-2030	73%	27%

Figure 7-3 - Decarbonisation roadmap for Whakatāne District Council's static energy (electricity and natural gas)

Figure 7-3 shows a high-level decarbonisation roadmap for Whakatāne District Council. Carbon reductions shown for steps 3 and 4 are approximate only and should be refined as Council approaches them. The roadmap starts from 2018, when Council first began its energy management programme. This shows a 20% reduction in static energy related carbon emissions to date. The next step, phasing out natural gas, will reduce carbon emissions to 67% of the baseline emissions. Ongoing efficiency improvements to electric loads is expected to reduce carbon emissions to 50% of baseline. Step 4 includes renewable generation, by which time Council will have reduced its emissions by 73%.

8 Electricity Tariff Review

The Whakatāne District Council is supplied electricity by Mercury and Genesis Energy. Electricity Network services are provided by Horizon Networks and the charges are passed on to the Whakatāne District Council by Mercury and Genesis Energy. There is an energy supply agreement in place which has been in effect from March 2019 and is due for renewal at the end of February 2022.

Within the contract the Whakatāne District Council has 186 separate electricity accounts, which are billed under three main categories.

- Time of Use (TOU) or Fixed Price Variable Volume - 12 larger accounts, which are charged energy costs based on time of use, and network charges based on demand.
- Non Half Hour (NHH or Anytime Rates) - 170 accounts are on anytime rates inclusive of all energy and network charges.
- Distributed Unmetered Load - 4 accounts are unmetered streetlights with a fixed daily charge, which accounts for total load, times of operation and number of units.

Figure 8-1 shows the cost breakdown by type of contract. 41% of energy costs come from NHH sites and 55% of costs come from TOU sites. Note that the average account volume for TOU is much larger than for NHH accounts.

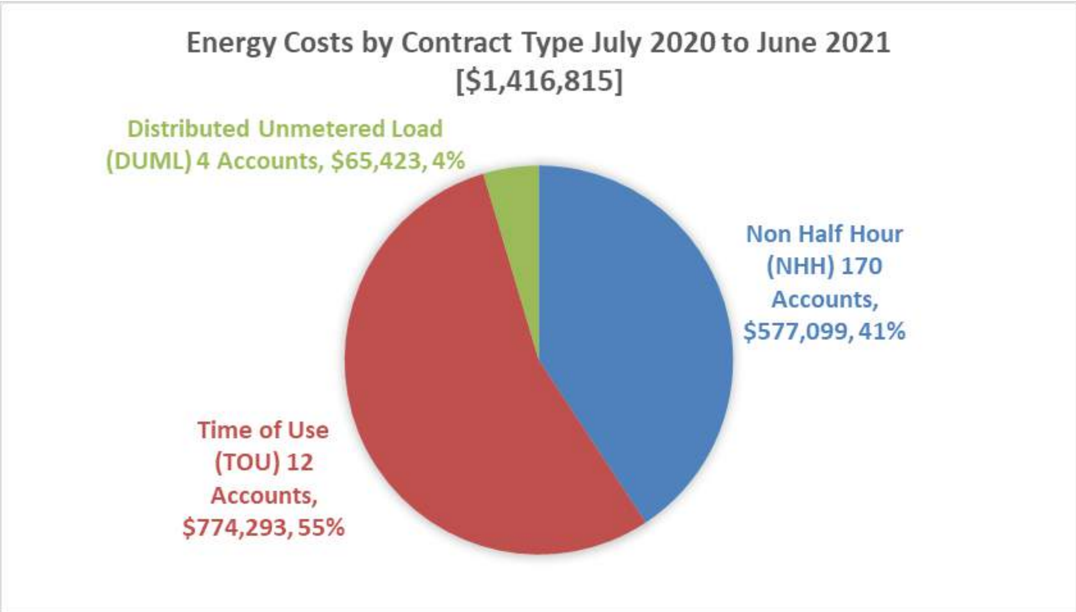


Figure 8-1 - Energy Cost by Contract Type

Figure 8-2 below shows the annual cost of the ten largest accounts, as well as the combined annual cost of all remaining accounts. The total electricity cost was $1,416,815 in the 12 months to June 2021, with 55% of this cost attributed to the ten largest accounts.

Table 8-1 shows the electricity use and cost for each of the Whakatāne District Council's ten highest cost electricity accounts. Also shown is the contract type associated with that site. Water Treatment Plant, Civic Centre, the Aquatic Centre and pump station sites are the most expensive sites for the council to meet their electricity requirements.

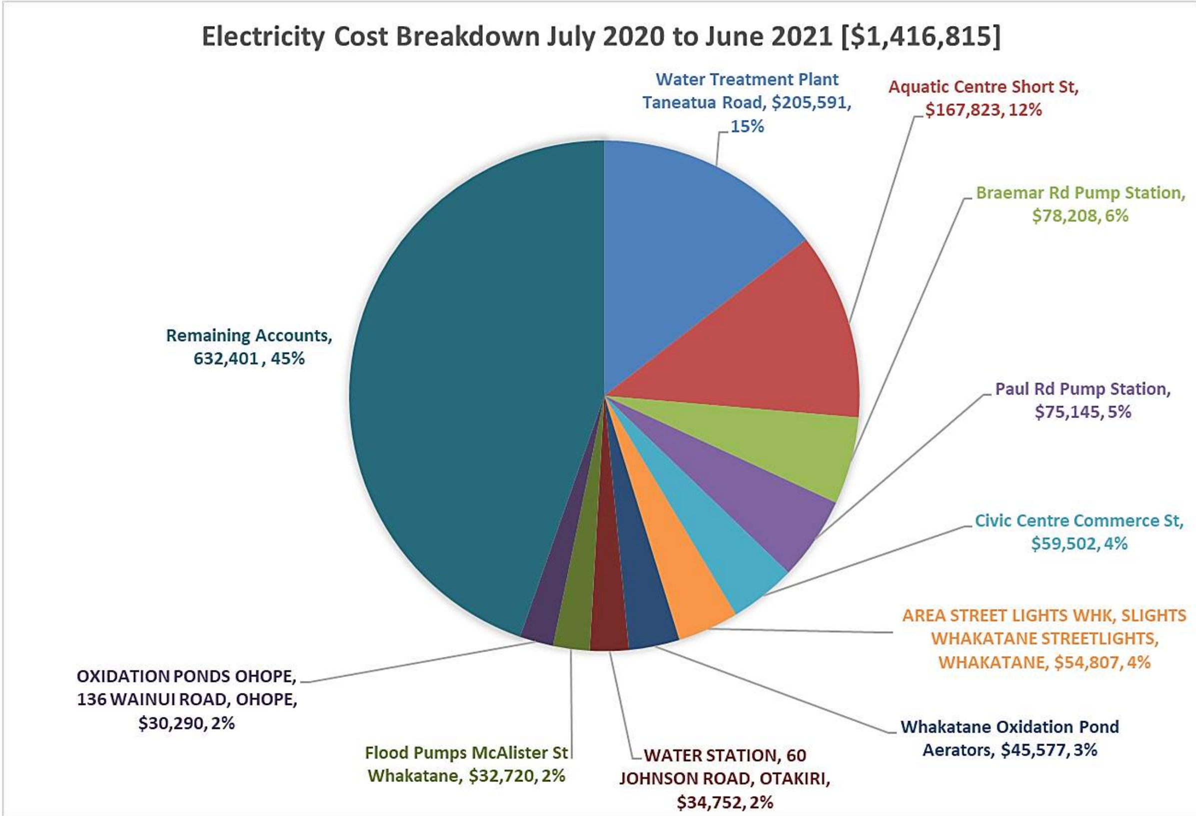


Figure 8-2 - Breakdown showing relative cost of the Whakatane District Council's largest electricity accounts

Also shown in Table 8-1 is the gross price (annual cost divided by usage) which varies from $0.12/kWh at Paul Rd pumping station, to $1.47/kWh at the Drainage Pump Station at McAlister Street. The Drainage Pump Station at McAlister Street has a high gross average price, which is typical for flood pumps that require large transformers and are only used occasionally; this is discussed further in Section 8.1. The average for all the Whakatāne District Council's accounts was $0.19/kWh.

Table 8-1 - Electricity cost for Whakatāne District Council's ten highest cost accounts

Account Name	Account Type	Annual Electricity Use (kWh)	Annual Cost ($)	Gross Cost ($/kWh)
Water Treatment Plant Taneatua Road	TOU	1,534,656	$205,591	0.13
Aquatic Centre Short St	TOU	1,374,393	$167,823	0.12
Braemar Rd Pump Station	TOU	548,030	$78,208	0.14
Paul Rd Pump Station	TOU	419,504	$75,145	0.18
Civic Centre Commerce St	TOU	362,106	$59,502	0.16
Area street lights whk, slights Whakatane streetlights, Whakatane	DUML	-	$54,807	N/A
Whakatane Oxidation Pond Aerators	TOU	317,019	$45,577	0.14
Water station, 60 Johnson road, Otakiri	NHH	167,766	$34,752	0.21

Flood Pumps McAlister St Whakatane	TOU	22,204	$32,720	1.47
Oxidation ponds Ohope, 136 Wainui road, Ohope	NHH	210,490	$30,290	0.14
Remaining Accounts		2,401,578	$632,401	0.26
All Accounts		**7,357,746**	**$1,416,815**	**0.19**

8.1 Electricity costs

Electricity costs are the summation of Network charges and Supplier energy usage charges; each includes a fixed charge component, and a variable charge component. These charges are calculated in different ways for each type of contract at Whakatāne District Council.

Electricity costs for the sites on Time of Use data state explicitly the proportion of network charges and retail prices charged to the Council. Sites on anytime use pay a marginal rate and fixed rates agree on contractually, where network charges are implicitly included.

Figure 8-3 shows the overall electricity cost breakdown for Time of Use sites. The total cost was $774,293 or 55% of the total electricity bill. The TOU accounts include the Murupara Swimming Baths and Whakatane Oxidation Ponds, which are a focus of this audit.

71% of TOU charges ($550,000) can be attributed to variable charges (55% is based on retail cost of energy supplied, 16% variable charges from the Horizons Networks and <1% as an EA Levy) and 29% or $224,000 is defined as fixed charges which comprise of a demand charge and installed capacity charge from the network, and a metering charge from the retailer. The network charges are discussed further in Section 8.2. Note, although demand charges are considered 'fixed' they can vary and reduce electricity costs.

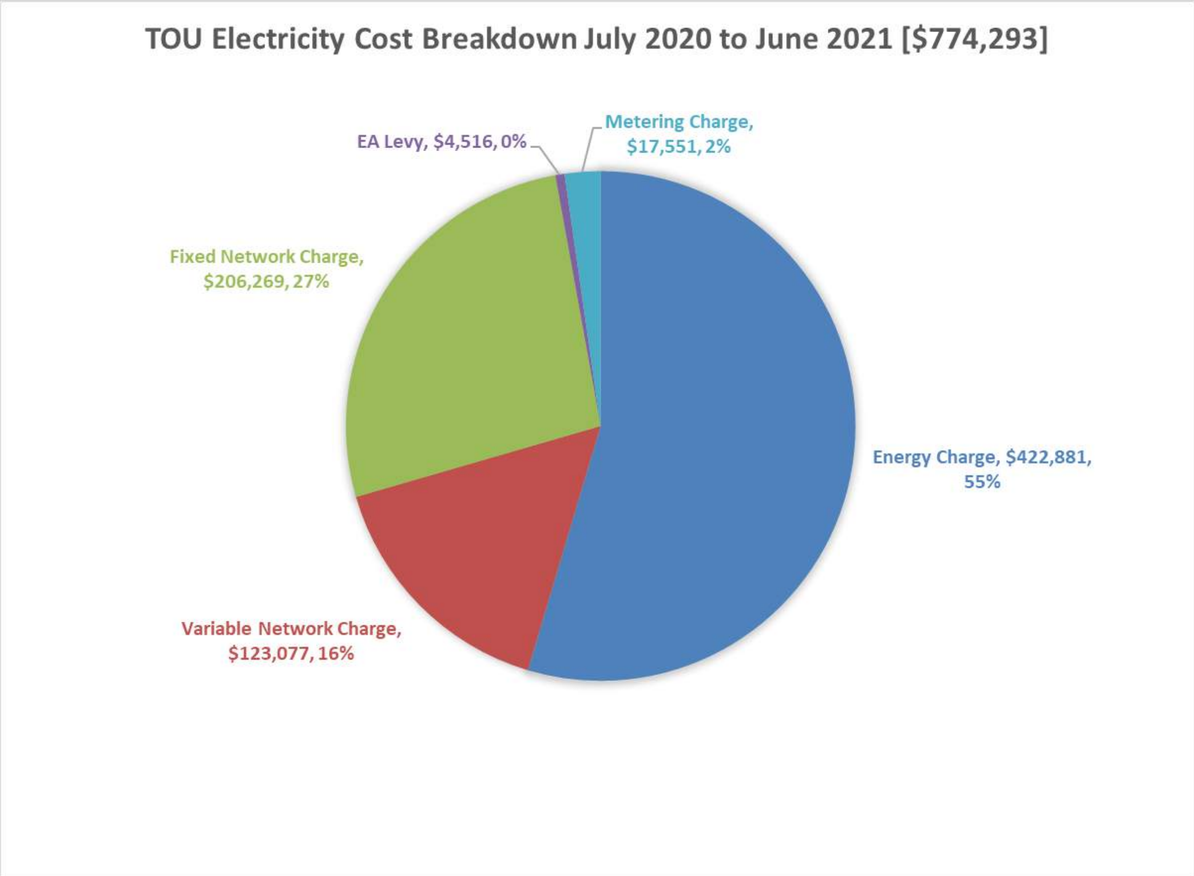


Figure 8-3 TOU Electricity Cost Breakdown

Costs vary by site and are dependent on the times at which the energy is consumed, and the demand profile of the site. Figure 8-4 shows the gross marginal rate per kWh for each component for the five sites of interest. The retail energy portion of the cost is around 13 c/kWh.

The fixed network charges vary the most between sites and can be between 1 and 7 c/kWh. Network costs represent a significant opportunity to reduce costs, this is discussed in Section 8.2

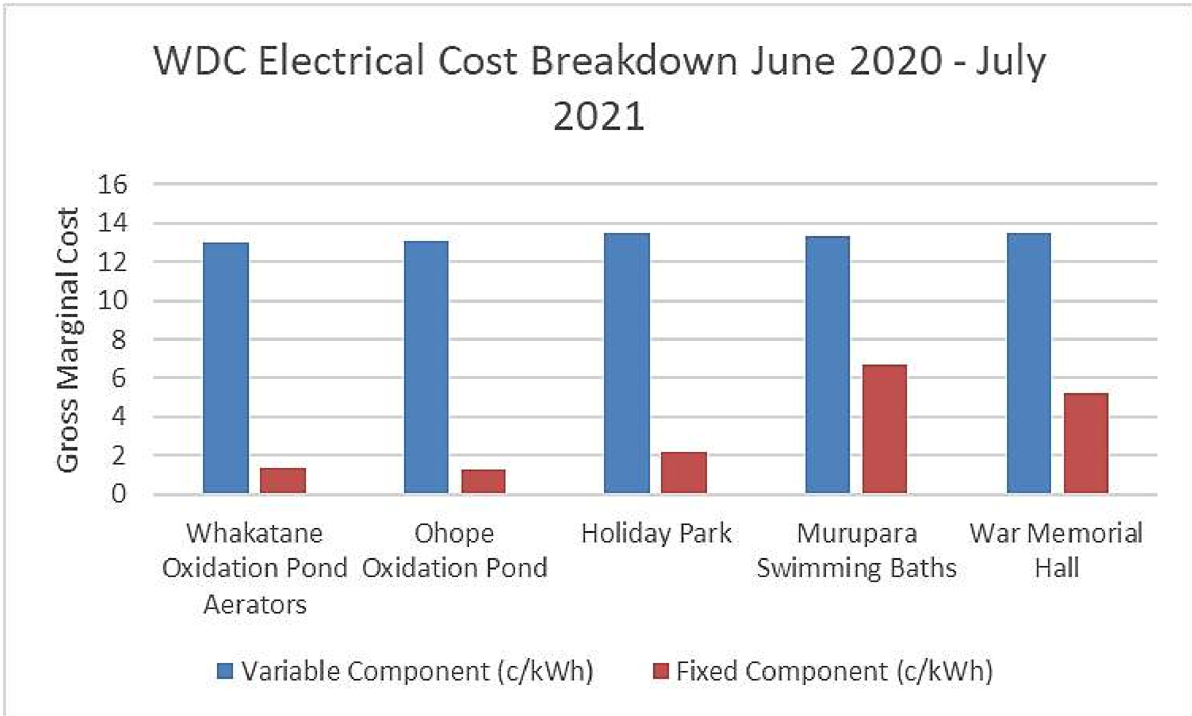


Figure 8-4 – Electricity cost breakdown for five significant sites.

Some accounts with the council have abnormally high gross cost per kWh rate. Whilst a normal rate is between 10-30 c/kWh (dependant on contract and usage), Emsol has found 64 accounts that pay more than $1.00/kWh in gross electricity costs, due to high fixed costs. Table 8-2 lists 7 accounts that used no energy between July 2020 – June 2021. These accounts should be reviewed with the intent of closing unnecessary accounts.

Table 8-2 - Whakatane District Council electricity accounts with unusually high gross electricity cost.

Account Name	Electricity (kWh)	Cost ($)	Gross Cost ($/kWh)
MITCHELL PARK, 27 PYNE STREET, WHAKATANE	-	$849	N/A
FLOW METER EDGECUMBE, 160 COLLEGE ROAD, EDGECUMBE	-	$840	N/A
FOXGLOVE PUMP STATION, 61 MELVILLE DRIVE, WHAKATANE	-	$833	N/A
SEWER STATION, 132 HARBOUR ROAD, OHOPE	-	$830	N/A
TOILETS SOCCER PAV, 0 SHORT STREET, WHAKATANE	-	$828	N/A
0 WEKA STREET, WHAKATANE	-	$828	N/A
PUMP STATION, RIVERSIDE DRIVE, WHAKATANE	-	$828	N/A

Account Name	Electricity (kWh)	Cost ($)	Gross Cost ($/kWh)
AWATAPU FLOOD PUMP NORTH END, AWATAPU DRIVE, WHAKATANE	1,500	$9,392	6.26
PUMP STATION WHAKATANE BRIDGE, THE HUB, WHAKATANE	3,000	$15,088	5.03
Pumps near SH30 57D Mill Road Coastlands	5,467	$19,448	3.56
PUMP STATION, 0 KEEPA ROAD, WHAKATANE	4,200	$10,402	2.48
SEWER PUMP STATION, 0 AWATAPU DRIVE, WHAKATANE	7,200	$14,304	1.99
Flood Pumps McAlister St Whakatane	22,204	$32,720	1.47

Also listed are five high energy use accounts with unusually high gross costs, such as the Whakatane pumps at 57D Mill Road. The accounts have high fixed costs which is symptomatic of a large load that operates infrequently throughout the year, or incorrectly specified transformers/pricing codes.

Figure 8-5 shows Mill Road Pumps' TOU profile for the period July 2020 – June 2021. The rated capacity is 300 kVA and the demand charge is set at 60% of the installed capacity, however usage data shows that electricity demand peaked at 75 kW and exceeded 30 kW for only a very small portion of the time.

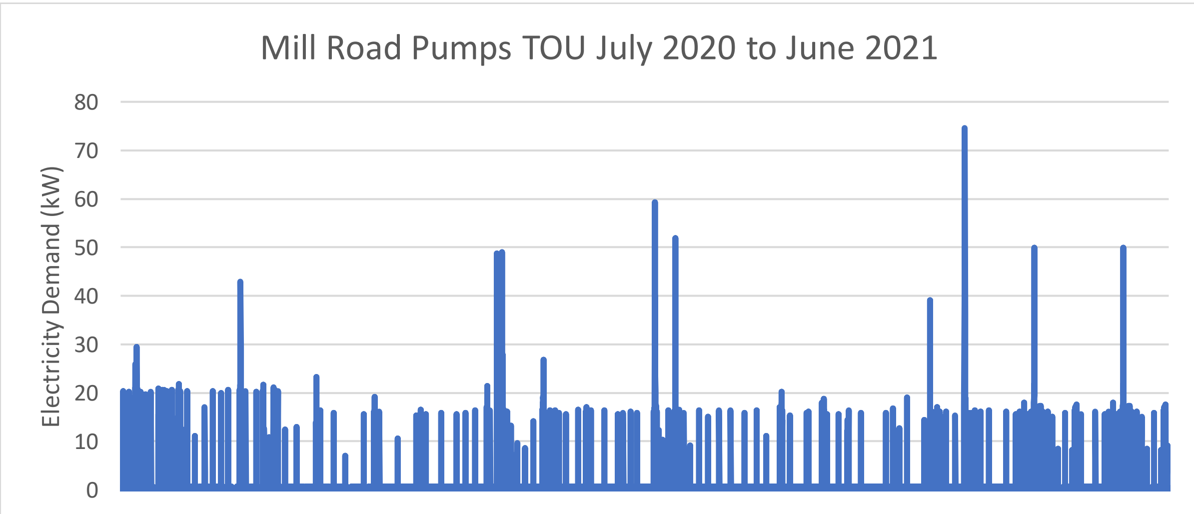


Figure 8-5 - Time of use data for McAlister Street Drainage July 2017 to May 2018

Emsol recommends reviewing each of the accounts in Table 8-2 to ensure that:

1. The demand or supplied capacity is appropriate for the site.
2. The pricing category set by the Horizons networks is appropriate for the site.
3. Approach Horizons Networks about opportunities to consolidate accounts.

Recommendation

Commission a detailed investigation of Whakatane District Councils lines and network charges per account. Save approximately $12,000 per year. The cost of this should be approximately $4,200 based on Emsol's experience quoting for similar jobs.

8.2 Network Charges

Horizons Networks (Horizons Energy Distributions ltd.) provides Whakatāne District Council with its lines and network services; supplied from the Edgecumbe GXP.

Network charges totalled $329,346 in the year to end June 2021, which accounted for 43% of the total electricity cost for TOU sites.

NHH sites and DUML also incur network charges, however these charges are concealed within the monthly invoices for each site and totals are not readily available. The charges are set annually by Horizons Networks and come into effect April 1st Each year.

Network charges are set dependant on capacity of the connection and whether the connection is urban or rural. Pricing categories are shown in Table 8-3 including corresponding number of accounts and fixed network charges. All of the 12 TOU accounts fall under the Network Maximum Demand category except for the Whakatane Oxidation Ponds (N3R).

Table 8-3 - Network tariff details for Whakatāne District Council Accounts

Pricing Group	Code	Load Range [kVA]	Daily Fixed [$/ICP per day]	Capacity [$/kVA per month]	Demand [$/kW per month]	Variable Charge [$/kWh]
Standard Urban	NDU	<15 kVA	$ 2.22	-	-	$ 0.00729
Standard Rural	NDR		$ 2.22	-	-	$ 0.00729
Group 2 – Urban	N2U	15-42 kVA	$ 2.18	-	-	$ 0.04064
Group 2 – Rural	N2R		$ 3.43	-	-	$ 0.06873
Group 3 – Urban	N3U	43-70 kVA	$ 5.83	-	-	$ 0.05416
Group 3 – Rural	N3R		$ 9.15	-	-	$ 0.05205
Group 4 – Urban	N4U	70-100 kVA*	$ 12.55	-	-	$ 0.05848
Group 4 – Rural	N4R		$ 14.23	-	-	$ 0.06605
Group 5 – Urban	N5U	>100 kVA*	-	$ 3.14	-	$ 0.05229
Group 5 – Rural	N5R		-	$ 3.64	-	$ 0.09392
Network Maximum Demand	NMD	>70 kVA	-	$ 1.95	$ 5.43	$ 0.02573

**Price group not available for new connections.*
Note: Street lights are charged based on a rate of $5.71852/light/month

For TOU, network costs comprise of a Capacity Charge and a Demand Charge. NHH sites are charged a fixed charge per connection ($/ICP), and for older connections greater than 100 kVA, a capacity charge in $/kVA/month. All connections are charged a variable rate ($/kWh).

The capacity charge is set at the installed capacity (fuse or transformer size) and is charged in $/kVA/month. The 2020-2021 capacity charge for **TOU accounts is $1.95494/kVA/month (approx. $23.46/kVA per year),**

Peak demand (charged in $/kW/day) is calculated at installation and set annually based on demand from September-August of the previous year. Demand is calculated as the higher of:

- 60% of the Capacity Charge (in kW) or
- Single highest peak demand incurred in the preceding RCPD year. And:

- If data is unavailable, using the supplied capacity, assuming PF of 0.95.

Table 8-4 shows the capacity (kVA) and demand (kW) charges for 11 TOU accounts at the council. Also shown is the annual peak demand (kVA) for each site. It can be seen that for some sites the transformer or suppled capacity is much larger than the actual peak demand from that site. For example, Whakatāne Water Treatment Plant has a capacity of 750 kVA, however from July 2020 – June 2021 had a peak load of 266 kVA.

Reducing the capacity of the Whakatāne Water Treatment Plant transformer to 500kVA, 188% of peak load, the demand and capacity charges would decrease. Emsol has calculated a saving of $15,600 per year in reduced network charges. Similar calculations were done for the Council's other TOU accounts.

Reducing capacity can sometimes be a paper exercise with the lines company or sometimes requires investment in new transformers. Reserve capacity may be in place for future upgrades on pumping stations. In this case a trade-off exists between having capacity on hand for future upgrades and excessive network charges in the interim.

Table 8-4 - Network capacity details for Whakatane District Council

Account Name	Capacity [kVA]	Demand [kW]	Annual peak [kVA]	Transformer downrated to [kVA]	Annual Savings
Swimming Baths 68 Pine Drive Murupara	111	69	79	N/A	$0
0 Kiorenui Murupara Bay of Plenty	85	51	32	50	$2,074
Braemar Rd Pump Station	300	210	189	236	$2,858
Water Treatment Plant Taneatua Road	750	450	266	500	$15,641
Museum and Research Centre Boon Street	173	104	35	77	$6,019
Aquatic Centre Short St	300	236	267	N/A	$0
Civic Centre Commerce St	277	185	185	231	$1,080
Flood Pumps McAlister St Whakatane	500	300	184	277	$12,780
Te Koputu Library Kakahoroa Drive	111	67	40	85	$1,653
Pumps near SH30 57D Mill Road Coastlands	300	180	75	111	$11,250
Paul Rd Pump Station	500	300	134	277	$13,952

Recommendation

Reduce the capacity of transformers where possible. Save up to $67,300 per year in reduced network charges.

The cost of implementation for this requires an in-depth review with the Lines Company, which could be part of the energy management programme.

8.3 Energy supplier charges

Whakatane District Council has an electricity supply contract with Genesis Energy for its NHH accounts and Mercury for its TOU accounts.

8.3.1 TOU Site Energy Supplier Charges

The larger users of electricity with TOU meters are on a Fixed Price Variable Volume contract where the energy portion of the charges is fixed at the commencement of the contract. The contract stipulates agreed prices for 12 time periods in each of the 36 months of the contract. Periods split into 4-hour segments and split by weekend and weekday rates.

Table 8-5 and Table 8-6 show the agreed weekday and weekend rates for each 4-hour period, each month between March 2022 and Feb 2023. Energy charges are based on half hourly time of use (TOU) consumption data multiplied by the relevant tariff for each 4-hour period.

Table 8-5 Retail Fixed prices per 4hr block - Business Day [c/kWh] ex. GST

	0000-0400	0400-0800	0800-1200	1200-1600	1600-2000	2000-2400
Mar-22	12.96	15.58	20.18	20.73	19.03	16.20
Apr-22	12.40	17.04	21.01	19.33	24.31	16.61
May-22	12.94	17.78	21.93	20.17	25.37	17.33
Jun-22	14.17	20.21	24.41	19.42	24.21	19.00
Jul-22	14.32	20.42	24.67	19.63	24.46	19.20
Aug-22	12.99	18.51	22.35	17.79	22.16	17.40
Sep-22	11.94	15.58	18.85	17.31	17.18	15.29
Oct-22	11.08	14.44	17.46	16.04	15.91	14.17
Nov-22	10.61	13.83	16.71	15.35	15.23	13.57
Dec-22	9.82	11.77	16.19	16.99	15.41	13.08
Jan-23	9.85	11.81	16.25	17.05	15.47	13.13
Feb-23	10.65	12.79	16.52	16.97	15.59	13.28

Table 8-6 Retail Fixed prices per 4hr block - Weekend [c/kWh] ex. GST

	0000-0400	0400-0800	0800-1200	1200-1600	1600-2000	2000-2400
Mar-22	11.82	11.80	15.58	14.83	15.68	14.07
Apr-22	12.10	12.14	16.89	15.18	18.08	13.45
May-22	12.62	12.66	17.63	15.83	18.87	14.03
Jun-22	14.31	14.30	18.04	16.64	18.45	16.22
Jul-22	14.46	14.45	18.23	16.82	18.64	16.39
Aug-22	13.12	13.11	16.53	15.25	16.90	14.87
Sep-22	11.91	12.59	15.91	13.92	14.93	14.43
Oct-22	11.05	11.67	14.75	12.91	13.84	13.37
Nov-22	10.58	11.18	14.12	12.36	13.25	12.81
Dec-22	8.82	9.55	11.80	11.36	12.00	10.87
Jan-23	8.85	9.59	11.84	11.40	12.04	10.91
Feb-23	9.72	9.71	12.78	12.17	12.87	11.55

Price variances are linked to expected spot market prices at the time of the contract. Over the 12 months from March 2022 to February 2023, weekdays between 8am and 12 pm is the most expensive time to use electricity at Whakatāne District Council (avg. 19.71 c/kWh), however higher peak rates occur between 4pm and 8pm. In winter months electricity is more expensive than summer months, however prices do increase to 17 c/kWh From December to February during the hotter parts of the day.

The period of 0000 hrs to 0400 hrs is the cheapest time to purchase energy year-round, averaging 11.98 c/kWh. Weekends are also 19% cheaper per kWh than weekdays on average.

A metering charge of $130/month per site is also charged by Mercury Energy.

8.3.2 Non-Half Hour Energy Retailer Charges

Energy cost for non-half hour loads for Whakatane District Council was fixed in the supply contract for until the end of February 2022 with Genesis, the Council is currently off contract. Non-half hour accounts are charged both a fixed and variable charge per site based on the network pricing category. The variable charges can be on anytime rates, meaning that the rate does not vary based on when the energy was used. The variable charges may also be split between time of day, if TOU metering exists.

Retail charges for NHH accounts are often grouped into variable and fixed charges on invoices. Retailer prices will be additional to the lines charge component presented in Table 8-3.

8.4 Marginal tariffs

Tariffs for savings calculations use the marginal price of electricity, which is the price that applies when a unit of electricity (kWh) is saved. The marginal price for Whakatāne District Council is different for TOU meters, Anytime Meters and Distributed Unmetered sites. **The average marginal rate for March 2022—Feb 2023 TOU meters is 20.13 c/kWh**. This is the price used when calculating savings throughout this report unless specified otherwise. **The average marginal rate for March 2022—Feb 2023 NHH (Anytime Meters) is expected to be 25.5 c/kWh[vi].**

The fees at Whakatāne District Council that are a function of usage include:

- Electrical retail prices as stated in Section 8.3
- A multiplier for electricity "losses" of 1.0574 (only applicable for TOU sites).
- Electricity Levy 0.08853 c/kWh
- A marginal network fee determined annually by Horizons Networks as stated in Section 8.2.

Forecast marginal prices for the 12 major TOU sites March 2022 – February 2023 is summarised in Table 8-7, the majority of which is retail price component. Retail prices also account for all the variation between periods.

The three price groups used in savings evaluations depending on when the load typically occurs:

a. Running continuously all year, 24 hours a day
b. Running during 8am to 8pm - "days"
c. Running during 8pm to 8am and weekends - "after hours"

Table 8-7 – Time of Use (TOU) Electricity marginal cost for various periods c/kWh

Marginal Price [cents/kWh]	TOU site "energy" [c/kWh]	Total marginal cost including loss factors and network [c/kWh]
Every 24 Hours	16.52	20.13
Summer day	16.84	20.47
Summer night	12.26	15.63
Winter day	21.36	25.25
Winter night	15.61	19.17

These prices are useful for identifying where and when the largest energy cost savings from efficiency improvements will be achieved. For example, energy at the larger TOU sites is most expensive at during the day and in winter. Moving loads to night periods where possible can save on electricity costs.

[vi] Based on retail price increases for TOU electricity accounts from July 2020-June 2021 compared to new contract

All other electricity accounts including the Whakatāne Streetlights and the Ohope oxidation Ponds are charged on a contractual Anytime rate. This means the account is charged a set marginal rate per kWh inclusive of all lines losses, network fees and levies and is independent of time of use. Genesis Energy also offers a 20% prompt payment discount which is included in the analysis.

The electrical retailer and network component of the marginal rates vary dependent on the pricing category. The category is based ion installed capacity set by Horizon Networks.

Usually anytime marginal rates are more expensive than TOU rates, however depending on the demand profile and installed capacity, fixed charges can be more or less. Whether a load is better suited to TOU or anytime rates is determined on a case-by-case basis.

Emsol assists businesses in this process of tariff negotiation by being familiar with a range of electricity contract options; reducing negotiation time and ensuring a suitable tariff is secured.

Standard electricity supply contracts may contain certain provisos such as “Maximum Annual Quantity” and “Exclusive Supply”. Emsol offers expert advice and analysis of these clauses (including modelling of tariff scenarios) to prevent its clients incurring additional charges.

When reviewing offers from suppliers; carefully analyse the contracts that have prices for multiple periods during the day. Some electricity retailers offer up to six tariff periods per day.

Emsol analyses various contract offers compared to historical usage to ensure the offer best matches a plants individual use. Emsol’s contract negotiation service includes analysing future costs and contract terms and conditions.

8.5 Peak load control

Whakatāne District Council's lines company, Horizons Networks charges demand on a supplied capacity rate of $1.95/kVA per month (as discussed in Section 8.2). Horizon calculates this rate on installed capacity. A higher supplied capacity than required is costly, therefore any control over peak loads to reduce the required supplied capacity would save money if the transformer or connection was reviewed.

Demand charges (also discussed in Section 8.2) are charged at a rate of $5.43/kW per month. These charges are a function of peak load and are calculated based on the highest half hour peak during the previous Sep-Aug year. The demand charge has a lower limit of 60% of transformer capacity, which means for sites with oversized capacity, there is no opportunity to reduce this charge.

The marginal cost of peak demand is $65.16/kW for the **Whakatāne District Council**'s TOU accounts. This has been used for calculating cost savings where an energy saving project will also result in a demand saving.

As peak loads for two separate ICPs rarely coincide at the same time, savings can often be achieved by combining two ICPs given that points of supply are relatively close to one another. For instance, the Whakatane Oxidation Ponds have two separate ICPs that could be combined. Separately the maximum demand for each of these ICPs are 49.9 kW and 43.1 kW for the TOU and NHH accounts respectively. By combining these two accounts, maximum demand for the same period is 89.4 kW. The benefit of combining these two accounts is further discussed in Section 9.2.4.

8.6 Power Factor Correction

Horizons Networks currently does not charge for reactive power (kVAr). Power factor is a measure of the reactive power (kVAr) supplied (due to inductive loads such as those generated by induced magnetic fields in motors) in proportion to the energy used. Typically, connections to the network are required to maintain a power factor of 95% or better. Some lines companies charge penalties if power factor is below 0.95, however Horizon does not.

Furthermore, Horizon Networks bases its lines fees on peak half hour demand in kW (not kVA) which means power factor has no effect on lines charges either. There is therefore no financial gain to the Whakatāne District Council by improving power factor.

9 Study of End Uses

The Whakatāne District Council has a mix of modern equipment as well as older, less efficient equipment. For the most part equipment is well maintained and some consideration has been given to energy efficiency. Despite this, there are still opportunities for improvement with current energy consumption and associated costs; by adopting many small changes as part of improved energy management practices the Whakatane District Council can expect to see further energy savings.

Some of the Whakatāne District Council's facilities have relatively high hours of operation which will help energy saving projects to have quicker payback periods. Facilities that that have equipment operating for business hours only can be more difficult for opportunities to achieve quick paybacks.

9.1 Murupara Swimming Baths

9.1.1 Energy Balance

An Energy Balance is a reconciliation of energy use by each end use technology with the site's invoiced energy consumption. The energy balances in the following sections were generated using information from:

- Electricity invoices and TOU data
- Information about end use equipment load ratings [kW]
- Office/facility opening hours and equipment running hours

9.1.1.1 Electrical Energy Balance

Shown below in Figure 9-1 is the energy balance for electricity consumed at the Whakatāne District Council's Murupara Swimming Baths; the energy balance has been broken down into categories based on end use technology group. Compared to indoor pools, outdoor pools avoid using energy on space conditioning and lighting. Electricity is used in two main areas at the Murupara Swimming Baths: water heating and water circulation.

- Water heating is the largest electrical load and accounts for 79% of demand. Water heating is provided by two heat pumps and the main electrical loads are two compressors and some pumps.
- Excluding heating, the main electrical loads associated with operating each of the pool areas are the pump systems. Annual consumption accounts for 21% of electricity used.

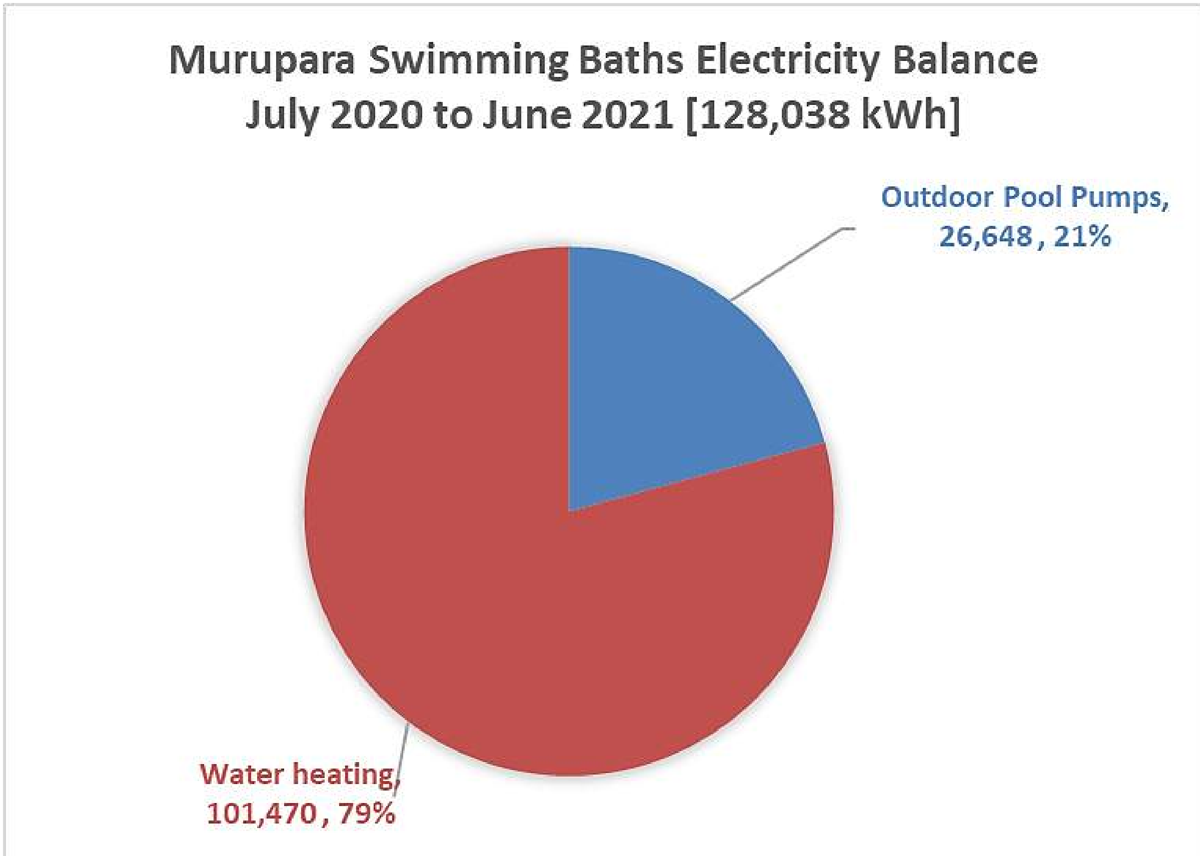


Figure 9-1 - Energy balance for the Murupara Swimming Baths, July 2020 to June 2021

9.1.2 Pumps

The circulation pump is 7.8 kW and uses approximately 26,600 kWh per year. The pools have a requirement to have turnover of 3 hours for the pool (210m^3/hr). It is estimated that the pump circulates water at a rate of 270 m^3/hr. By installing a VSD on the circulation pump, speed could be lowered to 72% of maximum and still meet the requirements. This would reduce the amount of power used by 62%. At the gross cost for the pools, 20 c/kWh, this would save $3,300 per year, and 16,600 kWh per year.

Additionally, if the pump speed was able to be lowered outside of normal operating hours, further savings could be achieved. Savings achieved for reducing the pump speed at night would save 6,300 kWh per year and $1,230 per year.

Recommendation

Install a VSD on the circulation pump, save approximately 23,000 kWh, $4,600, and 2,500 kgCO2e per year. At a cost of approximately $7,000 for a VSD and flow meter, payback is 1.5 years.

9.1.3 Hot Water Heat Pumps

The Murupara Swimming Baths use two heat pumps to heat the pool, one older and one newer. The older 95 kW heat pump is the lead heat pump and the newer 120 kW heat pump is used for trim. The older heat pump is nearing end of life and is due for replacement soon. Heat pumps are an efficient solution for heating water. When two heat pumps of similar size are used together, only one VSD is required to meet all levels of demand. Although VSDs improve efficiency when operating at part loads, there are inherent losses, even when operating at full capacity. Less energy would be used if only one VSD was installed for two heat pumps. When selecting a new heat pump, ensure to select a system that uses a low global warming potential (GWP) refrigerant.

9.1.4 Pool Covers

For outdoor pools, evaporation alone can be responsible for 70% of heat loss. Using a pool cover after hours will prevent evaporation and heat loss. Pool covers are particularly effective when used in windy areas as convective heat loss will be reduced. Pool covers also have other benefits such as reducing makeup water require by 30-50%, reducing chemical consumption, and reducing cleaning time by keeping dirt and other debris out of the pool.

Recommendation

Install pool covers for the 33m and toddler pool at the Murupara Swimming Baths, save approximately 35,500 kWh, $7,100, and 3,900 kgCO$_2$e annually. At an estimated cost of $32,000, payback is approximately 4.5 years. Simple paybacks for pool covers are usually between 2-3 years, however as the Murupara pools are only used in summer the payback is longer.

9.2 Whakatāne Oxidation Ponds

9.2.1 Energy Balance

An Energy Balance is a reconciliation of energy use by each end use technology with the site’s invoiced energy consumption. The energy balances in the following sections were generated using information from:

- Electricity invoices, TOU data, and smart meter readings
- Information about end use equipment load ratings [kW]
- Office/facility opening hours and equipment running hours

9.2.1.1 Electrical Energy Balance

Shown below in Figure 9-2 is the energy balance for electricity consumed at the Whakatane District Council’s Whakatāne Oxidation Ponds located on Shaw Rd. for both the NHH and TOU accounts; the energy balance has been broken down into categories based on end use technology group. The most notable results are:

- Aerators use 69% of annual electricity used by the Oxidation Ponds.
- Pumps account for 31% of annual electricity use.

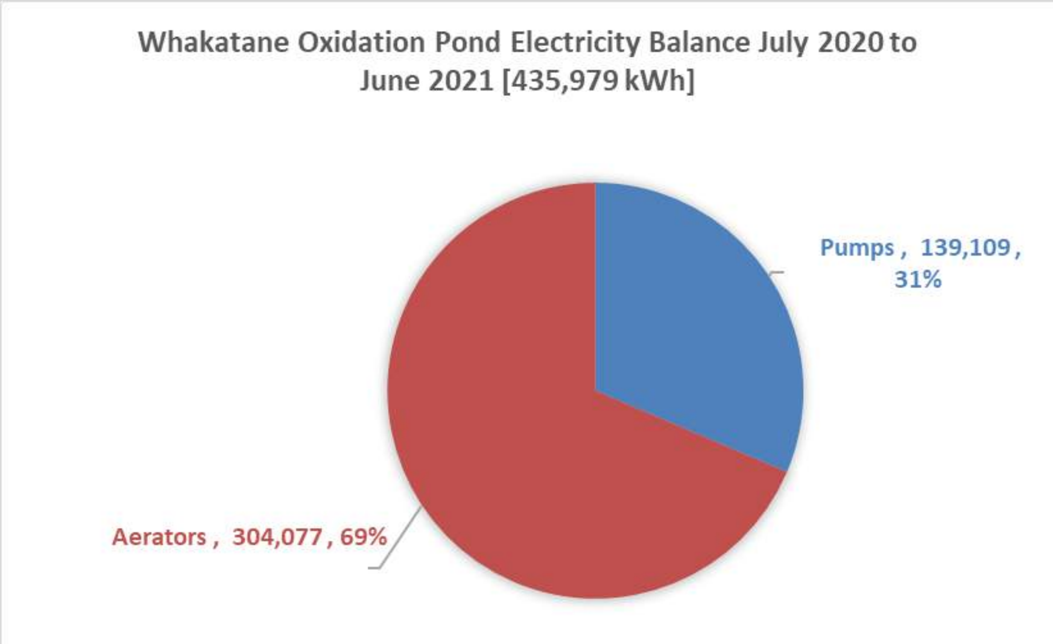


Figure 9-2 - Whakatāne Oxidation Ponds' electricity balance, July 2020 to June 2021

9.2.2 Pumps

The two 37 kW pump and motor systems installed at the ponds are modern with high efficiency pumps that are VSD driven. The smaller 11 kW pump is used during periods of low demand. This is an efficient arrangement, ongoing energy monitoring should be used to ensure the efficiency is maintained.

9.2.3 Aerators

Council has two types of aerator in use at its Whakatāne oxidation ponds. Shown below in Figure 9-3 is a mechanical surface aerator that works by agitating the water surface to promote uptake of oxygen and to generate mixing.

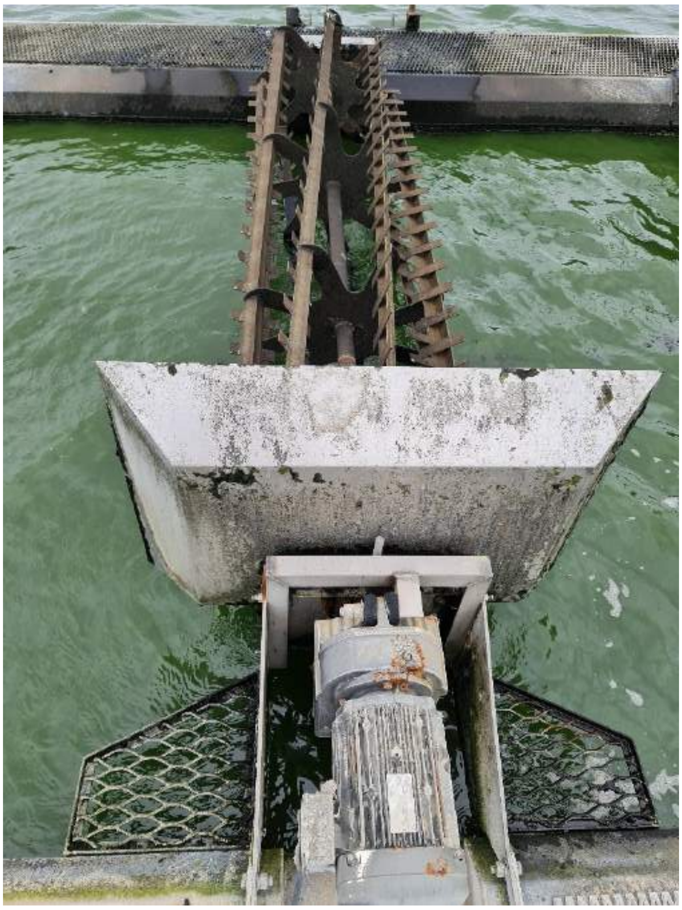


Figure 9-3 - Surface aerator at Whakatāne oxidation ponds

A second type of aerator in used is referred to as an Aquarator; these aerators use blowers to blow air into the water near the bottom of the pond to create an aeration and mixing effect. The manufacturer of these claims they use less energy per unit of waste treated. It is unlikely that there would be an investment case to change from one type to the other, however at times of replacement or significant maintenance of aerators this may become cost effective. To check the relative efficiency of aerators, Council would need to quantify energy use, dissolved oxygen levels, surface area and depth of the respective ponds, and any differences in biological oxygen demand (BOD) of the ponds.

9.2.4 Electricity Supply

Whakatane Oxidation Ponds are supplied electricity by two accounts, one is NHH and the other TOU account. Account details are listed in Table 9-1 below.

Table 9-1 Whakatane Oxidation Ponds' electricity accounts

ICP	Site	Type	Code	Supplier	kWh/yr.
1000011419BP583	Whakatane Oxidation Pond Aerators	TOU	N3R	Mercury	317,019
1000011418BP9C6	Whakatane Oxidation Pond	NHH	NMD	Genesis	118,960

Usually NMD accounts use more electricity, at the Whakatane Oxidation Ponds, the NMD account uses less than half of the electricity of the other account. N3R accounts have higher lines fees for electricity use ($/kWh) than NMD accounts. By combining these two ICPs, the Council would benefit from reduced lines charges for the N3R account and reduced retail cost for the NMD account. This would save the Council $6,200 in lines charges and $3,400 in retail costs. An additional $2,000 could be saved per year by decreasing combined transformer capacity to 150 kVA.

Recommendation
Combine ICPs for Whakatane Oxidation Ponds, save approximately $9,600 per year. This would require the NHH account to be supplied by Mercury, which could be done before contract renewal. Combining ICPs would require collaborating with the lines company.

9.3 Ohope Oxidation Ponds

9.3.1 Energy Balance

Shown in Figure 9-4 is the energy balance for electricity consumed at the Whakatāne District Council's Ohope Oxidation Ponds located on Wainui Rd. The energy balance has been broken down into categories based on end use technology group. The most notable results are:

- Discharge pumps use almost half of the electricity at the Oxidation Ponds
- Aerators use 31% of annual electricity used by the Oxidation Ponds.
- UV treatment accounts for 15% of annual electricity use.

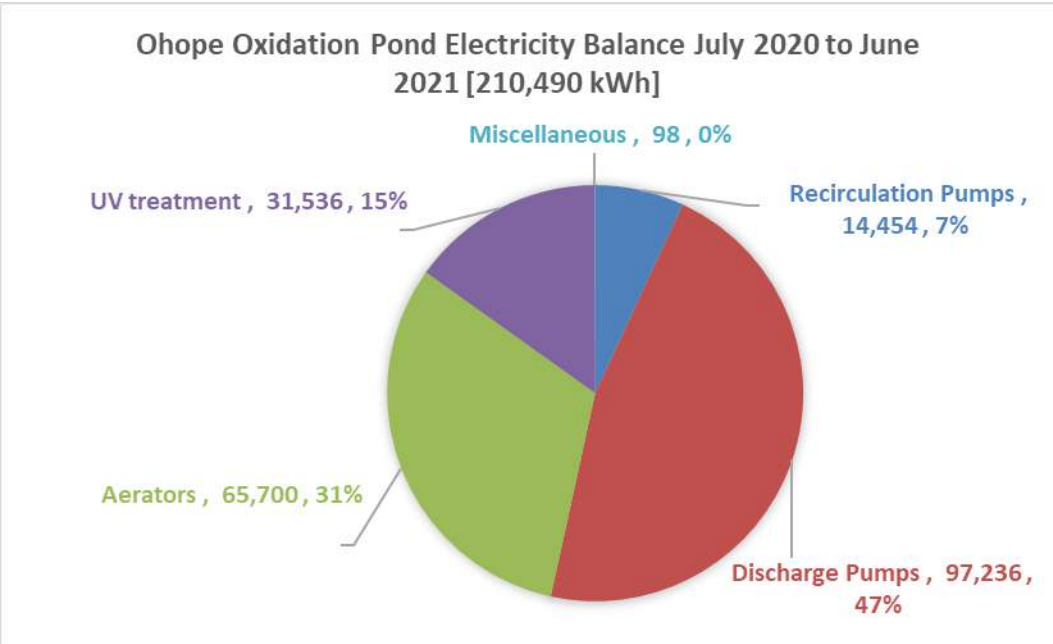


Figure 9-4 Ohope Oxidation Pond electricity balance, July 2020 to June 2021

9.3.2 Electricity Supply

Ohope Oxidation Ponds are supplied electricity from their NHH account with Genesis Energy, the account is currently classified under the N3R code. Due to the high percentage of loading for a smaller transformer, changing to a NMD account would save the Council on network charges. The Ohope Oxidation Ponds use a smart meter, demand was able to be estimated using these readings. Estimated annual network costs for both account categories are summarised in table below.

Table 9-2 Ohope Oxidation Ponds' annual network charges for account types

Annual Usage (kWh/yr.)	Code	Annual Capacity Charge	Annual Demand Charge	Annual Consumption Charge	Daily Fixed	Total Lines Charges
210,490	N3R	$0	$0	$10,956	$2,245	$13,201
210,490	NMD	$1,642	$3,495	$5,416	$0	$10,553

Changing the account to a NMD would save the council approximately $2,600 per year in lines charges. If the Council was able to take advantage of TOU pricing, retail costs would also decrease. The cost of electricity is expected to be 4.5 c/kWh less for TOU accounts. Savings from switching to TOU accounts is expected to save the Council a further $9,600 per year.

Recommendation

Change the electricity account from N3R to NMD and from NHH to TOU for the Ohope Oxidation Ponds, save approximately $12,000 per year in lines charges and retail charges. This would require the NHH account to be supplied by Mercury, which could be done before contract renewal. Changing the account type will require discussion with the lines company.

9.3.3 Pumps

The two discharge pumps are the largest loads on site at 15 kW and 22kW each. These are modern with high efficiency pumps and motors that are VSD driven. There is little to improve here, besides ongoing energy monitoring to ensure the efficiency is maintained.

9.3.4 Aerators

Surface aerators are used at Ohope oxidation ponds and these are generally controlled on a time basis. This means there is no direct control feedback to the amount of aeration actually required. Improving the control of these aerators would likely lead to a reduction in operating time which would save energy and reduce maintenance requirements. Control of aerators could initially be manually implemented by operators, or a control system could be implemented using dissolved oxygen (DO) levels as the control variable.

Recommendation

Improve control of the aerators to reduce operating hours. This will save 13,100 kWh and $2,600 per year in electricity. Carbon emission reductions from electricity savings are 1,400 kgCO_2e per year.

9.4 Museum and Research Centre

9.4.1 Energy Monitoring and Targeting

The Museum and Research Centre was not included in the 2018 audit, however it was later brought into Council's energy monitoring. Figure 9-5 and Figure 9-6 below show the electricity and gas monitoring produced and reviewed monthly for the Museum and Research centre. Council's energy management programme has included training of staff with HVAC operation, as well as improvements to the BMS control. These have led to the reductions in both electricity and natural gas observed in Figure 9-5 and Figure 9-6.

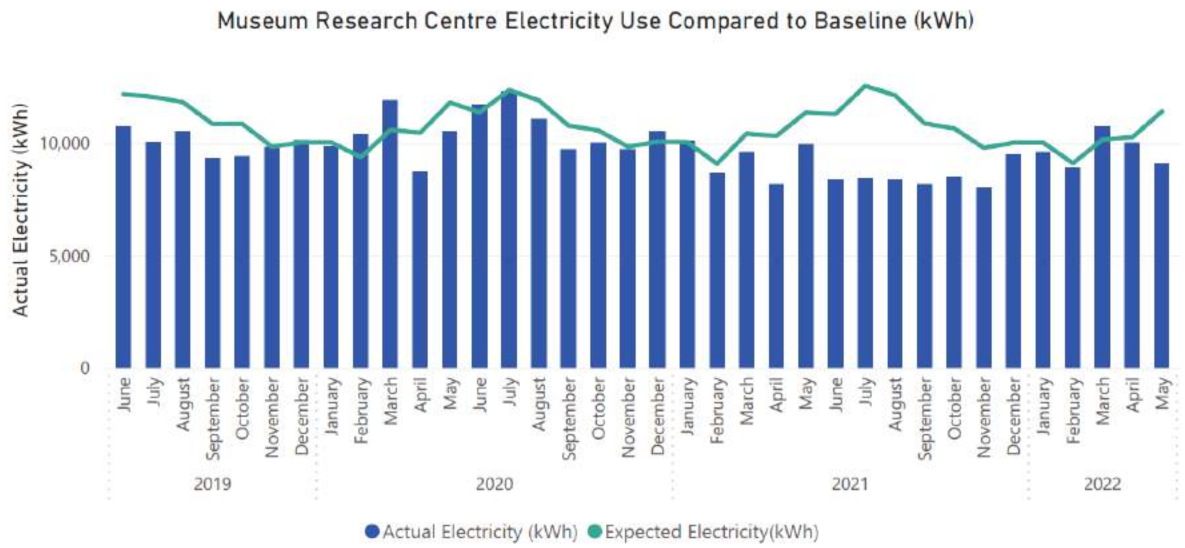


Figure 9-5 - Electricity monitoring from monthly reporting for Museum and Research Centre

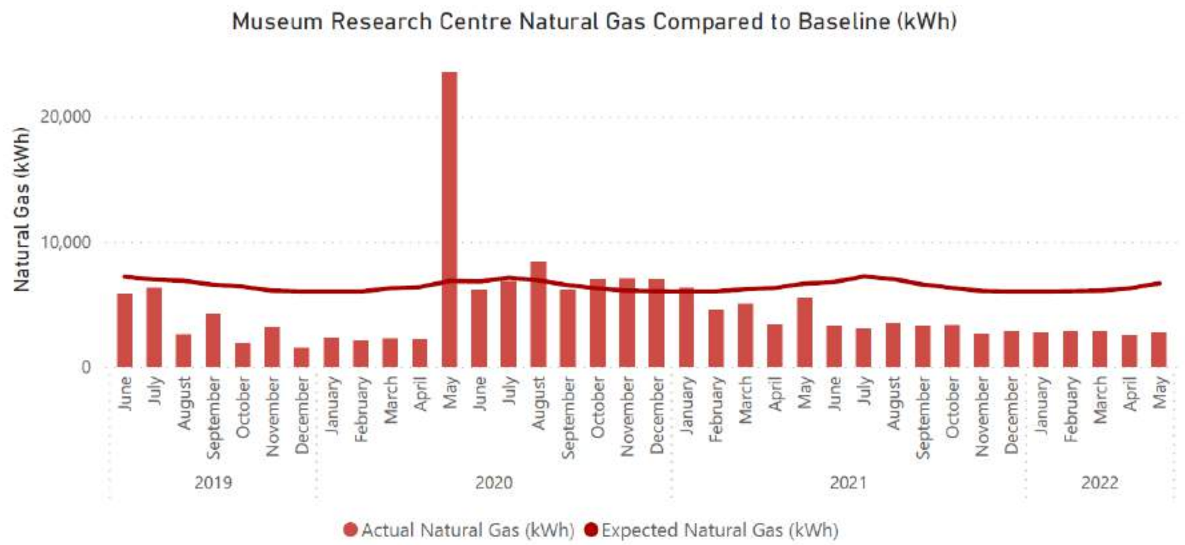


Figure 9-6 - Natural gas monitoring from monthly reporting for Museum and Research Centre

9.4.2 Continuous Commissioning

The Museum and Research Centre HVAC has split unit heat pumps for most areas occupied by staff. It also has a central HVAC system used for storage areas rooms that must have temperature and humidity tightly controlled due to the storage of artifacts. The system brings in fresh air via an air handling unit with cooling and heating capabilities. This air handling unit (AHU1) supplies air to three other AHUs. These three AHUs recycling air and allow in fresh air from AHU1. Each of these three AHUs (AHU2-AHU4) has the ability to cool, heat, or humidify the air. Dehumidification is done by cooling below the dew point to remove moisture, and then re-heating to the target air temperature. This central HVAC system is very similar to the Library and Exhibition Centre HVAC.

Recommendation

Council should continue to monitor energy use at the Museum and Research Centre as part of its energy management programme. This should include continuous commissioning of the HVAC and EUI benchmarking of the facility against the Library and Exhibition Centre.

9.4.3 Natural Gas Boilers

Heating for the central HVAC system is provided by two 110 kW natural gas fired hot water boilers. Water is heated to 60^{o}C and is passed through heating coils in the air handling units to provide space heating. This heating could be done more efficiently with heat pump, either by heating the water for the coils, or replacing the coils with new refrigerant coils connected to a heat pump. This would use less energy and would significantly reduce carbon emissions. Energy cost savings are not as significant, because the efficiency gained with the heat pump is offset by the higher marginal price of electricity compared to natural gas. This results in a payback period that is unfavourable, however this is highly sensitive to the relative prices of electricity and natural gas and may change quickly in the years ahead.

Replace natural gas boilers with a heat pump for space heating. Save a net $1,500 per year in energy costs and reduce carbon emissions by 12,800 kgCO_2e/year. Estimated capital cost is $40,000, giving a payback of 26.2 years.

Council has initiated a feasibility study that includes replacing natural gas use at its Museum and Research Centre with a lower carbon alternative. This study will develop a detailed business case for installing heat pumps in place of natural gas boilers.

9.5 Holiday Park

The Whakatane Holiday Park uses 192,000 kWh of electricity per year at a cost of $30,000. It also uses bottled LPG for hot water heating, costing $17,200 per year. The holiday park accounts for only 2.6% of total electricity used by Council, however it accounts for over 8% of annual carbon emissions. It's energy related carbon emissions are 81,000 kgCO_2e/year, making it the third largest emitter of all of Council's facilities. This is due to the higher emissions associated with LPG use compared to electricity.

9.5.1 LPG Hot Water Califonts

The Holiday Park uses bottled LPG for hot water califonts on eleven of its units. These have an advantage that heating is on demand, so there are no standing losses associated with a heated cylinder. Califonts are significantly less efficient than hot water heat pumps which are a common technology now for water heating. Furthermore, the carbon emissions associated with combusting LPG are much higher than electricity needed for a hot water heatpump, even after considering standing losses with hot water storage. Standing losses can be minimised by switching off water heating when cabins are not used.

Recommendation

Replace LPG hot water califonts with hot water heat pumps and switch off when cabins are not in use. Save $9,400 in annual energy costs and reduce carbon emissions by 55,600 kgCO_2e/year. Estimated cost is $88,000, giving a payback of 9.4 years.

Note, Council has initiated a feasibility study that will include a detailed business case for replacing LPG califonts with a low carbon alternative.

9.5.2 Energy Monitoring and Targeting

The Holiday Park has not yet been incorporated into Councils energy monitoring and targeting. Council's Energy Action Group has agreed this should be included in future monitoring. This will help capture the impact of any fuel switching that is implemented. Section 6.4.1.1 shows the relationship between heating degree days and electricity use on a monthly basis. There is a correlation, however there are clearly other factors that can affect electricity used too. Council may wish to explore using bed-nights as a factor in its baseline for energy monitoring.

Recommendation

Include the Holiday Park in monthly energy monitoring and targeting. Consider using bed-nights as an independent variable for the electricity baseline.

9.6 War Memorial Hall

The War Memorial Hall uses 80,000 kWh/year of electricity at a cost of $14,900. It also uses 31,300 kWh/year of natural gas at a cost of $4,900. Annual energy related carbon emissions are 15,200 kgCO_2e. This accounts for 1.6% of Council's annual energy related carbon emissions and has the 14th highest level of emissions of Council's facilities.

9.6.1 Natural Gas Boiler

The War Memorial Hall is one of the few remaining Council facilities that uses natural gas. It has a 660 kW natural gas fired boiler that is used for space heating. Heating is used infrequently, however is highly inefficient when it is used. Fan coil units are located near the top of the stadium area, next to an uninsulated roof. Temperature stratification means significant energy is required to have any meaningful effect at ground level.

Heating is often only needed for short periods in the stadium. This would more effectively be done with radiant heaters, which would avoid having to heat the entire volume of air in the stadium. The foyer and theatre areas could be heated with split unit heat pumps.

Replace natural gas boiler with a combination of radiant heating in the stadium, and heat pumps in the foyer and theatre. This will save $1,200 in net energy costs per year and reduce annual carbon emissions by 4,400 kgCO_2e. Estimated cost is $40,000, resulting in a 31.3 year payback.

This opportunity will be explored in detail in a separate natural gas feasibility study. The return on investment is unlikely to be attractive; Council needs to factor in its long term plans for the War Memorial Hall with any potential investments.

10 Energy Management Programme

Whakatāne District Council has a desire to be proactive in mitigating the environmental impacts of its facilities and operations, with a special interest in reducing CO_2 emissions that contribute to climate change. The Council aims to be a leader within the Whakatāne district with its energy efficiency and climate change mitigation activities.

Whakatāne District Council initiated its energy management programme by commissioning an energy audit in 2018 and has shown commitment by expanding the audit to cover the next tier of assets by commissioning this audit. The Council has also been monitoring energy use for some of its primary facilities since September 2019. The Council has recently undertaken a redevelopment of its Civic Centre, with goals to reduce energy consumption and increase energy efficiency and several case studies have been produced as part of the Energy Management Programme that help to improve community engagement.

Through Whakatāne District Council's Energy Management Policy, an Energy Action Plan was incorporated into a Sustainability Policy review in 2019. Whakatāne District Council is fortunate to have a team interested in improving energy efficiency. A number of staff members have an awareness of the processes and technologies involved with energy management, as well as the importance of gathering key energy usage data. A strategy for managing energy to help Council towards its goal of becoming carbon neutral by 2030 is presented in the Appendices, Section 12.4.

As a result of the Council's Energy Management Programme, in the 12 months to March 2022, \$136,000, 1,700,000 kWh, and 342,000 kg CO_2e has been saved, which is an excellent result. The Council's commitment to reducing energy use and carbon emissions, along with staff engagement has been keystones to the programme's success. It is important to keep the momentum that the Council has gained through the programme, without energy management, energy productivity typically declines at a rate of 3% per year. *Without continued energy management, the Council could expect energy costs to increase by \$44,000/year, energy use increase by 240,000 kWh/year, and CO_2e emissions to increase by 29,000 kgCO_2e/year*.

For an established energy management programme, it is expected that energy productivity improves by 2% per year, approximately \$29,000, 160,000 kWh, and 19,600 kg CO_2e.

Recommendation

Continue with ongoing energy management activities. At a cost of \$25,000 per year, increase savings by \$4,500, 160,000 kWh, and 19,600 kg CO_2e, and prevent regression of \$44,000, 240,000 kWh, and 29,000 kgCO_2e

10.1 Organisation

"Organisation" is about ensuring the appropriate personnel structure is in place for Whakatāne District Council to deliver improved energy savings in the most efficient manner. Central to any successful energy management programme is a coordinator and driver that makes it happen; otherwise it won't happen. It is important they have appropriate time available to commit to energy projects as well as their normal day to day responsibilities.

A rule of thumb advised by EECA is to commit one full time employee for every $3M spent annually on energy. At Whakatāne District Council, this equates to a person spending approximately half their time in this role. Unless a person(s) has the allocated time and resources, energy management will not be enough of a priority among daily activities to happen.

Council has a Climate Change Co-ordinator role established; this position was held by Katri Harmoinen until December 2021. **Council needs to prioritise recruitment for this position**.

This person would:

- Develop and maintain an energy management plan,
- Raise staff awareness
- Commission and support monitoring, targeting and reporting achievements
- Coordinate savings projects
- Work with agreements between Whakatāne District Council and maintenance contractors
- Work closely with an energy champion at each facility
- Maintain Council's annual carbon inventory

The list of recommendations in this energy audit can be added to Council's action plan.

Council has established an Energy Action Group which is effectively a steering committee for energy and carbon management. The group meets bimonthly and includes representatives from large energy using facilities, as well as Council management. The group is chaired by Georgina Fletcher (General Manager Community Experience). Emsol attends bimonthly Energy Action Group meetings to provide technical expertise and guidance to Council.

Energy champions at each facility can reduce energy use by making ongoing improvements in efficiency and avoiding energy waste. This includes:

- Ensuring equipment and lights operate only when needed
- Reviewing the size and or/control of water pumps
- Fitting automatic controls to control space heating and cooling
- Upgrading lights to LED
- Change temperature set points to match each season

10.2 Monitoring

Energy monitoring, targeting and reporting is a key element to any savings programme and has been a big part of the success Council has achieved to date. This needs to be central to all other aspects of improving energy management. EECA advise that "implementing an M&T programme will lead to savings of 5-25% of the annual energy expenditure".

Whakatāne District Council initiated a monitoring and targeting programme following the 2018 Type 2 Energy Audit and included these large energy using facilities:

- Aquatic Centre
- Whakatāne Water Treatment Plant
- Braemar Rd Pumps
- Paul Rd Pumps
- Civic Centre
- Te Koputu Library and Exhibition Centre

Council has added facilities to its monitoring programme over the course of its energy management programme and during this audit update. These include:

- Museum and Research Centre
- Johnson Rd Pumps
- Whakatāne Oxidation Ponds
- Ohope Oxidation Ponds
- McAlister St Pumps
- Rose Garden Pumps
- War Memorial Hall
- Murupara Swimming Baths (yet to be added)
- Whakatāne Holiday Park (yet to be added)
- Bridger Glade Pumps

Whakatāne District Council now includes energy dashboards on its website. These are updated monthly.

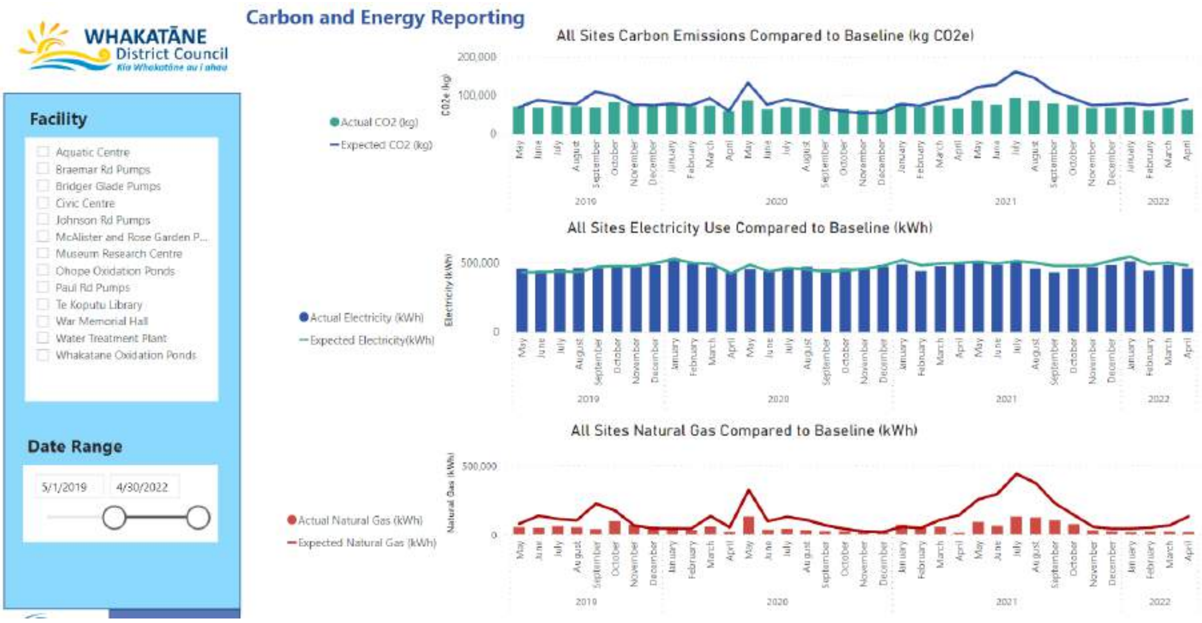


Figure 10-1 - Example of energy dashboards available at Whakatāne District Council's website

10.3 Marketing

Council has used case studies effectively to market energy efficiency and carbon management both internally and externally. Some of these case studies have made both local and national newspapers.

The energy dashboards shown in Section 10.2 are also an effective tool to market energy efficiency to the community.

The formal launching and maintaining of an energy savings programme has helped to develop an energy saving culture and maintain input from staff. Some individuals are good with closing doors and switching off equipment and lights when not needed; however, there are still many opportunities with improving these procedures. Seeking ideas, using notice boards, raising awareness at staff meetings and events helps easily and cheaply achieve “buy-in” to the energy efficiency message.

Council’s Energy Action Group and an energy champion (previously this was the Climate Change Co-ordinator) are responsible for the effective marketing of its energy management internally and to the public, in line with Council’s goal to be a leader in the community in this space.

12 Appendices

12.1 Electricity Accounts

Location	Annual Electricity Use (kWh)	Annual Cost ($/yr)	Gross Marginal Cost (c/kWh)
XMAS TREE LIGHTS, MAIN STREET, EDGECUMBE	- 10,456	-$926	8.9
STAGE AREA, CHARLES STREET, OHOPE, WHAKATANE	- 13,769	-$1,374	10.0
Aquatic Centre Short St	1,374,393	$167,823	12.2
Water Treatment Plant Taneatua Road	1,534,656	$205,591	13.4
I-SITE, TOP FLOOR, 2 KAKAHOROA DRIVE, WHAKATANE	29,071	$4,097	14.1
Braemar Rd Pump Station	548,030	$78,208	14.3
Whakatane Oxidation Pond Aerators	317,019	$45,577	14.4
OXIDATION PONDS OHOPE, 136 WAINUI ROAD, OHOPE	210,490	$30,290	14.4
WATER PUMP STN, 0 NGAHINA ROAD, REWARAU	144,884	$21,864	15.1
TE TEKO PUMP STN, 0 TAHUNA ROAD, TE TEKO	133,498	$20,218	15.1
1 MCGARVEY ROAD, WHAKATANE	192,080	$30,039	15.6
WATER STATION, 0 PUKETI ROAD, TANEATUA	74,638	$11,782	15.8
SEWERAGE STATION, 0 TUATI STREET, PORT OHOPE	28,215	$4,455	15.8
GREEN SHED KNS OF ROAD, 0 THORNTON ROAD, THORNTON	69,225	$11,070	16.0
HARBOUR CAR PARK BIG GAME, 0 MURIWAI DRIVE, WHAKATANE	25,623	$4,127	16.1
Te Koputu Library Kakahoroa Drive	143,772	$23,567	16.4
Civic Centre Commerce St	362,106	$59,502	16.4
BRIDGER GLADE, 0 MOKORUA GORGE, WHAKATANE	159,400	$26,649	16.7
WHAKATANE OXIDATION PONDS, 100 SHAW ROAD, WHAKATANE	118,960	$20,238	17.0
WHAKATANE MAIN COMMERCIAL WHARF, STRAND EAST, WHAKATANE	19,174	$3,301	17.2
0 Kiorenui Murupara Murupara Bay of Plenty	98,775	$17,046	17.3
TOILETS HEADS, 0 MURIWAI DRIVE, WHAKATANE	16,879	$2,998	17.8
SEWERAGE STATION, 0 DOUGLAS STREET, WHAKATANE	16,238	$2,887	17.8
SEWER STN MARAETOTARA RESERVE, POHUTUKAWA AVENUE, OHOPE	16,876	$3,007	17.8
Paul Rd Pump Station	419,504	$75,145	17.9
ROSE GARDEN DRAINAGE PUMPO STN, 0 MCGARVEY ROAD, WHAKATANE	45,025	$8,140	18.1
REFUSE SORTING SHED, 52 TE TAHI STREET, WHAKATANE	15,543	$2,823	18.2
STREETLIGHTS COMMERCE, COMMERCE STREET, WHAKATANE	11,459	$2,121	18.5
AIRPORT LIGHTING, 0 AERODROME ROAD, WHAKATANE	27,563	$5,117	18.6
WHK GREEN WHARF, 0 KAKAHOROA DRIVE, WHAKATANE	14,563	$2,711	18.6
AIRPORT TERMINAL, 0 AERODROME ROAD, WHAKATANE	27,123	$5,057	18.6
WHK WAR MEM HALL, 0 SHORT STREET, WHAKATANE	79,980	$14,936	18.7
0 MCALISTER STREET, WHAKATANE	32,345	$6,236	19.3
SEWERAGE STATION, 67 POHUTU STREET, WHAKATANE	12,967	$2,508	19.3
Swimming Baths 68 Pine Drive Murupara	128,038	$25,591	20.0
U/VERANDAH LIGHTING THE STRAND, 262 WDC THE STRAND, WHAKATANE	11,483	$2,314	20.1
Museum and Research Centre Boon Street	118,046	$24,075	20.4
DEPOT & WORKSHOP, 0 TANEATUA ROAD, WHAKATANE	60,218	$12,331	20.5
WATER STATION, 60 JOHNSON ROAD, OTAKIRI	167,766	$34,752	20.7
U/VERANDAH LIGHT KAKAHOROA DR, 1 KAKAHOROA DRIVE, WHAKATANE	10,564	$2,201	20.8
HEADS HARBOUR HOUSE, 1A MURIWAI DRIVE, WHAKATANE	8,560	$1,795	21.0
DOG POUND, 0 TE TAHI STREET, WHAKATANE	8,185	$1,738	21.2
UNDER VERANDAH LIGHTING, 172 THE STRAND, WHAKATANE	9,808	$2,104	21.5
CREMATORIUM, 0 OHOPE ROAD, OHOPE	15,719	$3,442	21.9
WORKSHOP VALLEY ROAD, 0 TANEATUA ROAD, WHAKATANE	22,462	$4,943	22.0

Location	Annual Electricity Use (kWh)	Annual Cost ($/yr)	Gross Marginal Cost (c/kWh)
WHAKATANE YOUTH CENTRE, 4 THE STRAND, WHAKATANE	8,923	$1,995	22.4
COUNCIL UNDERVARANDA LIGHT, JAMES STREET, WHAKATANE	7,160	$1,631	22.8
SEWER STATION, 0 HINEMOA STREET, WHAKATANE	43,281	$9,936	23.0
SEWER PUMP STATION, 0 AWATAPU DRIVE, WHAKATANE	8,304	$1,911	23.0
0 EDGECUMBE ROAD, AWAKERI-EDGE	12,310	$2,940	23.9
STORMWATER, 0 MCALISTER STREET, WHAKATANE	56,200	$13,767	24.5
PARKS DEPOT PIRIPAI, 0 KEEPA ROAD, RD 1, WHAKATANE, WHAKATANE	11,204	$2,810	25.1
WATER STATION, 21 HODGES ROAD, WAIMANA	11,125	$2,803	25.2
SEWER STATION, 37 KOWHAI STREET, EDGECUMBE	6,879	$1,736	25.2
WATER TREATMENT PLANT, 0 CAVERHILL ROAD, MATATA	10,231	$2,669	26.1
EDGECUMBE MEM HALL, 0 MAIN STREET, EDGECUMBE	6,073	$1,633	26.9
AMBER GROVE DRAINAGE PUMP STNN, 0 AMBER GROVE, WHAKATANE	5,573	$1,557	27.9
LIGHTS PORT OHOPE WHARF SHED, HARBOUR ROAD, OHOPE	4,964	$1,388	28.0
WAIRAKA RESERVE, 0 MURIWAI DRIVE, WHAKATANE	5,471	$1,549	28.3
PIKOWAI TOILETS, 0 TAURANGA ROAD, MATATA	17,831	$5,089	28.5
SEWERAGE STATION, 0 FERRY ROAD, WHAKATANE	5,357	$1,529	28.5
ROCK LIGHTS CANNING PLACE, CLIFTON ROAD, WHAKATANE	4,816	$1,375	28.6
EDGECUMBE LIBRARY, 0 COLLEGE ROAD, EDGECUMBE	5,073	$1,507	29.7
TOILETS I-SITE LOWER FLOOR, 2 KAKAHOROA DRIVE, WHAKATANE	4,501	$1,339	29.7
MURUPARA SERVICE CENTRE, 0 PINE DRIVE, MURUPARA	15,763	$4,802	30.5
OHOPE HALL, BLUETT ROAD, OHOPE	11,128	$3,398	30.5
1D MURIWAI DRIVE, WHAKATANE	7	$2	31.0
WDC PUMP-, 0 RATA AVENUE, EDGECUMBE	10,420	$3,313	31.8
0 COMMERCE STREET, WHAKATANE	3,914	$1,334	34.1
REX MORPETH PARK ATHLETIC CENTR, 0 SHORT STREET, WHAKATANE	3,871	$1,342	34.7
TOILETS CUTLER CRES, 0 CUTLER CRESCENT, WHAKATANE, WHAKATANE	3,716	$1,323	35.6
LANDFILL PUMP, 0 CAVERHILL ROAD, MATATA	5,443	$1,967	36.1
SEWERAGE STATION, 169 POHUTUKAWA AVENUE, OHOPE	3,360	$1,279	38.1
MURUPARA SPORTS PAVILLION, 0 PINE DRIVE, MURUPARA	10,141	$4,065	40.1
TE MAHOE, TE MAHOE	10,132	$4,067	40.1
SEWERAGE STATION, 0 POHUTUKAWA AVENUE, OHOPE	3,102	$1,246	40.2
UNDER VERANDAH LIGHTING, 8 WDC RICHARDSON STREET, WHAKATANE	2,862	$1,150	40.2
WATER STATION, 515 MC DONALDS ROAD, TETEKO	4,344	$1,815	41.8
SEWERAGE STATION, 0 FISHERMANS DRIVE, WHAKATANE	6,664	$2,789	41.9
SEWER PUMP, 245 HARBOUR ROAD, OHOPE	2,856	$1,214	42.5
SEWERAGE STATION, BRIDGE STREET, WHAKATANE	6,091	$2,683	44.1
0 EDGE TE TEKO ROAD, TE TEKO	8,843	$3,935	44.5
SEWER PUMP STN, 25 WESTEND, OHOPE	2,625	$1,185	45.1
CIVIL DEFENCE WAIEWE ST, 30 WAIEWE STREET, WHAKATANE	2,513	$1,171	46.6
TRANSFER STATION, 21 HARAKEKE ROAD, MURUPARA	2,310	$1,089	47.1
SEWERAGE STATION, 351 HARBOUR ROAD, OHOPE	2,207	$1,065	48.3
OLD WHAKATANE WHARF RESTAURANT, 2 THE STRAND, WHAKATANE	5,315	$2,567	48.3
HUB SEWER STN, PHOENIX DRIVE, WHAKATANE	2,316	$1,138	49.1
PUMP STATION, WHITE HORSE DRIVE, WHAKATANE	2,232	$1,135	50.8
DRAINAGE PUMP STATION, 0 BARRY AVENUE, WHAKATANE	4,834	$2,519	52.1
PYNE STREET, WHAKATANE	1,380	$721	52.2
SEWER PUMP STATION, 8 FACTORY ROAD, EDGECUMBE	3,150	$1,664	52.8
SEWERAGE STATION, 0 HARBOUR ROAD, OHOPE	2,071	$1,114	53.8

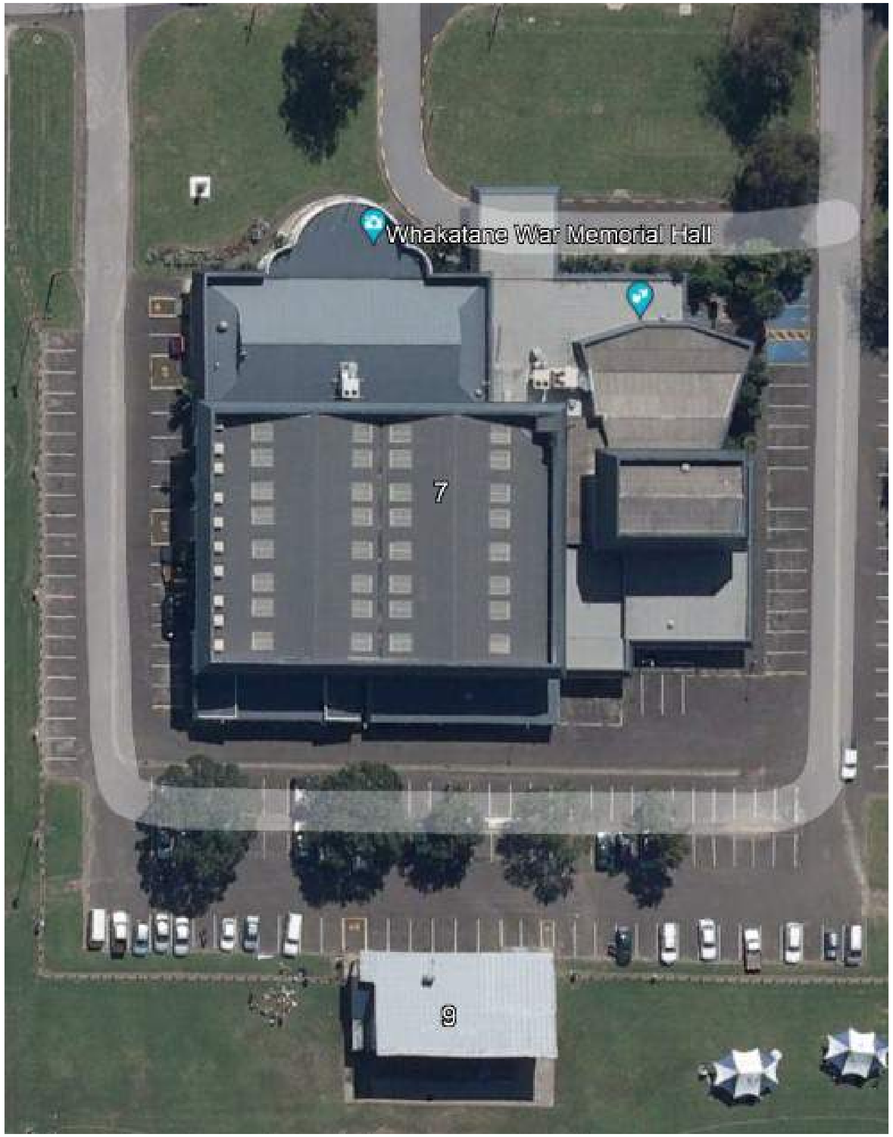
Location	Annual Electricity Use (kWh)	Annual Cost ($/yr)	Gross Marginal Cost (c/kWh)
SEWERAGE STATION, 77 MURIWAI DRIVE, WHAKATANE	2,035	$1,110	54.5
SEWERAGE STATION, 2 HYDRO ROAD, EDGECUMBE	2,043	$1,120	54.8
THE GAP COUNCIL LIGHTS ETC, 136-142 THE STRAND, WHAKATANE	1,902	$1,047	55.1
WATER STATION, MELVILLE DRIVE, WHAKATANE	4,066	$2,309	56.8
TOILETS HARBOUR ROAD, 58113 HARBOUR ROAD, OHOPE	1,814	$1,037	57.2
SEWER STATION, 59 WEST END ROAD, OHOPE	1,783	$1,077	60.4
SEWER PUMP, 38 OCEAN ROAD, OHOPE	1,713	$1,068	62.4
SEWERAGE STATION, 32 TAWHARA PLACE, EDGECUMBE	1,720	$1,076	62.6
LIBRARY OHOPE, HARBOUR ROAD, OHOPE	1,618	$1,015	62.7
SEWER STATION, 74 WATERWAYS DRIVE, OHOPE	1,694	$1,066	62.9
SEWER PUMP, 102 COLLEGE ROAD, EDGECUMBE	1,692	$1,072	63.4
AIRPORT WATER FAC, 0 AERODROME ROAD, WHAKATANE	2,449	$1,554	63.4
MAHY RESERVE TOILETS, 0 POHUTUKAWA AVENUE, OHOPE	1,435	$1,033	72.0
PUMP STN CNR KEEPA & BUNYAN RD, OHUIRERE ROAD, WHAKATANE	1,446	$1,041	72.0
SEWERAGE STATION, 38 BRIDGE STREET, EDGECUMBE	1,394	$1,034	74.2
TOILETS BOON ST, 0 BOON STREET, WHAKATANE	1,319	$981	74.4
SEWERAGE STATION, 0 GATEWAY DRIVE, WHAKATANE	1,359	$1,016	74.8
RICHARDSON STREET LIGHTS, RICHARDSON STREET, WHAKATANE	1,288	$973	75.5
OTAKIRI HALL, SOLDIERS ROAD, OTAKIRI	1,923	$1,488	77.4
LOT102, SHAW ROAD, RD 1, WHAKATANE	1,723	$1,448	84.0
SEWERAGE STATION, 10 TUHOE STREET, TANEATUA	3,791	$3,273	86.3
WATER PUMP STN, 16 TE MAHOE SCHOOL ROAD, RD 2, WHAKATANE	1,583	$1,424	90.0
SEWER PUMP STATION, 132 COLLEGE ROAD, EDGECUMBE	1,094	$996	91.0
WAIMANA HALL, 0 MAIN STREET, WAIMANA	1,548	$1,439	92.9
SERVICES SHED, ANIWHENUA CAMPGROUND, 71 BLACK ROAD, RD 1, MURUPARA	95	$89	94.1
DRAINAGE PUMP STATION, 0 GATEWAY DRIVE, WHAKATANE	970	$966	99.6
WATER STATION, OTARAWAIRERE, OHOPE	3,158	$3,187	100.9
TOILETS MATATA, DIVISION STREET, MATATA	919	$938	102.1
OTAKIRI FLOOD PUMP, 2 RIVERSLEA ROAD, EDGECUMBE	5,520	$5,842	105.8
SEWERAGE STATION, 0 CLAYDON PLACE, OHOPE	840	$957	113.9
SEWER PUMP PAST GATE, 63 BUNYAN ROAD, WHAKATANE	1,203	$1,371	114.0
DRAINAGE PUMP STATION, 0 DOUGLAS STREET, WHAKATANE	807	$951	117.8
SEWER PUMP STN AMOKURA RD, 0 AMOKURA ROAD, TANEATUA	2,524	$3,108	123.1
SEWERAGE STATION, 202 HARBOUR ROAD, OHOPE	721	$896	124.3
FLOOD PUMP DOUGLAS ST, 35 DOUGLAS STREET, WHAKATANE	1,655	$2,064	124.7
DRAINAGE PUMP STATION, 0 ARAWA ROAD, WHAKATANE	3,148	$4,163	132.2
SEWERAGE STATION, 0 STRAND EAST, WHAKATANE	670	$935	139.5
SEWERAGE STATION NO 10, 0 EASTBANK ROAD, AWAKERI-EDGE	916	$1,326	144.7
Flood Pumps McAlister St Whakatane	22,204	$32,720	147.4
TELEMETERY SITE, 1159 MATATA ROAD, EDGECUMBE	592	$911	153.9
SEWERAGE STATION, 0 ANNE STREET, OHOPE	591	$925	156.5
WATER RESERVOIR, 0 KOWHAI STREET, OHOPE	562	$896	159.5
TOILETS SURF CLUB, 0 POHUTUKAWA AVENUE, OHOPE	520	$884	170.0
TOILETS, 237 POHUTUKAWA AVENUE, OHOPE	508	$890	175.3
TOILETS NOVALOO EDGE RUGBY, WEST BANK ROAD, EDGECUMBE	728	$1,315	180.6
31 QUAY STREET, WHAKATANE	432	$843	195.2
SEWER PUMP STATION, 0 AWATAPU DRIVE, WHAKATANE	7,200	$14,304	198.7
WATER RESERVOIR, 0 TANEATUA ROAD, WHAKATANE	389	$868	223.1
TOILETS THORNTON, 0 THORNTON BEACH ROAD, THORNTON	388	$870	224.1

Location	Annual Electricity Use (kWh)	Annual Cost ($/yr)	Gross Marginal Cost (c/kWh)
TOILETS COASTLANDS, 0 OHUIREHE ROAD, WHAKATANE	390	$884	226.7
WORKS DEPOT HARAKEKE ROAD, 0 MAIN ROAD, MURUPARA	558	$1,276	228.6
SEWER PUMP STN, 27 BUNYAN ROAD, WHAKATANE	560	$1,292	230.7
PUMP STATION, 0 KEEPA ROAD, WHAKATANE	4,200	$10,402	247.7
WHAKATANE AIRPORT, MAIN GATE P1, 141 AERODROME ROAD, RD 1, WHAKATANE	302	$812	269.0
DRAINAGE PUMP STATION, 0 HINEMOA STREET, WHAKATANE	602	$1,917	318.5
OXIDATION PONDS MURUPARA, 0 NGATIMANAWA ROAD, MURUPARA	370	$1,249	337.5
DRAINAGE PUMP STATION, 0 SALONIKA STREET, WHAKATANE	259	$878	338.8
Pumps near SH30 57D Mill Road Coastlands	5,467	$19,448	355.7
TOILETS WEST END, 0 WEST END, OHOPE	237	$852	359.6
DRAINAGE PUMP STATION, 127 RIVERSIDE DRIVE, WHAKATANE	243	$879	361.5
TOILETS OHIWA WHARF, 0 HARBOUR ROAD, OHOPE	229	$851	371.8
PUMP IN CAR PARK, 13 CLIFTON ROAD, WHAKATANE	195	$855	438.5
TOILETS NTH EIVERS ROAD, 1 EIVERS ROAD, WHAKATANE	187	$849	454.3
SEWER PUMP STN, 0 OHUIREHE ROAD, COASTLANDS	274	$1,251	456.7
PUMP STATION WHAKATANE BRIDGE, THE HUB, WHAKATANE	3,000	$15,088	502.9
WHK ROSE GARDENS, 0 MCGARVEY ROAD, WHAKATANE	166	$847	510.3
PUBLIC TOILET, LIGHTS & HOT WATER, 16 KOROMIKO STREET, MURUPARA	143	$795	555.6
SEWERAGE STATION, 0 WAIEWE STREET, WELLINGTON	338	$1,891	559.4
PARKS PLAYGROUND, 50 TUHOE STREET, TANEATUA	151	$859	568.8
TOILETS PLANTATION, 0 PLANTATION RESERVE, OHOPE	146	$850	581.9
SURFCLUB - MAHY RESERVE, PUBLIC TOILETS, 7 MAIR STREET, OPHOPE	145	$852	587.8
AWATAPU FLOOD PUMP NORTH END, AWATAPU DRIVE, WHAKATANE	1,500	$9,392	626.1
SEWERAGE STATION, 0 WAINUI ROAD, OHOPE	189	$1,229	650.1
DRAINAGE PUMP, 151 JAMES STREET, WHAKATANE	129	$861	667.4
TE TEKO TOILETS, 0 ROTORUA ROAD, TE TEKO	182	$1,223	671.9
TOILETS OCEAN RD, 0 OCEAN ROAD, OHOPE	106	$845	797.2
0 MANAWAHE ROAD, MATATA	70	$1,232	1,760.2
DETAILING SHOP, 0 MCALISTER STREET, WHAKATANE	62	$1,291	2,082.0
FLOW METER MURUPARA, 68 MIRO DRIVE, MURUPARA	31	$833	2,685.9
CRICKET IRRIGATION, 0 GOULSTONE ROAD, WHAKATANE	28	$832	2,969.7
BOWLING CLUB, 16A KOWHAI AVENUE, EDGECUMBE	10	$820	8,198.4
VERANDAH LIGHTS STRAND EAST, 56 STRAND EAST, WHAKATANE	1	$833	83,329.0
AREA STREET LIGHTS WHK, SLIGHTS WHAKATANE STREETLIGHTS, WHAKATANE	DUML	$54,807	N/A
AREA AMMENITY LIGHTS WHK, SLIGHTS AMMENITY LIGHTS WDC, WHAKATANE	DUML	$5,227	N/A
AREA STREET LIGHTS MURUPARA, SLIGHTS RUATAHUINA STREETLIGHTS, RUATAHUNA	DUML	$4,989	N/A
MITCHELL PARK, 27 PYNE STREET, WHAKATANE	-	$849	N/A
FLOW METER EDGECUMBE, 160 COLLEGE ROAD, EDGECUMBE	-	$840	N/A
FOXGLOVE PUMP STATION, 61 MELVILLE DRIVE, WHAKATANE	-	$833	N/A
SEWER STATION, 132 HARBOUR ROAD, OHOPE	-	$830	N/A
TOILETS SOCCER PAV, 0 SHORT STREET, WHAKATANE	-	$828	N/A
0 WEKA STREET, WHAKATANE	-	$828	N/A
PUMP STATION, RIVERSIDE DRIVE, WHAKATANE	-	$828	N/A
AREA AMMENITY LIGHTS MURUPARA, SLIGHTS MURUPARA AMMENITY LIGHTS, MURUPARA	DUML	$401	N/A

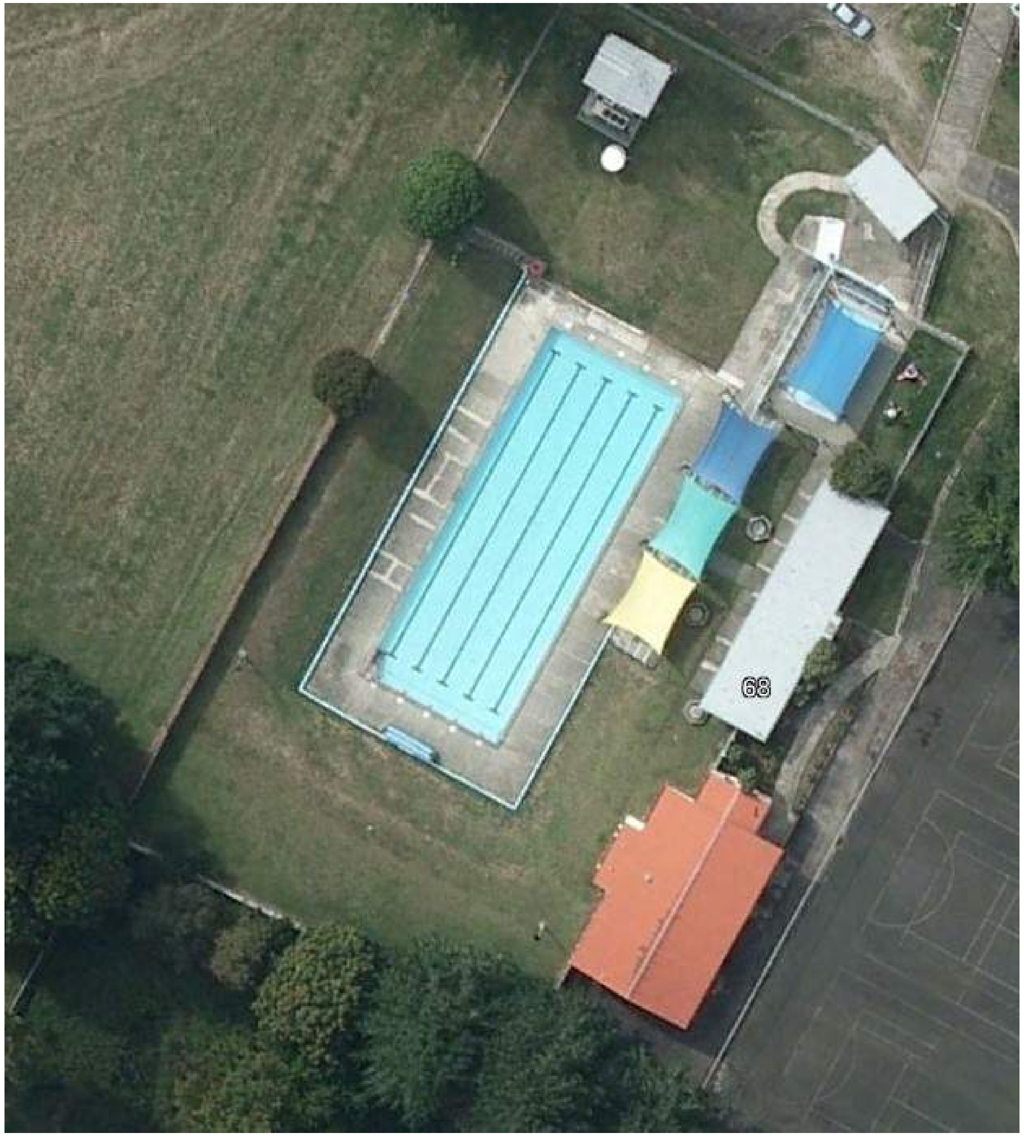
12.2 Site Maps

12.2.1 Whakatane Holiday Park

12.2.2 War Memorial Hall



12.2.3 Murupara Swimming Baths



12.2.4 Whakatane Oxidation Ponds

12.2.5 Ohope Oxidation Ponds

12.3 Energy Balance

12.3.1 Whakatane Oxidation Pond (NHH and TOU combined)

Department	Technology	Description	No. of items	kWh/yr	ave load kW	Hours/ year	After hrs (kW)	After hours % load	Process hrs (kW)	Process % load	kW rating per item	After hours/ year	Process hours/ year	Processing hours / week	Hrs/ wk outside process hrs	weeks per year	Days/wk	Hours/ day
Aeration	Aerators	Aquarator	4	195,523	22.3	8760	22.3	90%	22.3	90%	6.2	4392	4368	84	84	52	7	12
Aeration	Aerators	Aerator	4	78,209	8.9	8760	8.9	90%	8.9	90%	2.5	4392	4368	84	84	52	7	12
Low Lift Pumps	Low Lift Pumps	transfer pump	1	8,278	0.9	8760	0.9	90%	0.9	90%	1.1	24	8736	168	0	52	7	24
Aeration	Aerators	Surface Aerator	1	25,860	3.0	8760	3.0	90%	3.0	90%	3.3	4392	4368	84	84	52	7	12
Pumping	Recirculation Pump	pump motor	1	11,826	1.4	8760	1.4	90%	1.4	90%	1.5	4392	4368	84	84	52	7	12
Pumping	High Lift Pumps	Large pump	1	71,306	8.1	8760	8.1	22%	8.1	22%	37.0	4392	4368	84	84	52	7	12
Pumping	High Lift Pumps	Large pump (backup)	1	0	0.0	4368	0.0	0%	0.0	0%	37.0	4392	4368	84	84	52	7	12
Pumping	Low Lift Pumps	small pump	1	47,698	5.4	8760	5.4	50%	5.4	50%	11.0	4392	4368	84	84	52	7	12

12.3.2 Ohope Oxidation Ponds

Department	Technology	Description	No. of items	kWh/yr	ave load kW	Hours/ year	After hrs (kW)	After hours % load	Process hrs (kW)	Process % load	kW rating per item	After hours/ year	Process hours/ year	Processing hours / week	Hrs/ wk outside process hrs	weeks per year	Days/wk	Hours/ day
Aeration	Aerators	Surface Aerator	2	32,850	3.8	8760	3.8	25%	3.8	25%	7.5	4392	4368	84	84	52	7	12
Aeration	Aerators	Surface Aerator (aquaturl	2	32,850	3.8	8760	3.8	25%	3.8	25%	7.5	4392	4368	84	84	52	7	12
Miscellaneous	Miscellaneous	Algae control system	1	98	0.0	8760	0.0	100%	0.0	100%	0.0	24	8736	168	0	52	7	24
Pumping	Recirculation Pump	Recirculation Pump	1	14,454	1.7	8760	1.7	30%	1.7	30%	5.5	4392	4368	84	84	52	7	12
Pumping	Inlet Pumps	Inlet Pumps	2	97,236	11.1	8760	11.1	15%	11.1	15%	37.0	4392	4368	84	84	52	7	12
UV treatment	UV treatment	UV reactor	1	31,536	3.6	8760	3.6	100%	3.6	100%	3.6	4392	4368	84	84	52	7	12

12.3.3 Murupara Swimming Baths

Department	Technology	Description	No. of items	kWh/yr	ave load kW	Hours/ year	After hrs (kW)	After hours % load	Process hrs (kW)	Process % load	kW rating per item	After hours/ year	Process hours/ year	Processing hours / week	Hrs/ wk outside process hrs	weeks per year	Days/wk	Hours/ day
Outdoor Pool Pumps	Pumps	Circulation pump	1	26,648	3.0	8760	3.0	39%	3.0	39%	7.800	4028	4732	91	77	52	7	13
Water heating	Heatpumps	New Heat pump	1	21,024	2.4	8760	2.4	6%	2.4	6%	40.000	4028	4732	91	77	52	7	13
Water heating	Heatpumps	Old Heat pump	1	80,446	9.2	8760	9.2	29%	9.2	29%	31.667	4028	4732	91	77	52	7	13

12.4 Stationary Energy Decarbonisation Strategy