Sensitivity: General

Aquatic Facility Energy Efficiency Toolbox Manual

Prepared for Sport NZ
Prepared by Beca Limited

30 April 2026

Contents

Appendices

Revision History

Revision N°	Prepared By	Description	Date
3	Breanna Cottom	Draft Toolbox	11 Feb 2026
4	Joe Morrison	Sport NZ Amendments	30 April 2026

Document Acceptance

Action	Name	Signed	Date
Prepared by	Breanna Cottom		11 Feb 2026
Reviewed by	Xander Wijninckx		11 Feb 2026
Approved by	Nick Yannakis		30 April 2026
on behalf of	Beca Limited		

1 Important Terms / Acronyms

ASHP = Air source heat pump.

Audit = Checking the performance of a service or professional.

Bought energy = The quantity of energy purchased to operate the facility.

COP = Coefficient of performance.

Decarbonisation = Reducing the amount of carbon used through operational activities.

DHW = Domestic Hot Water.

Efficiency = The ratio of energy purchased to the total energy consumed by the end use.

Electrification = Type of decarbonisation that changes a facility from one that uses both gas and electricity energy sources to a facility using only electricity energy sources.

Electrified site = A facility that purely uses electricity as an energy source.

Energy intensive = Requires a lot of energy.

Fluid = Gas or liquid substance.

Heat exchanger = Heat recovery device that transfers heat between two or more fluids without the fluids mixing.

Heat wheel = Rotating heat exchanger.

HVAC = Heating Ventilation and Air Conditioning

Metering = Devices that read important instantaneous information typically energy or water usage.

Raw Energy = The energy consumed within a facility independent of efficiency of energy.

Retrofit = A facility that has already been built and is in operation.

Run around coil = Heat recovery device that transfers heat between two different flows using two or more finned coils connected by a pumped pipework loop containing heat transfer fluid.

2 Introduction

2.1 Overview

Aquatic facilities are essential community assets – but they are also some of the most energy intensive buildings in operation. Heating large volumes of water, maintaining appropriate humidity levels, and providing fresh air ventilation for greater comfortability of patrons means pools consume significantly more energy than most other facility types. Therefore, for owners and operators of aquatic facilities the operating cost, energy consumption, and carbon emissions produced are important.

This toolbox calculator and guide have been developed in partnership with Sport NZ to help aquatic facility owners and operators better understand how energy is used within their facility and where that energy comes from. It provides a practical, first step approach to understanding energy and emissions, supporting informed conversations about efficiency improvements and decarbonisation such as electrification.

Using the toolbox follows a clear and logical process:

1. **Start with what you know**
   Gather basic information about your facility, including floor areas, pools, and recent energy consumption.
2. **Enter facility and pool details**
   Input key dimensions and operating characteristics into the calculator.
3. **Enter energy and water data**
   Add annual gas, electricity and water use where available. Estimates can be used where data is limited.
4. **Review Visual Representation of Data**
   Add annual gas, electricity and water use where available. Estimates can be used where data is limited.
5. **Review your estimated energy breakdown**
   The toolbox generates a simplified visual showing the facility energy sources and how it is used.
6. **Explore electrification scenarios**
   View a high-level comparison between your current system and an electrified alternative using heat pumps.
7. **Consider next steps**
   Use the results to identify priorities, questions, and opportunities for further investigation or action.

Detailed guidance for each of these steps is provided later in this guide.

2.2 Purpose

Due to aquatic facilities using so much energy, understanding the flow of where energy is coming from and where it is being used is of key importance. The type of fuel used (for example, gas versus electricity) and the technologies installed (such as boilers or heat pumps) strongly influence:

- Day-to-day operating costs
- Long-term energy price exposure
- Carbon emissions and sustainability performance

Reducing emissions from aquatic facilities is meaningful at a local, regional, and national level, and it also supports broader council, organisational, and government climate targets. Moving toward more efficient systems and cleaner energy sources can also improve long-term affordability. However, the first step in any improvement journey is understanding your current position.

This toolbox is designed to support a wide range of energy and decarbonisation journeys. It aims to improve energy monitoring and understanding, identify opportunities to increase efficiency, explore how electrification can reduce carbon emissions, and consider alternatives to fossil fuels as energy sources.

Specifically, it helps you:

- Understand your facility's energy use and emissions at a basic level
- See where energy is being used across major systems within the facility
- Identify areas where better metering or monitoring may be beneficial
- Compare your current setup with an electrified alternative, enabling benchmarking
- Explore high-level operational impacts of switching to technologies such as heat pumps
- Create facility sustainability plans and goals.
- Explore operational energy, carbon emission and cost savings of electrification

The outputs are intentionally visual and simple, supporting discussion with staff, management, and stakeholders.

The analysis produced by this toolbox is indicative and high-level. It includes assumptions, particularly around heat pump performance, which can vary by location, climate, and system design. As such, results should be used to inform discussions, support early planning and identify whether further investigation is warranted.

Where significant changes or investments are being considered, a detailed energy audit or specialist advice is recommended. Aquatic specialists, such as the Beca Aquatics team, can assist with more in-depth analysis and facility specific recommendations. This toolbox is intended to empower operators by making energy more visible and understandable. By starting with where you are today, you can better plan the path ahead.

2.3 About the Toolbox

This toolbox combines a simple, user-friendly calculator and a supporting guide, which explains how to use it and understand the results.

The toolbox calculator and guide enable a basic analysis of an aquatic facility using high-level inputs such as:

- Facility size and floorplan
- Pool areas and water temperatures
- Current energy sources (for example, gas and electricity)
- Annual energy consumption
- Annual water consumption

The toolbox calculator and guide then provide:

- A visual representation of how energy flows through your facility
- A comparison between your current energy setup and an electrified alternative
- High-level indications of potential energy, cost, and carbon emission savings-level indications of potential energy, cost, and carbon

Importantly, this toolbox is not a detailed energy audit. Instead, it is designed as an accessible starting point – a way to build awareness, identify opportunities, and support better decision making using the information operators already have. This approach is intended to make energy data more understandable and actionable for operators, even where detailed metering or audits are not yet in place.

3 How to use the Toolbox Calculator

3.1 Instructions

The Toolbox calculator has been designed to be simple and practical for everyday use. The 'Instructions' tab gives a quick overview of how to use the toolbox calculator, but the full walkthrough is explained below.

Before you start, make a copy of the toolbox calculator for your facility. You can create multiple copies to compare different years.

3.2 Inputs

3.2.1 Gather your information

Begin with the information you already have. You will need your facility floor plan, pool details, energy bills (electricity and gas) and water bills. The energy bills will look similar to the examples shown in Figure 1 and Figure 2 which are electricity and gas bills respectively.

Your account in detail

Account Number

Supply address

Supply period 1 1 May 2025 to 31 May 2025 (31days)

	Days	Quantity	Rate	Rate (incl. Energy losses)	Charge
Energy Charges					
Peak		52978.24 kWh	$0.114661 / kWh	$0.124186/kWh	$6,579.16
Off Peak		53276.832 kWh	$0.075919 / kWh	$0.082225/kWh	$4,380.69
Sub-total					**$10,959.85**
Network Charges					
Network Shoulder		18857.696 kWh	$0.049169/kWh		$927.21
Network Peak		34120.544 kWh	$0.062007/kWh		$2,115.71
Network Off Peak		53276.832 kWh	$0.020747/kWh		$1,105.33
Demand Variable		191.63 kVA	$8.62083/kVA		$1,652.01
Demand Capacity		320 kVA	$5.09750/kVA		$1,631.20
Network Access Charge		31 days	$20.74236/day		$643.01
Sub-total					**$8,074.47**
Renewable Energy Charges					
E&REC - LRET Flexi Renewable		106255.072 kWh	$0.008033 / kWh	$0.008704/kWh	$924.84
E&REC - SRES Flexi Renewable		106255.072 kWh	$0.005556 / kWh	$0.006020/kWh	$639.66
E&REC - VEET Flexi Renewable		106255.072 kWh	$0.011851 / kWh	$0.012841/kWh	$1,364.42
Sub-total					**$2,928.92**
Other Charges					
AEMO Pool Fees		106255.072 kWh	$0.000407 / kWh	$0.000441/kWh	$46.86
AEMO Ancillary Charge		106255.072 kWh	$0.000380 / kWh	$0.000412/kWh	$43.78
Metering Charges		1	$1.92907/day		$59.80
Retail Service Fee		1	$50.63000/month		$50.63
Sub-total					**$201.07**
Total GST					$2,216.43
Total current charges (incl. GST)					$24,380.74 3

Your meter and tariff information

Meter type: Interval

NMI: VBBB0012655

Meter usage: 7715534 = 52978.24 kWh, 7715534 = 53276.832 kWh

2 Total Usage this period = 106255.072 kWh

DLF = 1.0835 X MLF = 0.9996 = Total Loss Factor

Highest actual metered demand period is 200kVA, recorded on 17/05/2025 at 15:30

Your overall picture

Estimated greenhouse gas emissions for this bill

91.4 tonnes

Emissions are offset by any GreenPower percentage purchased.

Average daily electricity usage (kWh)

Estimated greenhouse gas emissions (tonnes)

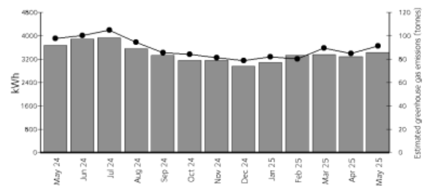
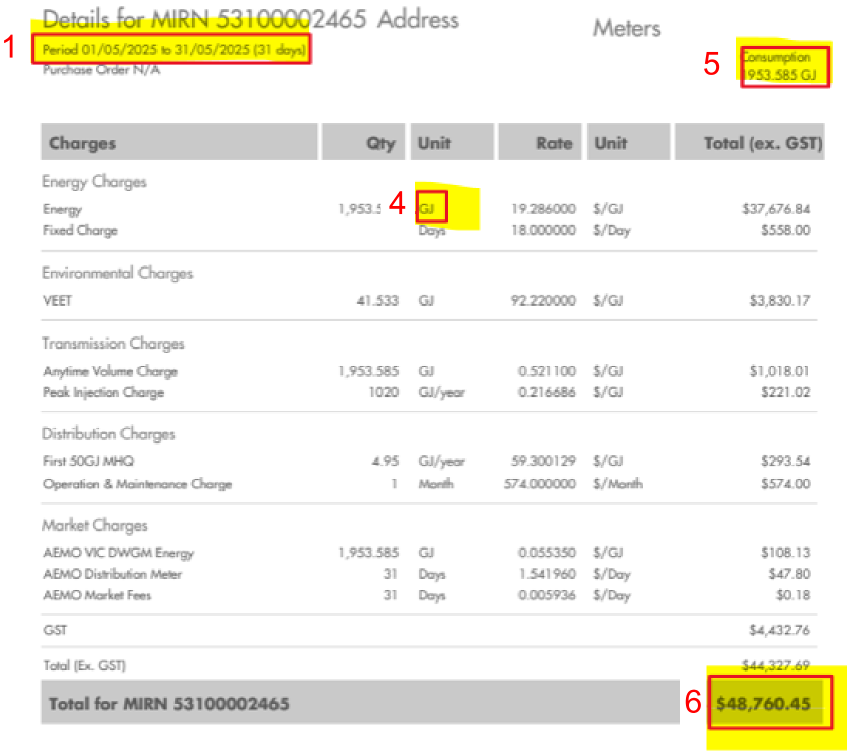


Figure 1: Electricity invoice example.



Details for MIRN 53100002465 Address

1 Period 01/05/2025 to 31/05/2025 (31 days)

Purchase Order N/A

Meters

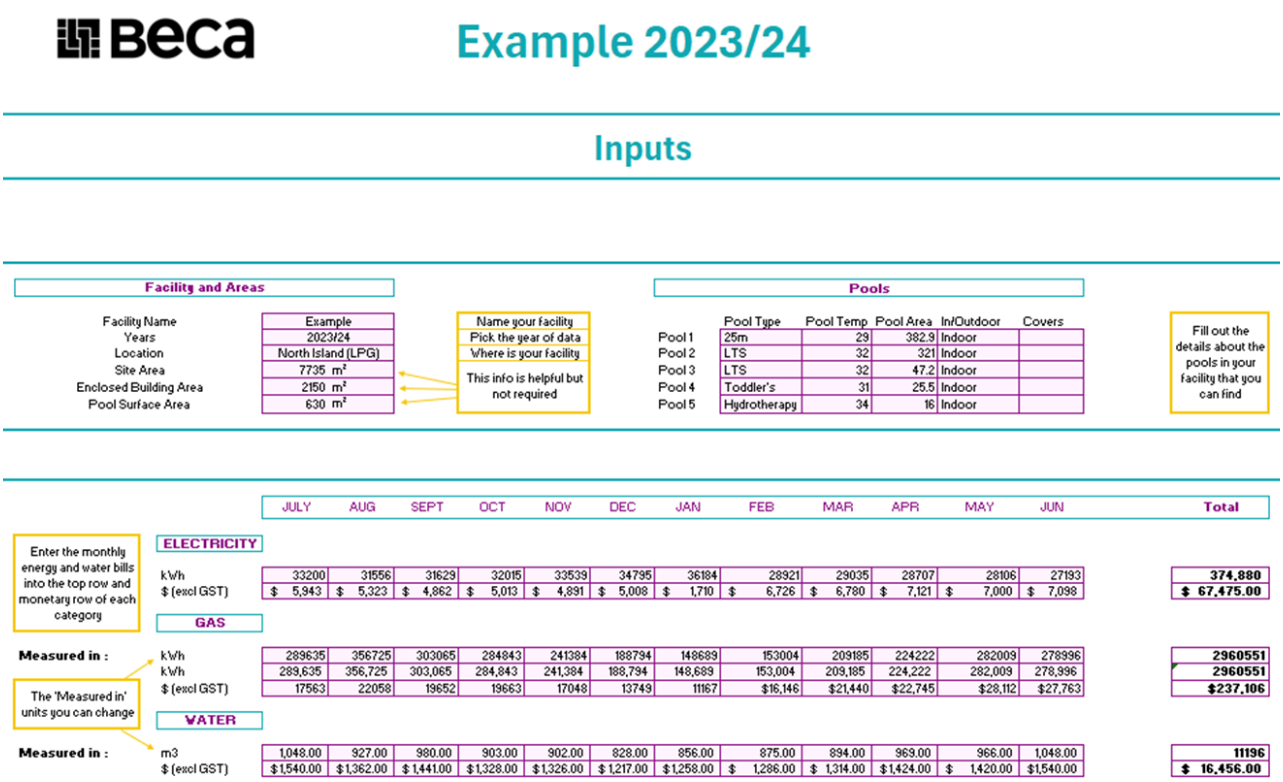
5 Consumption 1953.585 GJ

Charges	Qty	Unit	Rate	Unit	Total (ex. GST)
Energy Charges					
Energy	1,953.5	4 GJ	19.286000	$/GJ	$37,676.84
Fixed Charge		Days	18.000000	$/Day	$558.00
Environmental Charges					
VEET	41.533	GJ	92.220000	$/GJ	$3,830.17
Transmission Charges					
Anytime Volume Charge	1,953.585	GJ	0.521100	$/GJ	$1,018.01
Peak Injection Charge	1020	GJ/year	0.216686	$/GJ	$221.02
Distribution Charges					
First 50GJ MHQ	4.95	GJ/year	59.300129	$/GJ	$293.54
Operation & Maintenance Charge	1	Month	574.000000	$/Month	$574.00
Market Charges					
AEMO VIC DWGM Energy	1,953.585	GJ	0.055350	$/GJ	$108.13
AEMO Distribution Meter	31	Days	1.541960	$/Day	$47.80
AEMO Market Fees	31	Days	0.005936	$/Day	$0.18
GST					$4,432.76
Total (Ex. GST)					$44,327.69
Total for MIRN 53100002465					6 **$48,760.45**

Figure 2: Gas invoice example.

3.2.2 Entering Facility and Pool Details

Go to the 'Inputs' tab. This is where you enter all facility and annual data as shown in Figure 3.



Beca

Example 2023/24

Inputs

Facility and Areas

Facility Name	Example	Name your facility
Years	2023/24	Pick the year of data
Location	North Island (LPG)	Where is your facility
Site Area	7735 m²	This info is helpful but not required
Enclosed Building Area	2150 m²	
Pool Surface Area	630 m²	

Pools

	Pool Type	Pool Temp	Pool Area	In/Outdoor	Covers
Pool 1	25m	29	382.9	Indoor	
Pool 2	LTS	32	321	Indoor	
Pool 3	LTS	32	47.2	Indoor	
Pool 4	Toddler's	31	25.5	Indoor	
Pool 5	Hydrotherapy	34	16	Indoor	

Fill out the details about the pools in your facility that you can find

Enter the monthly energy and water bills into the top row and monetary row of each category

The 'Measured in' units you can change

		JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	Total
ELECTRICITY														
	kWh	33200	31556	31629	32015	33539	34795	36184	28921	29035	28707	28106	27193	374,880
	$ (excl GST)	$ 5,943	$ 5,323	$ 4,862	$ 5,013	$ 4,891	$ 5,008	$ 1,710	$ 6,726	$ 6,780	$ 7,121	$ 7,000	$ 7,098	$ 67,475.00
GAS														
Measured in :	kWh	289635	356725	303065	284843	241384	188794	148689	153004	209185	224222	282009	278996	2960551
	kWh	289,635	356,725	303,065	284,843	241,384	188,794	148,689	153,004	209,185	224,222	282,009	278,996	2960551
	$ (excl GST)	17563	22058	19652	19663	17048	13749	11167	$16,146	$21,440	$22,745	$28,112	$27,763	$237,106
WATER														
Measured in :	m3	1,048.00	927.00	980.00	903.00	902.00	828.00	856.00	875.00	894.00	969.00	966.00	1,048.00	11196
	$ (excl GST)	$1,540.00	$1,362.00	$1,441.00	$1,328.00	$1,326.00	$1,217.00	$1,258.00	$ 1,286.00	$ 1,314.00	$1,424.00	$ 1,420.00	$1,540.00	$ 16,456.00

Figure 3: Sport NZ tab 2 'Inputs'.

At the top of the tab, you'll see the 'Facility and Areas' section. Enter your information into the purple boxes. You will also see dropdown menus for:

- The year(s) your data covers
- Your facility's location (as shown in Figure 4)

Location matters because weather patterns, gas type, and common energy sources differ between the North and South Island.

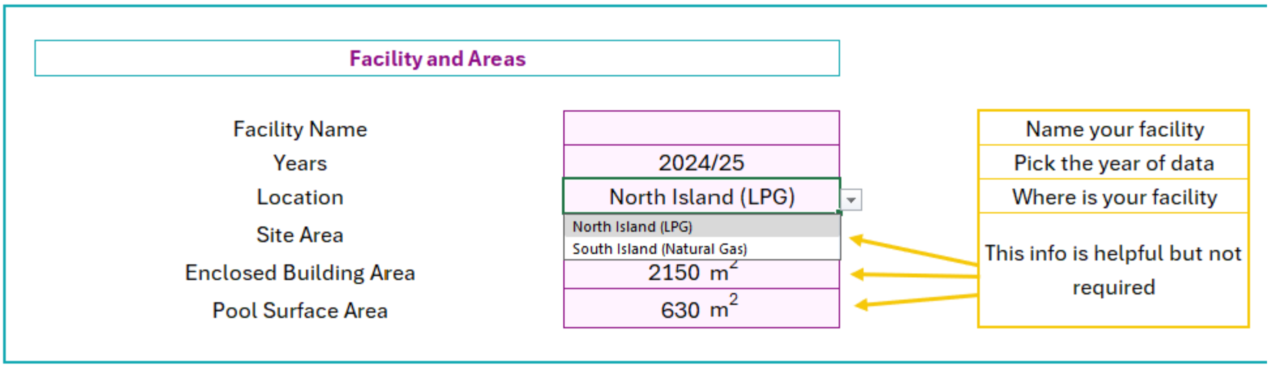


Figure 4: Location dropdown.

Area measurements are optional but helpful as shown in Table 1.

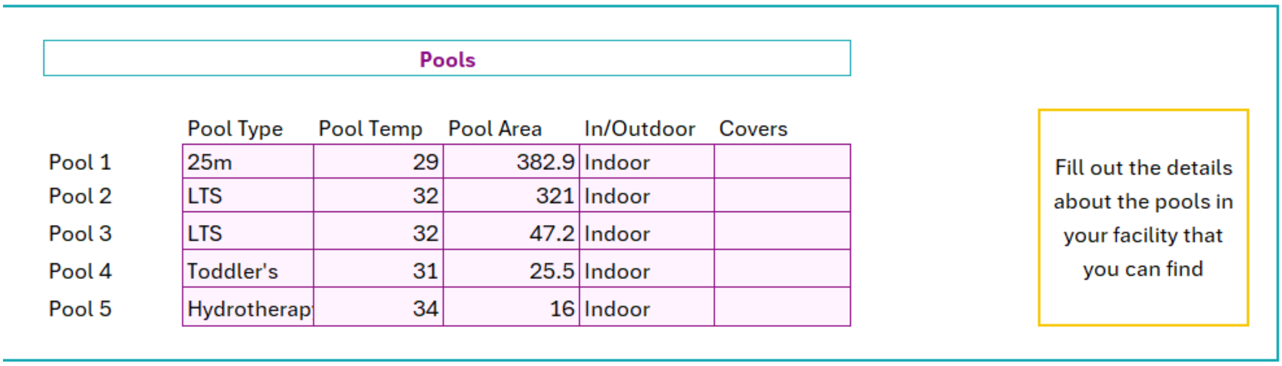
Table 1: Area measurement definitions

Area Name	Meaning
Site Area	Total land area inside the property boundary, including carparks and outdoor spaces.
Enclosed Building Area	All indoor floor area across all levels, including plant rooms.
Pool Surface Area	Total pool water surface area, including splash pads and hydroslide landings

The heading 'Pools' includes all essential information about each pool as shown in Figure 5 including:

- Pool Type (main use)
- Temperature (average or setpoint)
- Pool area (entered manually)
- If pools are indoor or outdoor
- If covers are used

All fields use dropdowns except for pool area.



	Pools				
	Pool Type	Pool Temp	Pool Area	In/Outdoor	Covers
Pool 1	25m	29	382.9	Indoor	
Pool 2	LTS	32	321	Indoor	
Pool 3	LTS	32	47.2	Indoor	
Pool 4	Toddler's	31	25.5	Indoor	
Pool 5	Hydrotherap	34	16	Indoor	

Figure 5: Entering Pool Information.

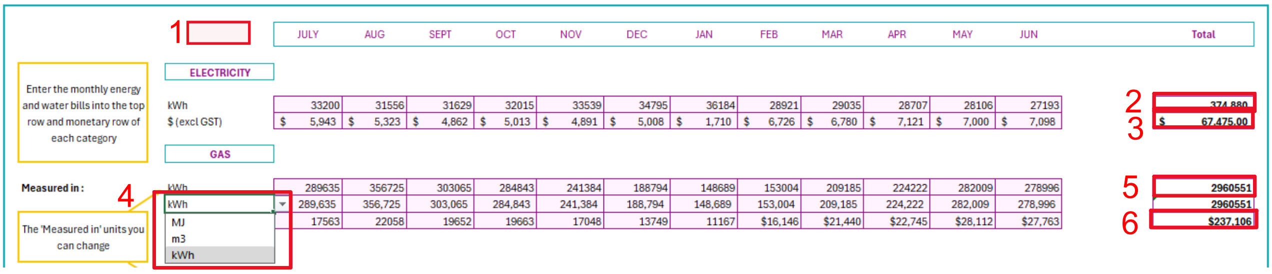
3.2.3 Enter Energy and Water Data

Next, enter your electricity, gas and water information from your bills. The toolbox calculator defaults to the pool financial year (July-June). You can change this on your copy to match the months your facility has data available.

Bills will show the following information as highlighted in Figure 1 and Figure 2:

- Quantity consumed
- Cost
- Unit of measurement
- Billing dates

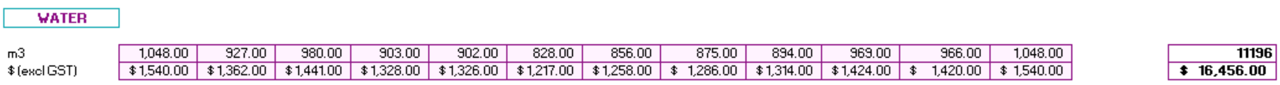
If your facility is fully electrified, you will only have electricity bills. If you use gas, check the unit (MJ, m^3, or kWh). Select the correct unit from the dropdown shown in Figure 6. This ensures energy is converted to kWh for consistency in calculations.



	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	Total
ELECTRICITY													
kWh	33200	31556	31629	32015	33539	34795	36184	28921	29035	28707	28106	27193	374,880
$ (excl GST)	$ 5,943	$ 5,323	$ 4,862	$ 5,013	$ 4,891	$ 5,008	$ 1,710	$ 6,726	$ 6,780	$ 7,121	$ 7,000	$ 7,098	$ 67,475.00
GAS													
kWh	289635	356725	303065	284843	241384	188794	148689	153004	209185	224222	282009	278996	2960551
kWh	289,635	356,725	303,065	284,843	241,384	188,794	148,689	153,004	209,185	224,222	282,009	278,996	2960551
	17563	22058	19652	19663	17048	13749	11167	$16,146	$21,440	$22,745	$28,112	$27,763	$237,106

Figure 6: Energy bill recording site, including unit selection.

The final data entry is the water usage bills. The water may be billed in m^3 or kL. These units are equivalent, but you still need to select the correct one in the dropdown shown in Figure 7.



WATER													
m3	1,048.00	927.00	980.00	903.00	902.00	828.00	856.00	875.00	894.00	969.00	966.00	1,048.00	11196
$ (excl GST)	$ 1,540.00	$ 1,362.00	$ 1,441.00	$ 1,328.00	$ 1,326.00	$ 1,217.00	$ 1,258.00	$ 1,286.00	$ 1,314.00	$ 1,424.00	$ 1,420.00	$ 1,540.00	$ 16,456.00

Figure 7: Water usage recording site including unit selection.

3.2.4 Visual Representation of Data Entered

At the bottom of the 'Inputs' tab, you'll see charts that automatically update based on what you entered as shown in Figure 8. These visuals help you quickly understand your facility's operational patterns.

These show monthly energy costs and consumption (split by electricity and gas) and monthly water costs and consumption.

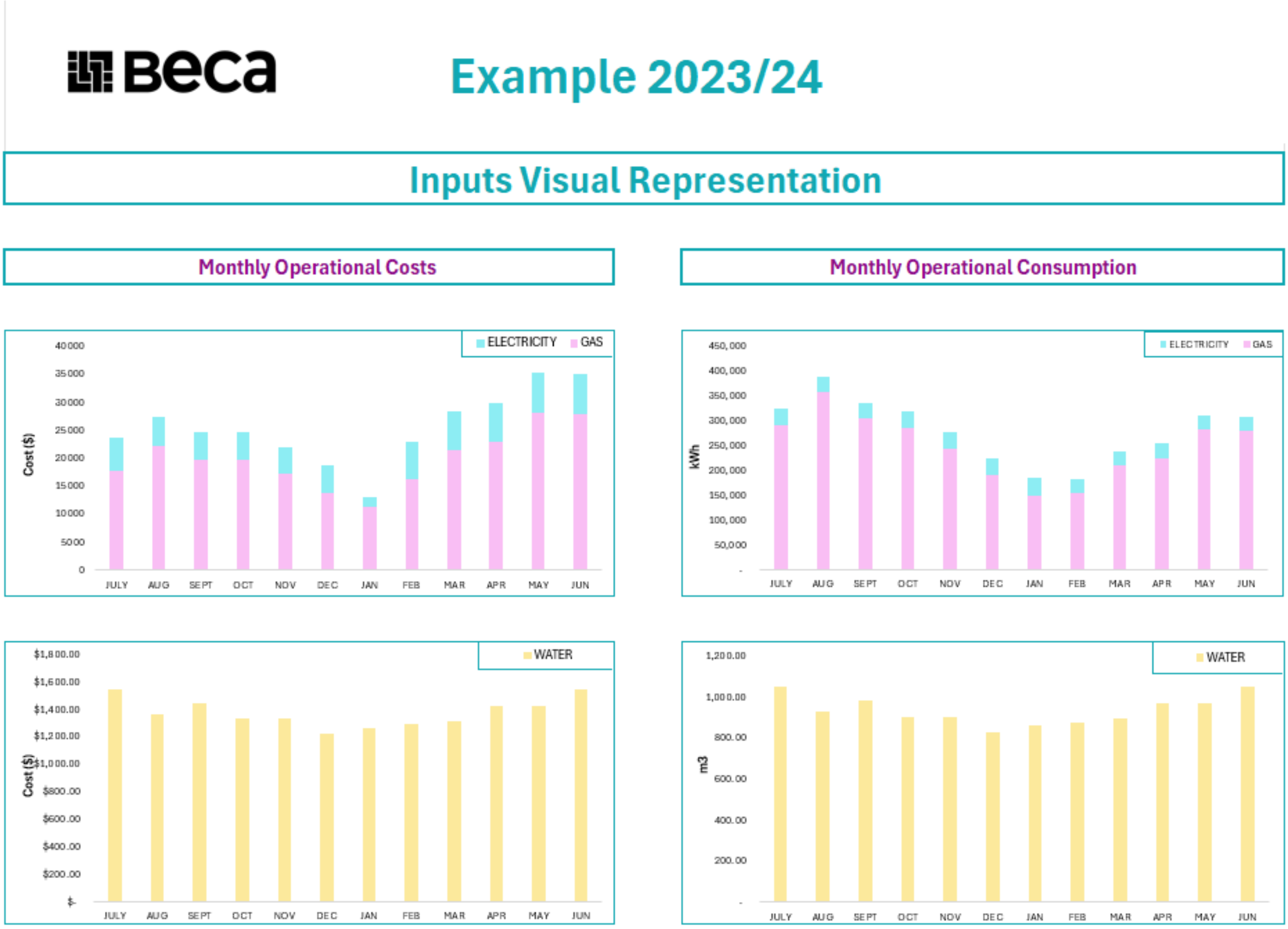


Figure 8: Visual representation of data inputted within the 'Inputs' tab.

3.3 Estimated Energy Breakdown

The third tab of the toolbox calculator shows your facility's estimated energy breakdown using Sankey diagrams. There are two versions available:

- Pools that are mainly indoors
- Pools that are mainly outdoors

You can review the diagram that matches your facility.

A Sankey diagram displays the energy source types on the left flowing to each part of the facility on the right. The typical sources are electricity and gas although some facilities use renewable energy. The larger the thickness of the energy flow the larger the quantity of energy flowing from the source to the building system. This makes it easy to compare energy consumption across different building systems and decipher which type of energy source is predominant as shown in Figure 9 and Figure 11.

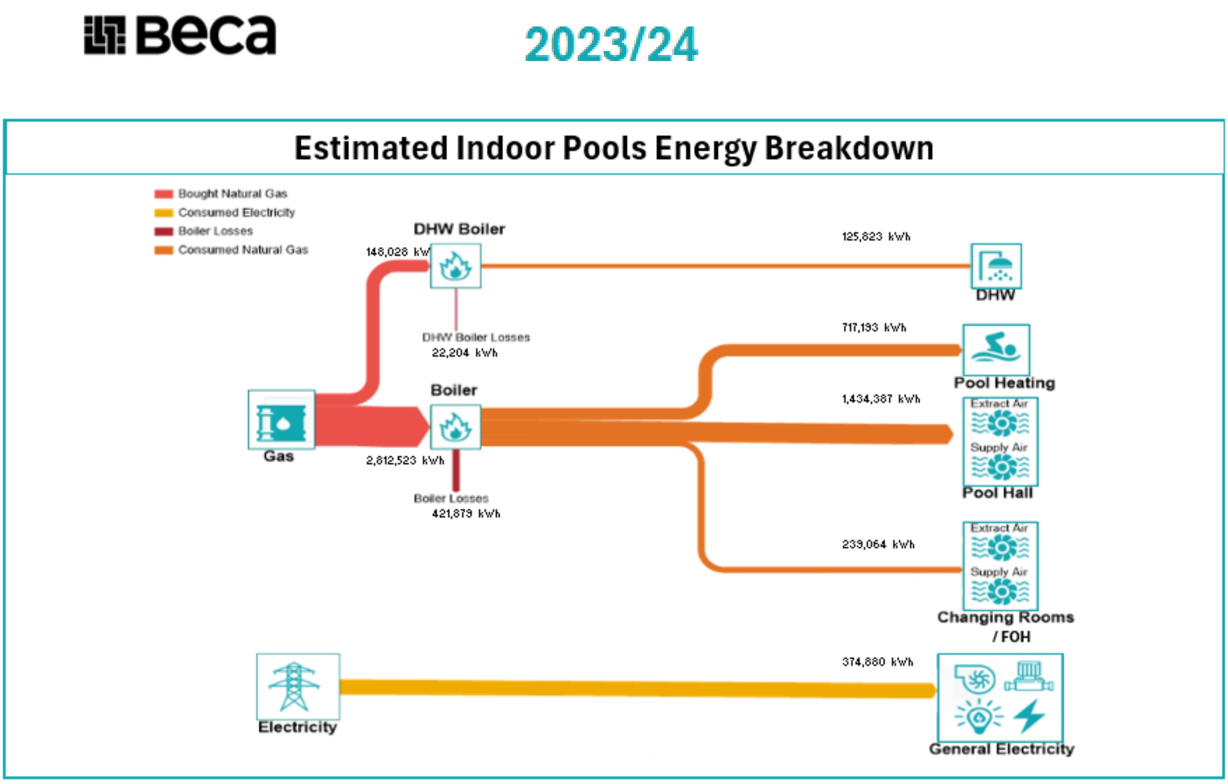


Figure 9: Indoor pool current estimated energy breakdown Sankey diagram.

As you input your annual electricity, gas and water data, the Sankey diagram values will automatically appear and update on the 'Estimated Energy Breakdown.' The layout is designed to easily see how much energy is going to each building system. For energy intensive indoor aquatic facilities, the key energy uses are outlined below.

1. Ventilation of the Pool Hall

Indoor pools require significant ventilation to maintain good air quality and control humidity.

- Too much moisture can damage building materials
- Too little moisture increases evaporation, which means more pool water heating is needed.
- A typical target humidity range is 40-60%, achieved with 4-6 air changes per hour.

2. Pool Water Heating

Heating the pool water is one of the largest energy demands because of the large volume of water that must be kept warm and clean.

3. Other Building Systems

Remaining energy is used for:

- HVAC systems outside the pool hall
- General electricity (lighting, equipment, etc)
- Domestic hot water (showers, bathrooms)

UK indoor pools have a similar energy breakdown as shown in Figure 10. However, empirical evidence suggests New Zealand facilities often use more energy for pool water heating (approximately 30%).

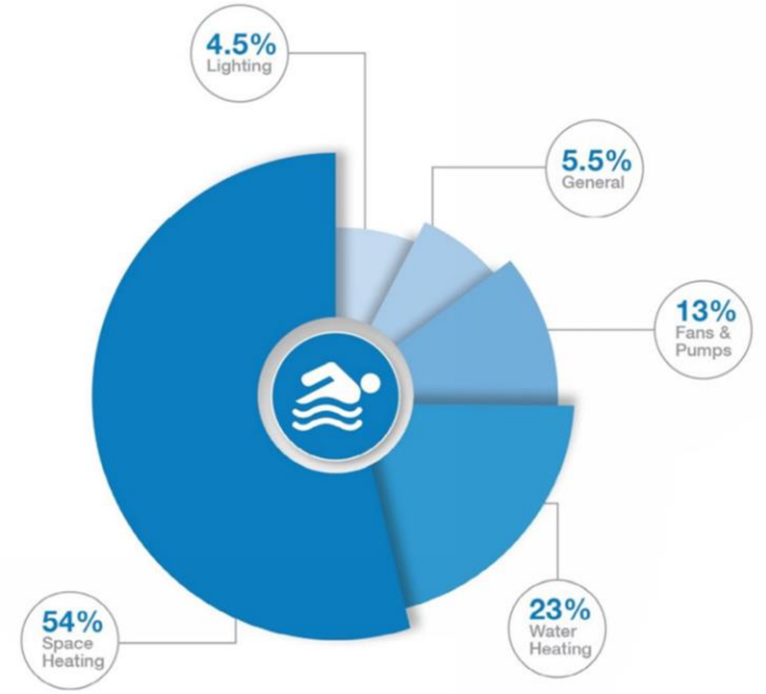


Figure 10: UK energy breakdown.

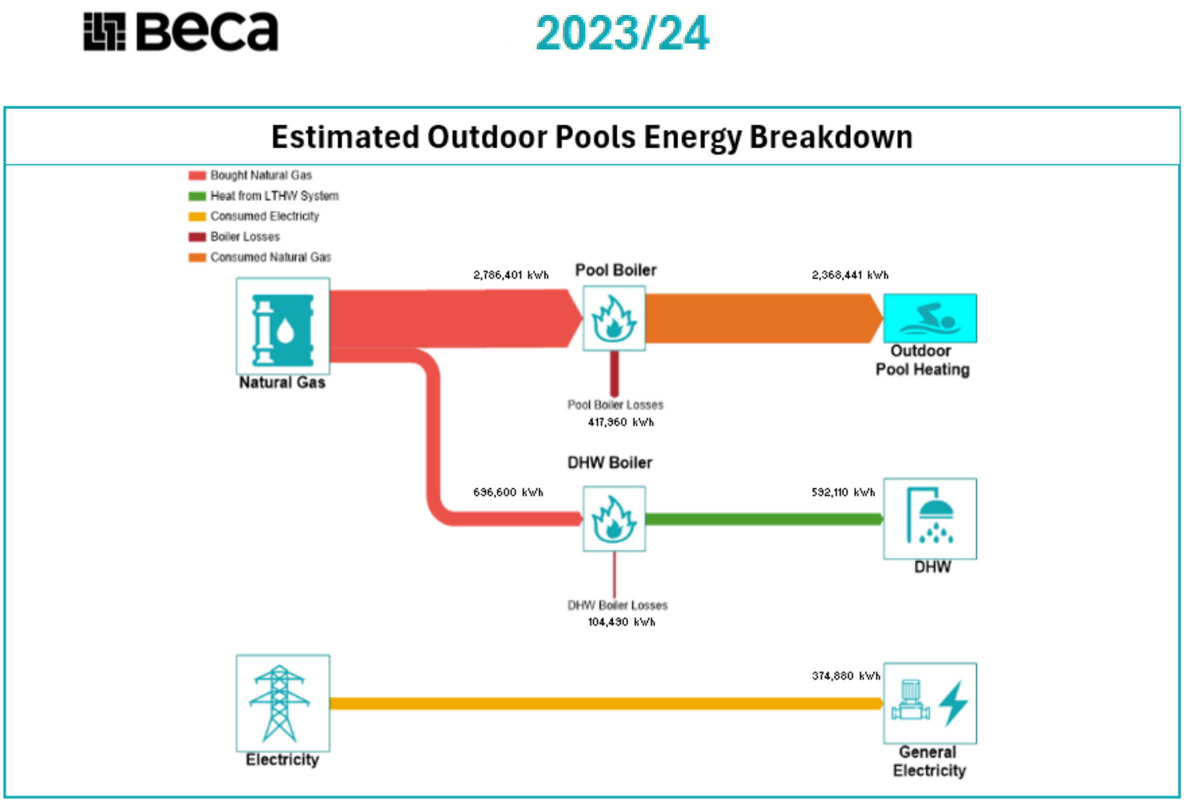


Figure 11: Outdoor pool current estimated energy breakdown Sankey diagram

Outdoor pools do not require ventilation or controlled air. As a result, majority of the energy consumption heats the pool water, especially due to the exposed conditions. The remaining energy is used for domestic hot water and general electricity. The outdoor Sankey diagram reflects this simplified energy profile.

Both indoor and outdoor Sankey diagrams show boiler losses for facilities using gas boilers. This helps highlight how much energy is wasted and how much energy could be saved by switching to more efficient systems such as heat pumps.

Some heat recovery options are:

- Run-around coils
- Heat exchangers
- Heat wheels (less common)

These systems recover heat and return it to the building, reducing the amount of billed energy needed. However, the Sankey diagrams shown in the toolbox calculator are high-level and assume zero heat recovery. They are based on typical percentages rather than a full engineering assessment.

For a deeper understanding of exactly where energy is going in your facility, you should speak with an aquatic's specialist, such as the Beca Aquatics team.

4 Energy Saving Initiatives

4.1 Electrification

Reducing carbon emissions is becoming increasingly important as we work to limit the effects of global warming and protect our current quality of life. Aquatic facilities use a large amount of energy, which means they also produce a significant amount of carbon emissions and have high operational costs. Due to the recent increase in gas prices, moving to electricity also offers possible operational cost decreases by using heat pumps. As a result, decarbonising these facilities can make a meaningful difference at local, regional, and national levels and is worth the effort.

There are several ways to decarbonise your facility, most of which lead to greater energy efficiency. The simplest and most effective way to reduce carbon emissions is electrification of the site. The results of electrifying your site are shown on the ‘Electrification Comparison’ tab as shown in Figure 12.

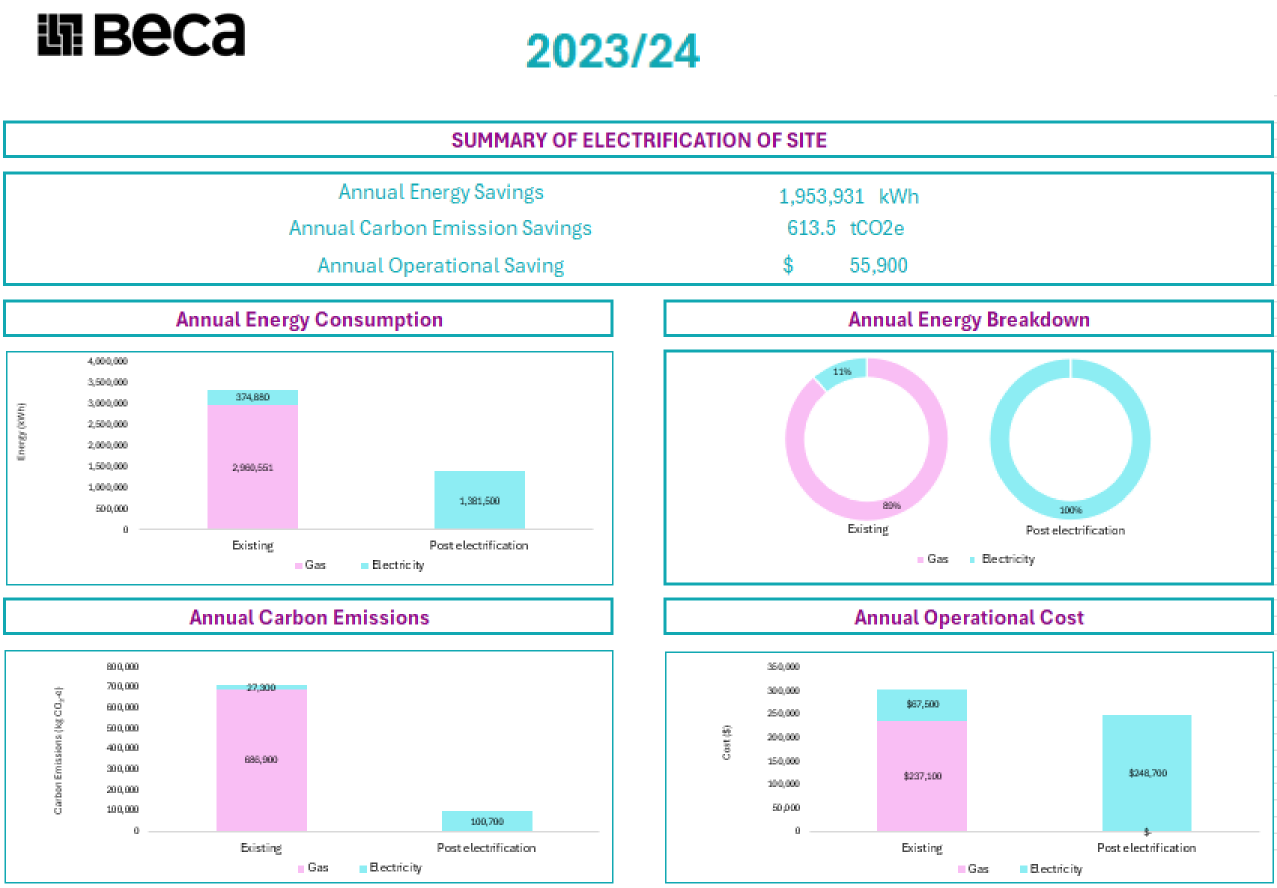


Figure 12: Electrification comparison results.

A summary of the differences fully electrifying your facility could make regarding annual energy savings, carbon emissions and monetary operational savings is found at the top of the ‘Electrification Comparison’ tab as shown in Figure 13.

SUMMARY OF ELECTRIFICATION OF SITE	
Annual Energy Savings	1,953,931 kWh
Annual Carbon Emission Savings	613.5 tCO2e
Annual Operational Saving	$ 55,900

Figure 13: Summary of annual savings when electrifying your site.

Electrification involves transitioning your facility away from natural gas (or LPG) and using electricity as the sole energy source shown in Figure 14. To ensure sufficient energy is produced, heat pumps appropriate to your facility are introduced during electrification. This leads to significantly lower billed energy for the facility due to the increased energy efficiency of an electrified site as shown in an example in Figure 15.

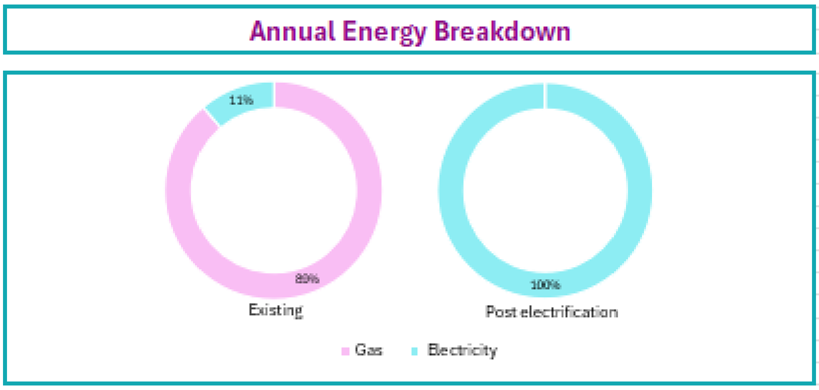


Figure 14: Energy source split before and after electrification.

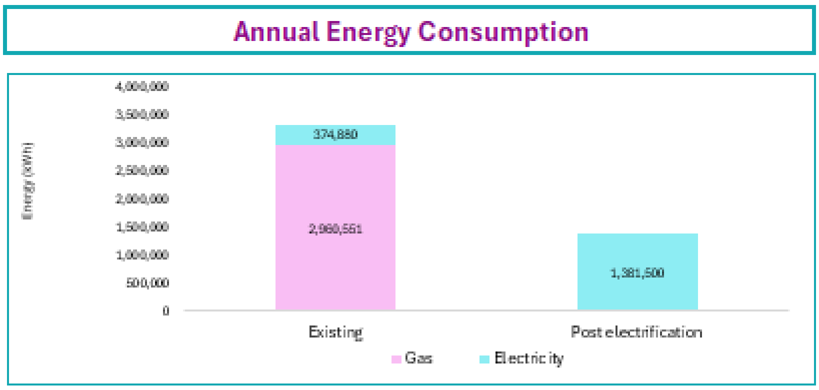


Figure 15: Energy source consumption comparison before and after electrification.

The main objectives of an electrification are decarbonising the site, reducing energy operational cost and the security of energy supply. The decreased energy consumption results in significantly lower carbon emissions, independent of a renewable electricity energy source used. However, if there is renewable energy used, the operational carbon emissions are significantly reduced for the facility as shown in an example in Figure 16.

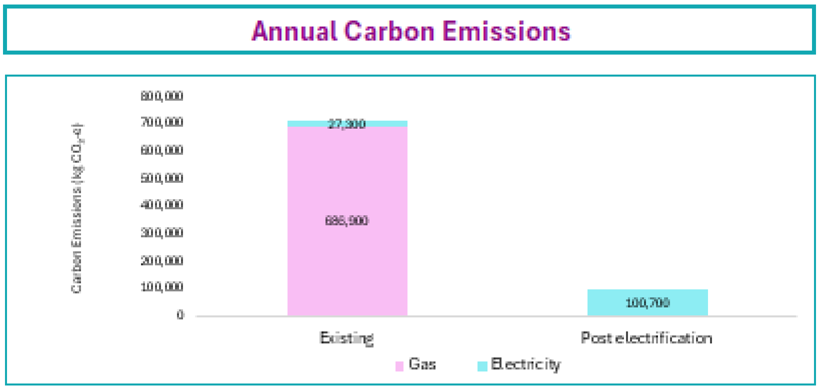


Figure 16: Annual operational carbon emissions split by energy source before and after electrification.

Given the decreased bought energy requirements due to the increased energy efficiency, the annual operational monetary cost decreases as shown in Figure 17.

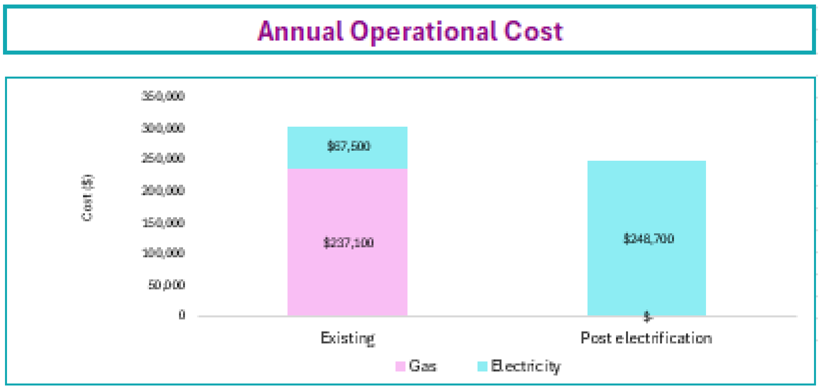


Figure 17: Annual operational costs split by energy source before and after electrification.

Personalised graphs will be available under ‘Electrification comparison’, updating automatically as you enter your annual energy into ‘Inputs’ in the toolbox calculator.

The Sankey diagrams described previously were adjusted with this new electrified information for both indoor and outdoor pools as shown in Figure 18 and Figure 19 respectively.

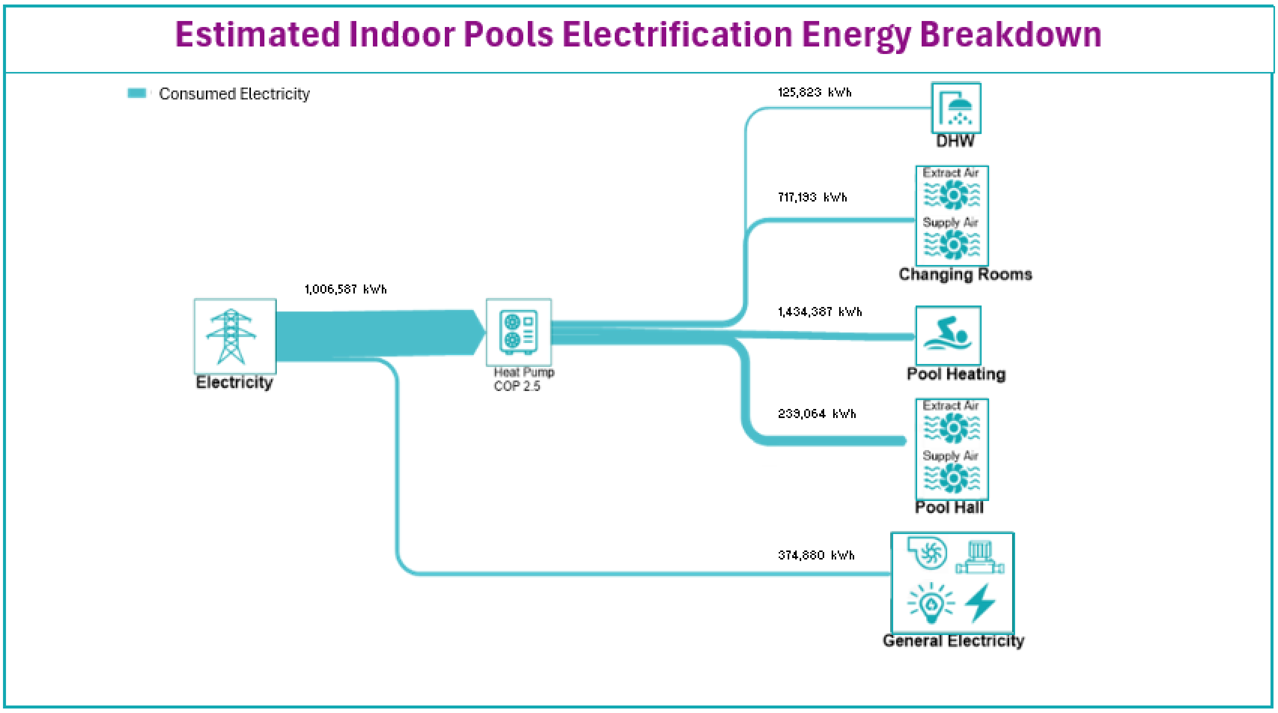


Figure 18: Indoor pool estimated energy breakdown after electrification.

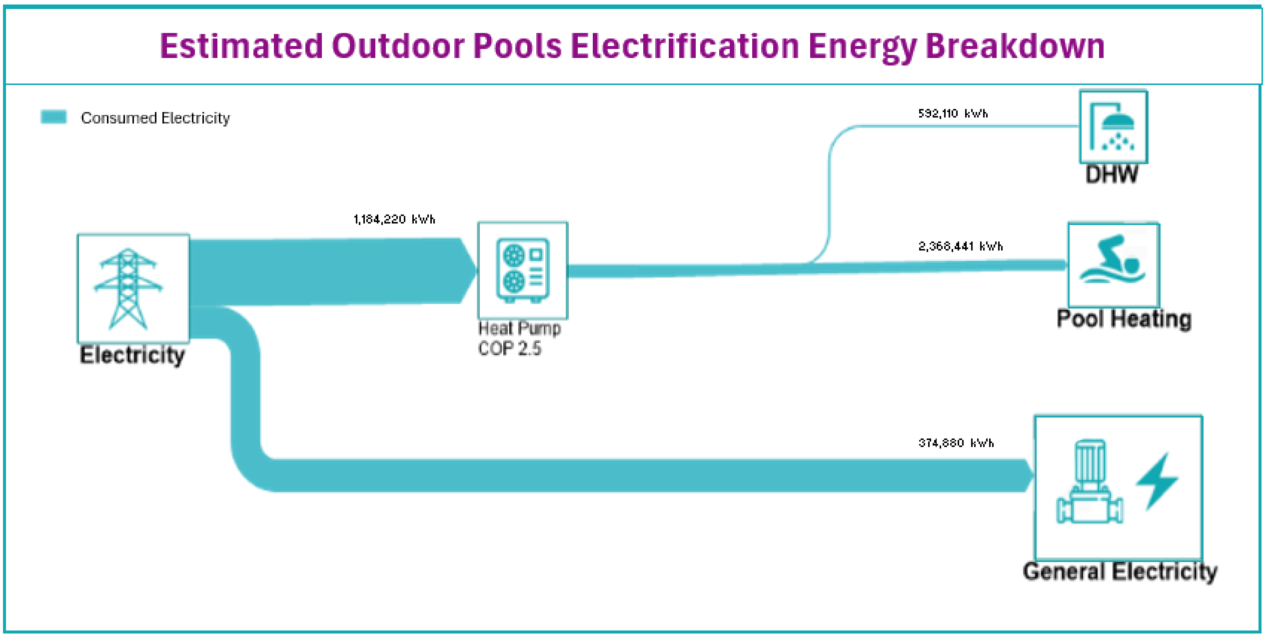


Figure 19: Outdoor pool estimated energy breakdown after electrification.

Prior to full electrification, it is important to review opportunities for heat recovery within your facility. Skipping this step risks oversizing electrical infrastructure and plant leading to elevated lines/capacity charges in addition to issues with plant short cycling or running sub optimally in low loads.

Good heat recovery options for aquatic facilities include:

- Run-around coils
- Heat exchangers

A less advised heat recovery option is a heat wheel. Application of these technologies reduce the billed energy and the size of the central heating plant without changing the performance of systems. Air-to-air heat exchangers are known reduce HVAC energy consumption by 50-60% or higher whilst run around coils and heat wheel systems can recover approximately 30% of the heat from the exhaust air from the pool. During the electrification process, all uses of gas within a site, including the generation of domestic hot water, direct space heating (including radiant), commercial kitchen appliances, etc should also be considered.

The effectiveness of each is very complex to assess and requires specialist consideration. The Beca Aquatics team have extensive experience in decarbonisation projects involving the retrofitting of existing facilities and can support in sizing correctly and the approach to align with your site's unique configuration/conditions and organisational journey/goals.

4.2 Smaller scale energy savers

Electrification delivers the largest carbon and cost savings, but there are many smaller, lower-cost improvements that can still reduce energy use and operational expenses as shown in Table 2. These options vary in cost and impact, but all contribute to more efficient facility operation.

Table 2: Energy saving options for aquatic facilities.

End Energy Use	Reduction Method	Reasoning	Cost of Implementation	Benefit
Pool Hall Ventilation	Pool Covers	Reduces pool water evaporation in the air, lowering ventilation load.	\$\$	✓✓
	Humidity Control	Maintains comfortable air conditions without over-ventilating.	\$\$	✓✓
	Night setback	Reduces ventilation at night when demand is low.	\$	✓✓
Pool Heating	Pool Covers	Pools retain more heat, reducing pool water heating demands. Helps outdoor pools far more than indoor pools.	\$\$	✓✓✓
	Temperature Set point Control	Prevents overheating and unnecessary energy use.	\$	✓

End Energy Use	Reduction Method	Reasoning	Cost of Implementation	Benefit
	Showers before swimming	Improves pool water cleanliness, reducing treatment and heating needs.	$	✓✓✓
Domestic Hot Water	Low-Flow Showerheads	Reduces the water volume used, lowering the domestic hot water heating demand.	$	✓
	Push-Button Timers	Limits shower duration and water use, lowering the domestic hot water heating load.	$	✓
General Electricity	Pump Scheduling	Reduce pump use during low-demand periods, lowering pump energy demand.	$	✓✓
	LED lighting	Use less electricity for the same light output.	$	✓
Changing Rooms Ventilation	Air to air heat recovery	Recovers heat from exhaust air, reducing billed energy.	$$$	✓✓✓

5 Technology

When planning to implement technology to save energy and reduce carbon emissions, it is important to understand how your existing systems operate. This includes the temperature of existing systems, such as where the heat can be recovered or extracted from and what temperatures are required for successful operation of the new systems. Retrofit facilities have limited space available for an HVAC system and ensuring that within the space the HVAC system has the capability to serve the entire facility's energy demand is essential and needs to be considered. Reducing the size of the HVAC system may also be important due to the high cost of the space.

There are many different types of HVAC technology that increase efficiency including heat pumps. All heat pumps have a coefficient of performance (COP), which is a measure of performance. A heat pumps COP is always greater than 1 (produces more heat energy than electrical energy consumed) with at least 100% efficiency. The greater the COP the greater the efficiency of the heat pump. Figure 20 shows a basic schematic for a heat pump with a COP of 4 and efficiency of 400% (delivering four units of heat energy for each unit of electrical energy consumed).

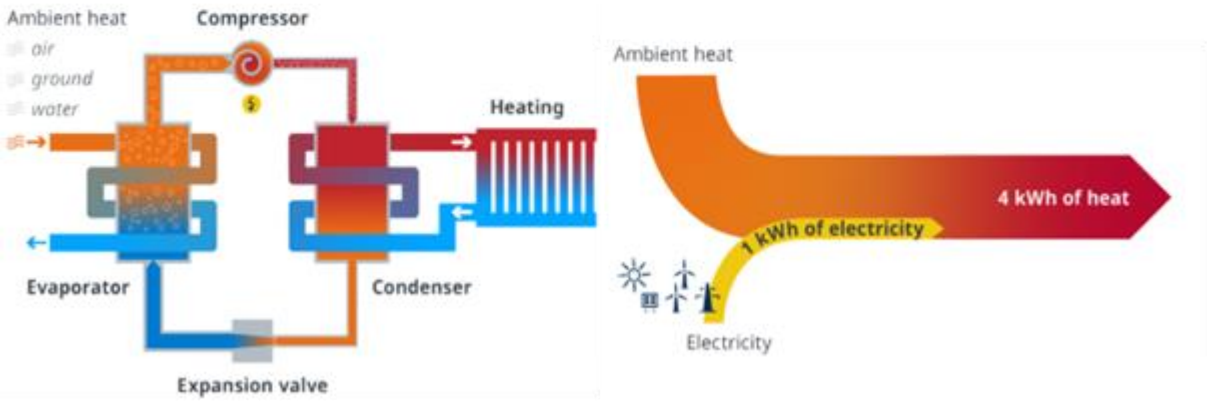


Figure 20: Schematic and heat flow diagram of a heat pump

Air source heat pumps (ASHP) are the most common for retrofit projects and is shown in Figure 21. An air source heat pump extracts heat from outside air and converts it into usable heat energy for the facility. This process does not produce operational carbon emissions unless the electricity used to power the heat pump comes from non-renewable sources. Heat pumps typically have a design life of 10-15 years, have an average COP of 3.25 (or efficiency of 325%) and heating and cooling capabilities. ASHP can realistically heat water up to 50-55 °C with slight variations based on climate. The key considerations for ASHP's for are available electrical capacity, the noise from the unit, and the temperature of the heat needed to be reached.

Figure 11: Air source heat pump examples

Some facilities use localised systems such as the localised direct water air source heat pump as shown in Figure 22. These heat pumps are designed to provide heat to one or two pools. These are best suited to facilities with only pool water heating demands, or where there are energy efficient HVAC systems already in place.

Figure 22: Direct hot water source heat pump example.

Another option is a water source heat pump (WSHP) as shown in Figure 23. These systems have a very high efficiency, with a COP of 6 (600% efficiency), and can heat water to 75-90 °C realistically. However, WSHP are rare due to the requirement to have a large body of water to extract heat from nearby. They are also significantly louder than air source heat pumps but can be contained within enclosed plantrooms.

Figure 23: Water source heat pump example.

Biomass boilers are another alternative that produces heat energy as shown in Figure 24. However, at a much lower efficiency than heat pumps of 90% on average. It is an automated process that feeds wood pellets into a boiler from an adjacent pellet store. However, the system requires a large amount of space. In terms of carbon emissions, the wood burned releases the carbon emissions it absorbed within the lifetime of the wood. Therefore, the emissions are relatively low, typically impacted by the source of energy used to dry the wood and transport the product to site.

Figure 24: Pellet boiler example.

Similarly, there are electric boilers available as shown in Figure 25. They use electricity to heat water and provide site heating. They are more compact and more efficient in comparison to other boilers. However, they have higher peak electrical demands and operation costs than heat pumps or pellet boilers. Therefore, they are not a common option when looking to decarbonise an aquatic facility.

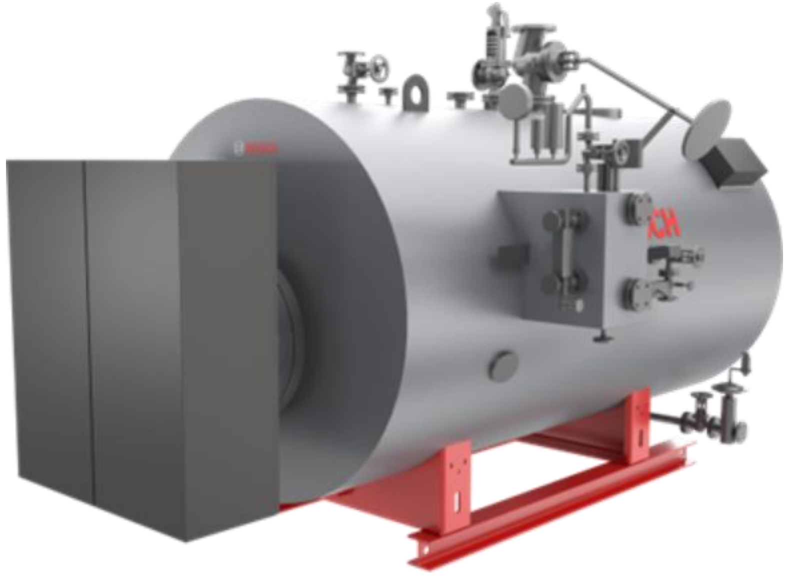


Figure 25: Electric boiler example.

Solar thermal collectors are a renewable option shown in Figure 26. They capture heat from the sun and use it to heat a fluid (generally water.) This form of energy is renewable but is highly dependent on the weather and the roof area available that the solar thermal collectors can occupy.

Figure 26: Solar thermal example.

Solar PV are renewable as well as their benefit highly dependent on the weather and area available able to be occupied. However, they instead of producing heat the photovoltaics convert light energy to electrical energy

A

Appendix A – NZ Council Indoor Pool Case Study

A New Zealand aquatic facility trialled the toolbox calculator and the following is a case study of this data.

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Example 2023/24

Inputs

Facility and Areas

Facility Name	Example	Name your facility
Years	2023/24	Pick the year of data
Location	North Island (LPG)	Where is your facility
Site Area	7735 m²	This info is helpful but not required
Enclosed Building Area	2150 m²	
Pool Surface Area	630 m²	

Pools

	Pool Type	Pool Temp	Pool Area	In/Outdoor	Covers
Pool 1	25m	29	382.9	Indoor	
Pool 2	LTS	32	321	Indoor	
Pool 3	LTS	32	47.2	Indoor	
Pool 4	Toddler's	31	25.5	Indoor	
Pool 5	Hydrotherapy	34	16	Indoor	

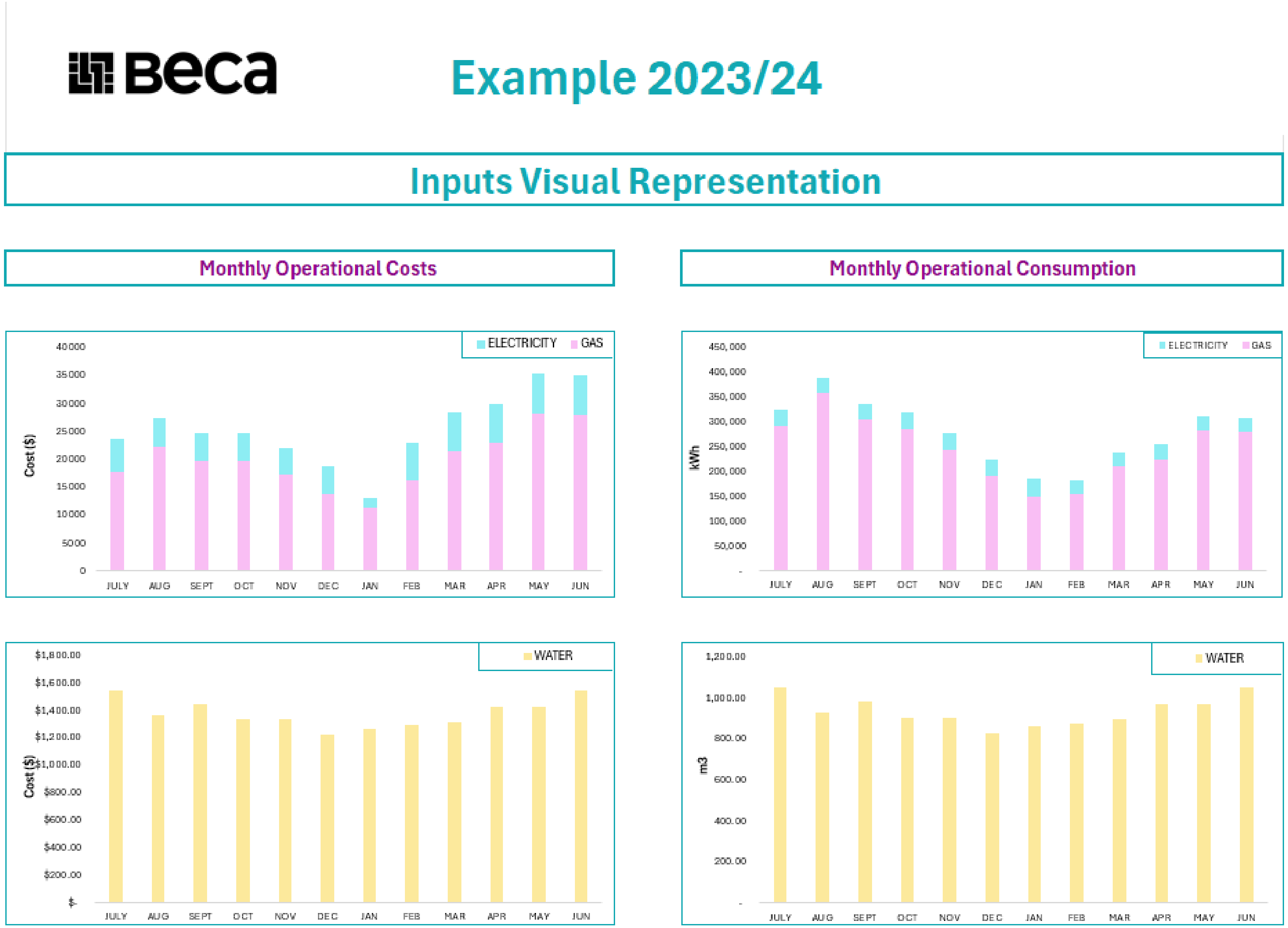
Fill out the details about the pools in your facility that you can find

Enter the monthly energy and water bills into the top row and monetary row of each category

The 'Measured in' units you can change

		JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	Total
ELECTRICITY														
	kWh	33200	31556	31629	32015	33539	34795	36184	28921	29035	28707	28106	27193	**374,880**
	$ (excl GST)	$ 5,943	$ 5,323	$ 4,862	$ 5,013	$ 4,891	$ 5,008	$ 1,710	$ 6,726	$ 6,780	$ 7,121	$ 7,000	$ 7,098	**$ 67,475.00**
GAS														
Measured in :	kWh	289635	356725	303065	284843	241384	188794	148689	153004	209185	224222	282009	278996	**2960551**
	kWh	289,635	356,725	303,065	284,843	241,384	188,794	148,689	153,004	209,185	224,222	282,009	278,996	**2960551**
	$ (excl GST)	17563	22058	19652	19663	17048	13749	11167	$16,146	$21,440	$22,745	$28,112	$27,763	**$237,106**
WATER														
Measured in :	m3	1,048.00	927.00	980.00	903.00	902.00	828.00	856.00	875.00	894.00	969.00	966.00	1,048.00	**11196**
	$ (excl GST)	$1,540.00	$1,362.00	$1,441.00	$1,328.00	$1,326.00	$1,217.00	$1,258.00	$ 1,286.00	$ 1,314.00	$1,424.00	$ 1,420.00	$1,540.00	**$ 16,456.00**

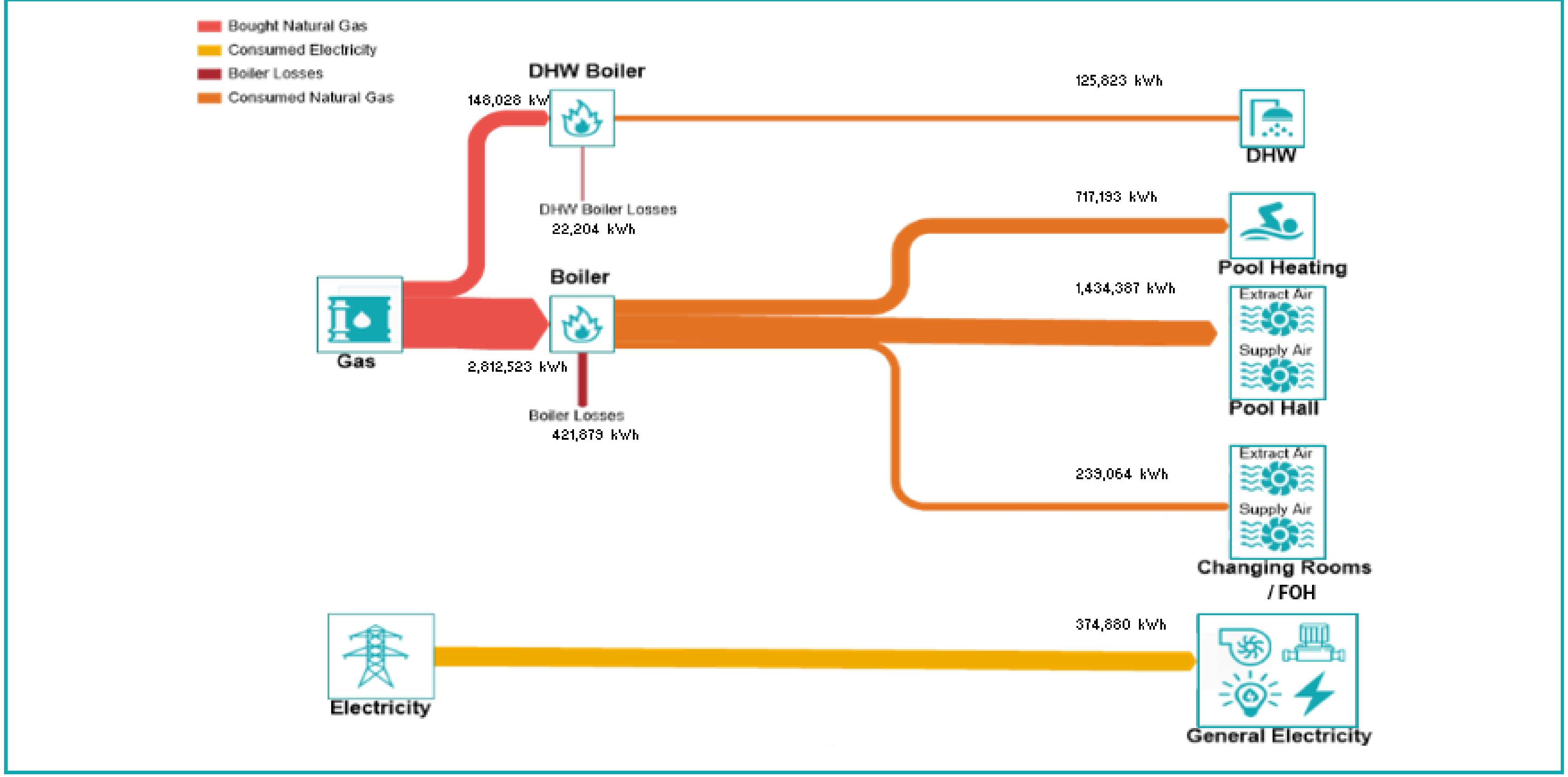
The direct visual outputs for this facility are shown below.



Given the aquatic facility is an indoor pool, the estimated indoor pools energy breakdown is relevant.

2023/24

Estimated Indoor Pools Energy Breakdown



The summary shows positive outcomes if an electrification process were to take place for a typical indoor aquatic facility.

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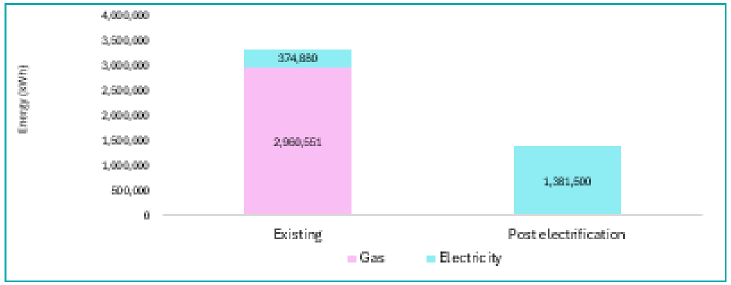
2023/24

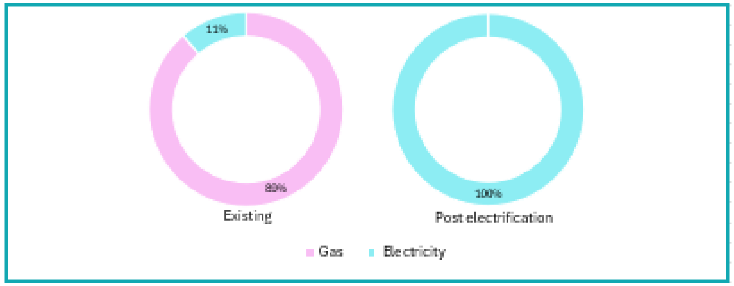
SUMMARY OF ELECTRIFICATION OF SITE

Annual Energy Savings	1,953,931 kWh
Annual Carbon Emission Savings	613.5 tCO2e
Annual Operational Saving	$ 55,900

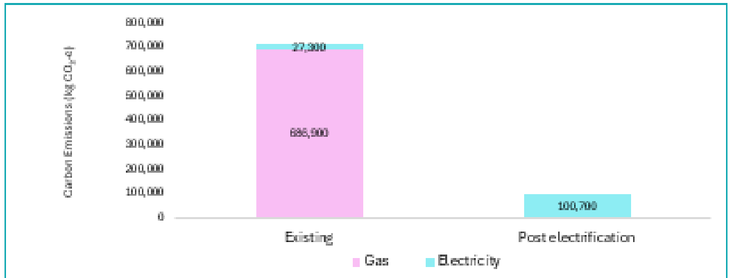
Annual Energy Consumption



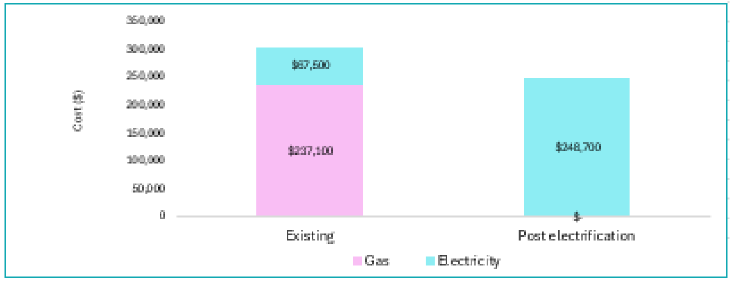
Annual Energy Breakdown



Annual Carbon Emissions



Annual Operational Cost



Due to the aquatic facility being an indoor pool, the estimated indoor pools electrification energy breakdown is relevant.

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2023/24