Ā Te Pūkenga Rautaki, Whāinga Hoki Hei Whakaiti Tuku Haurehu Kati Mahana

Te Pūkenga Greenhouse Gas Emissions Reduction Targets and Strategy

December 2023

Te Pūkenga – New Zealand Institute of Skills and Technology

Te Pūkenga

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Executive Summary | Whakarāpopotonga Matua

The Council of Te Pūkenga has adopted sustainability as an important outcome. One of the outcomes that Te Pūkenga is seeking to achieve pertains to sustainability:

"Become a sustainable network of provision creating social, economic, environmental and cultural wellbeing."

Various stakeholder groups, including kaimahi (staff), ākonga (learners), different branches of the New Zealand government and suppliers, have all articulated strong expectations for Te Pūkenga to establish a well-defined sustainability strategy, particularly in relation to addressing climate change and emissions reduction.

The New Zealand government in particular seeks to progress sustainability through multiple fronts including the Climate Change Response (Zero-Carbon) Amendment Act 2019. The Carbon Neutral Government Programme (CNGP) has been set up to accelerate the reduction of emissions within the public sector. The government will join businesses and communities already leading the way to reduce their emissions as we transition to a low-emissions economy.

The CNGP requires public sector agencies to measure and publicly report on their carbon emissions, including offsets, by 2025. As part of Tranche 3 of the CNGP, Te Pūkenga is **encouraged** to:

- report on emissions and publish its first reduction plan by 1 December 2023
- achieve carbon neutrality by December 2025[1]
- reduce its emissions by 42% by 2030.

Te Pūkenga GHG emissions for 2022 were 23,697 tonnes of carbon dioxide equivalent (tCO_2-e). To align with the CNGP targets, Te Pūkenga would need to achieve a 42% reduction by 2030 from its base year (2022). However, our estimations suggest that the 42% reduction pathway would require a substantial investment, posing financial risks. Consequently, Te Pūkenga will take a reduction pathway to a 35% emissions reduction by 2030. Although the 35% target does not fully align with the CNGP requirements, it still represents a meaningful reduction path. Moreover, this pathway surpasses the minimum globally accepted reduction targets aimed at limiting warming to a minimum of 2°C.

In addition, it is important to note that this high-level reduction plan is designed to target the 'low-hanging fruit' across the network to achieve quick wins. Te Pūkenga will develop four detailed regional emissions reduction plans (one for each Rohe) in 2024-2025, focusing on specific reduction projects within each Business Division. This approach will enable us to:

- gain a comprehensive understanding of the remaining lifespan of our assets and formulate a practical and financially viable replacement plan for such assets. This, in turn, will allow us to explore further opportunities, such as fuel switching for sites with smaller boilers, which are not included in the current roadmap but can be identified through the regional emissions reduction plans

[1] The CNGP has directed government agencies participating in the programme to prioritise emissions reduction efforts. An offsetting plan will be formulated for Te Pūkenga in accordance with the MfE guidelines for offsetting in due course.

- allocate sufficient time for consultations with each Business Division, as well as engage with iwi, hapū and local governments to tailor the regional plans to the specific needs of each region
- identify emission reduction opportunities for upcoming phases that are more financially feasible and were not initially identified in this high-level reduction plan.

It is possible that more cost-effective opportunities may emerge through the four Regional Reduction Plans, potentially enabling Te Pūkenga to attain a higher reduction target closer to the 42% goal aligned with the CNGP.

It is also important to note that this reduction plan is intended to be a dynamic document that can be adjusted as new information emerges, technology costs evolve, and the results of our emissions reduction initiatives become apparent. This reduction plan will be updated annually.

This plan details a proposed greenhouse gas (GHG) emissions reduction plan for Te Pūkenga to meet the 2030 emissions reduction target of 35%. The results of this plan will guide Te Pūkenga to make technically and commercially viable investment decisions that support its transition to a low emissions future.

Achieving 35% emissions reduction by 2030 is possible for Te Pūkenga. However, it will require rethinking and innovative approaches to how we operate and utilise our assets, as well as some behaviour and policy change – particularly around travel and our vehicle fleet. This pathway can be achieved in three phases (Figure 1).

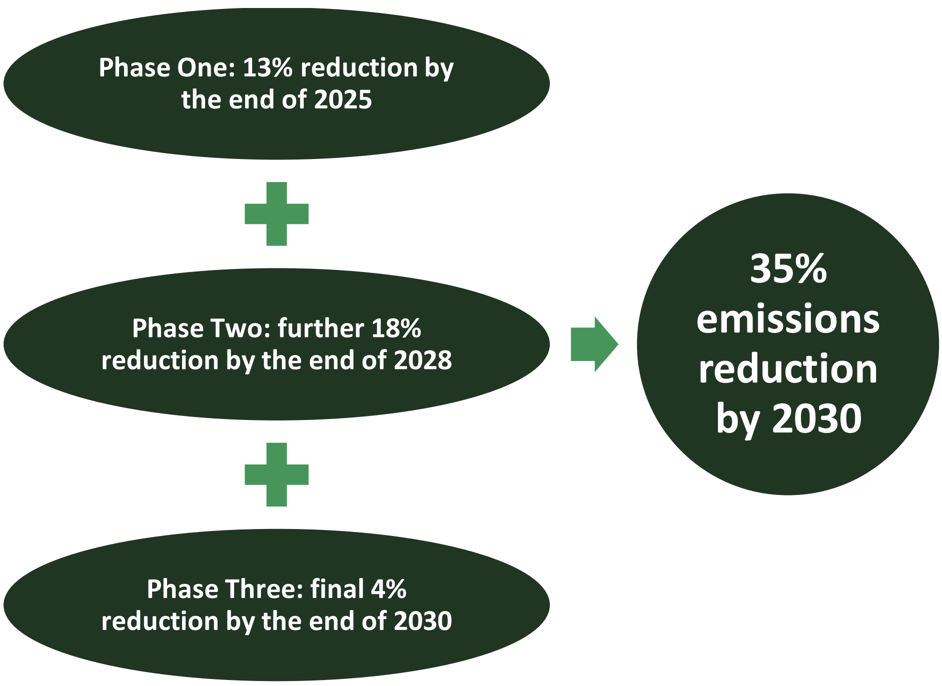

Figure 1: Three-phase plan for 35% emissions reduction by 2030

Te Pūkenga can reduce GHG emissions by 35% between now and 2030, with an overall investment of ~$18m, with annual savings expected of ~$7.6m. This pathway would also achieve a 13% reduction by 2025.

The plan can be achieved by focusing initially on low-cost initiatives such as changing behaviour and improving efficiency, but more significant investment will be required later in the plan period (2026-2030).

Phase One of the plan (2024-2025) will concentrate on diminishing emissions from energy, travel, waste and paper through behavioural changes (reducing air travel, minimising paper usage, generating less waste) and efficiency measures, including energy audits. When feasible, end-of-lease vehicles will be replaced with lower-emission models, particularly hybrids. During this phase, only the most economically viable conversions of fossil-fuel boilers (e.g. NMIT diesel boiler) will be pursued. Although such projects can yield substantial emissions reductions, their financial attractiveness is comparatively lower than alternative options.

In Phase Two (2026-2028) other energy efficiency opportunities for sites with LPG and diesel boilers will be pursued. Additionally, there will be an increase in the amount of battery electric vehicle (BEV) conversions in the fleet.

Finally, in Phase Three (2029-30) the remaining boiler conversion opportunities will need to be pursued, along with mostly all vehicle change outs being to Battery Electric. To achieve the plan, approximately 50% of vehicles will need to be Battery Electric by 2030, with most of the other vehicles being hybrids.

The preparation of this plan was undertaken by Te Pūkenga sustainability team with guidance and modelling support from emission experts at Lumen. For inquiries related to this plan, please reach out to Te Pūkenga sustainability team at sustainability@tepukenga.ac.nz.

Emissions Reduction Roadmap to 2030 for Te Pūkenga

Figure 2 in the next page shows a possible road map for Te Pūkenga to achieve a reduction target of 35% by 2030.

These figures are founded on specific assumptions, a comprehensive list of which can be found in Section 8 of this plan. The estimates provided in this figure are derived from previous projects and industry standards. To determine the precise cost of each initiative, individual business cases will be completed prior to commencing the projects. The operational expenditure (Opex) savings include potential offsetting costs.

The projects highlighted in green have a negative Marginal Abatement Cost (MAC), indicating they are more cost-effective, with reduction costs lower than or equal to those of business as usual. The initiatives marked in white in the MAC column are expected to have a positive Marginal Abatement Cost, signifying they will incur additional costs compared to business as usual.

Category	Opportunity	Year	Annual savings (t CO_2-e)	Annual savings (%)	Remaining emissions	Capex ($k)	Opex savings ($k/yr) (Year 1)	Opex savings ($k/yr) (Avg)	MAC ($/t)
Baseline emissions		2022			100% (23,697 t CO_2-e/yr)				
Fuel switching	SIT Coal Transition	2024	308	1.3%	99%	$1,200	$7	$40	$400
Process change	10% Reduction in Domestic Flights	2024	260	1.1%	98%	$0	$400	$420	-$1,400
Fuel switching	Fleet Transition 2024	2024	176	0.7%	97%	$700	$48	$150	-$200
Energy efficiency	Energy Audits	2025	1,165	4.9%	92%	$4,000	$1,200	$1,300	-$600
Fuel switching	NMIT Diesel Transition	2025	228	1.0%	91%	$1,400	$150	$230	-$200
Building utilisation	Site Rationalisation 2025	2025	305	1.3%	90%	$0	$330	$370	-$900
Process change	Reduce Waste Emissions by 16.5% (Organics Diversion)	2025	340	1.4%	88%	$0	$28	$45	$0
Process change	Reduce Paper 30%	2025	83	0.4%	88%	$0	$290	$300	-$3,500
Fuel switching	Fleet Transition 2025	2025	201	0.8%	87%	$600	$83	$210	-$400
Phase 1 sub totals			3,067	13%		$7,900	$2,536	$3,065	-$534
Fuel switching	Ara Christchurch LPG & Diesel Transition	2026	396	1.7%	85%	$3,200	$240	$330	$100
Fuel switching	Ara Woolston LPG Transition	2026	265	1.1%	84%	$2,400	$160	$200	$200
Fuel switching	Fleet Transition 2026	2026	208	0.9%	83%	$500	$110	$250	-$600
Process change	40% Reduction in Flight Emissions (Data Quality)	2026	780	3.3%	80%	$0	$68	$110	$0
Other	Installing Water & Wastewater Metering	2026	720	3.0%	77%	$300	$63	$99	$0
Fuel switching	Fleet Transition 2027	2027	311	1.3%	76%	$1,000	$230	$440	-$700
Process change	Additional Travel Initiatives	2027	63	0.3%	75%	$0	$6	$9	$0
Fuel switching	Fleet Transition 2028	2028	312	1.3%	74%	$1,100	$310	$550	-$1,000
Process change	Reduce Waste Emissions by 42% (Organics Diversion)	2028	520	2.2%	72%	$0	$52	$77	$0
Process change	Reduce Paper 50%	2028	55	0.2%	72%	$0	$200	$200	-$3,500
Building utilisation	Site Rationalisation 2028	2028	642	2.7%	69%	$0	$1,100	$1,100	-$1,500
Phase 2 sub totals			4,272	18%		$8,500	$2,539	$3,365	-$400
Fuel switching	Fleet Transition 2029	2029	300	1.3%	68%	$900	$290	$540	-$1,100
Fuel switching	Remaining Fossil Fuel Energy Transitions	2029	48	0.2%	68%	$400	$27	$37	$300
Energy supply	Electricity Emissions Factor Reduction - 2030	2030	359	2%	66%	$0	$0	$0	$0
Fuel switching	Fleet Transition 2030	2030	286	1%	65%	$700	$280	$550	-$1,300
Phase 3 sub totals			993	4%		$2,000	$597	$1,127	-$1,055
Total			**8,330**	**35%**		**$18,000**	**$5,700**	**$7,600**	**-$500**

Figure 2: Emissions Reduction Roadmap to 2030 for Te Pūkenga

1. Introduction | Kupu Whakataki

This plan outlines a proposed emissions reduction plan aimed at achieving a 35% reduction target by 2030 for Te Pūkenga. The overarching strategy is to identify the most effective pathway to reach this reduction target by prioritising emissions reduction initiatives based on their financial outcomes while minimising impacts on kaimahi and ākonga. For example, although reducing travel, particularly flights, could yield substantial emissions reductions and financial benefits at first glance, there may be adverse effects on staff morale, learning outcomes and overall business performance. Consequently, we recognise that there is a realistic limit to the level of travel reductions that can be achieved.

The plan also outlines the potential outcomes of a 'business as usual' approach to emissions reductions, acknowledging that achieving the 35% reduction target could pose numerous financial, behavioural and practical challenges.

As previously noted, this plan is designed to be a dynamic document that can be modified over time as new information and results from additional studies become available.

1.1 Te Pūkenga organisational context

Te Pūkenga brings together 16 Institutes of Technology and Polytechnics (ITPs) and eight industry training organisations (ITOs) across Aotearoa New Zealand, under one national network.

Te Pūkenga employs approximately 9000 kaimahi and delivers training services to approximately 271,000 learners across Aotearoa New Zealand.

2. Te Pūkenga GHG Emissions | Ā Te Pūkenga Tuku Haurehu Kati Mahana

2.1 Background

Te Pūkenga, for the first time, has measured its emissions for 2022 in compliance with the CNGP requirements. Emissions are categorised following the guidelines of ISO 14064:2018-1. The list of emissions sources required by CNGP for reporting is provided in Appendix A.

The greenhouse gas (GHG) inventory for 2022 was compiled by energy and carbon professionals from Lumen during January–May 2023. Subsequently, the inventory underwent independent verification by Toitū Envirocare between May and September 2023.

The measured and verified Te Pūkenga GHG emissions for 2022 amounted to 23,697 tCO_2-e.

Table 1 and Figures 3, 4 and 5 provide an overview of where the emissions are occurring across the network.

Table 1: Te Pūkenga GHG emissions for 2022 by Category

Emissions	tCO_2-e
Category 1 - Direct	8823
Category 2 – Indirect energy	7355
Category 3 – Indirect transport	3508
Category 4 – Indirect products/services	4011
Total	23,697

Te Pūkenga has no Category 5 or Category 6 emissions.

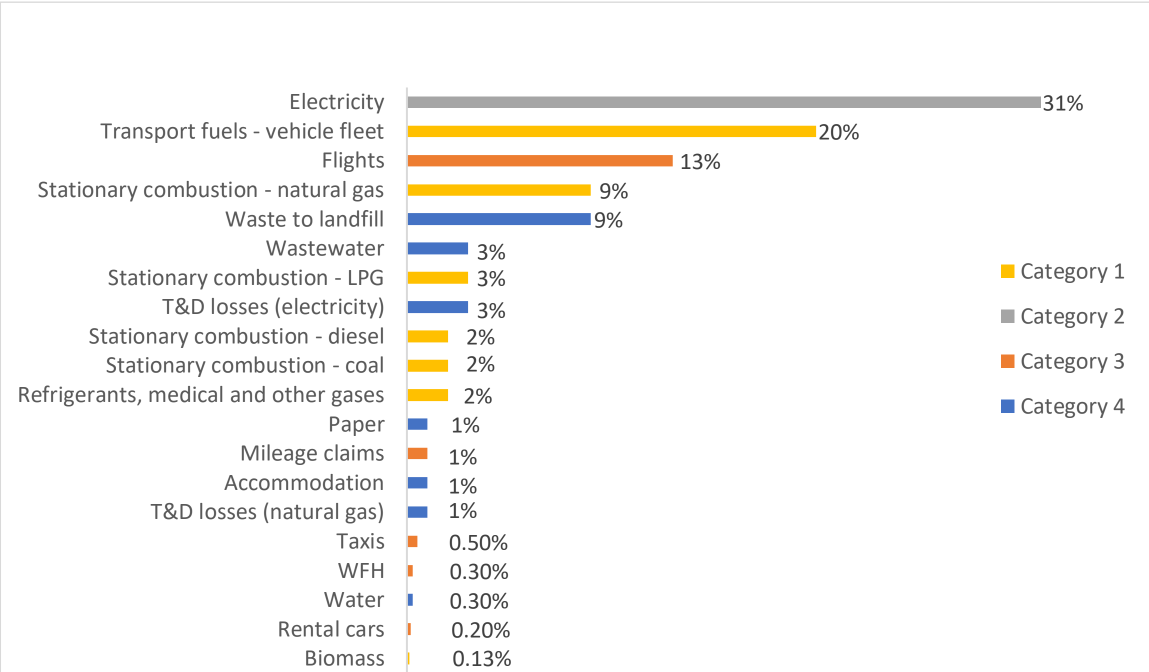

Figure 3: Te Pūkenga GHG emissions for 2022 by Source (tCO2-e)

The largest individual emissions source is electricity as shown in Figure 3, followed by transport fuel.

In Figure 4 emissions are separated into their source groups across the four emissions categories (Category 1-4). This increases electricity to 34% of total emissions (as transmission and distribution losses are included), followed by transport fuels (petrol, diesel), stationary fuels (coal, diesel, gas), travel and waste.

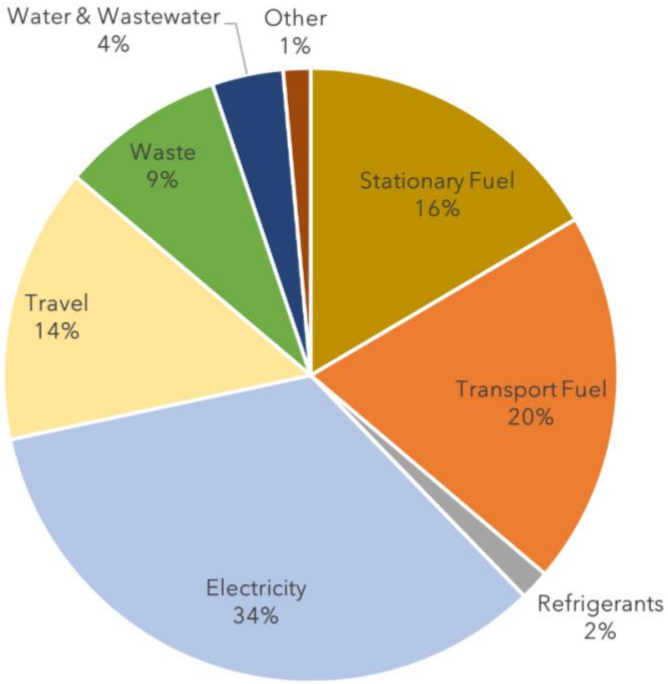

Figure 4: Emissions by source group

Figure 5 visualises the contribution by organisation and emissions source.

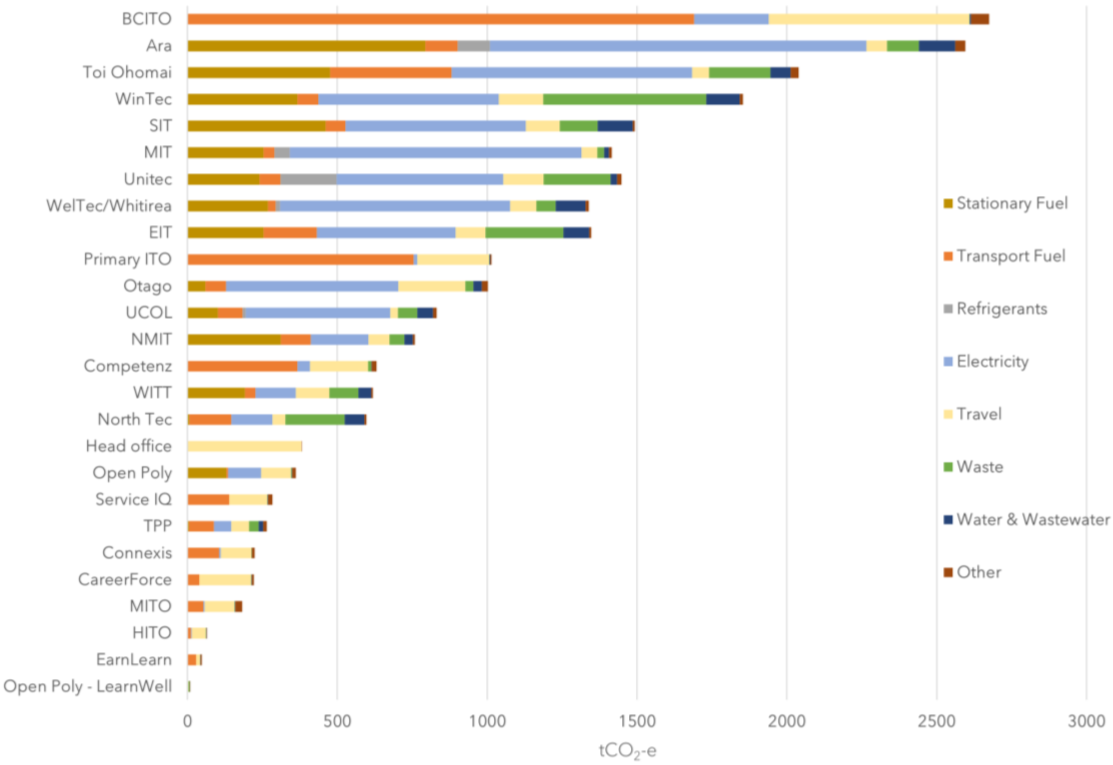

Figure 5: Emissions by organisation and source group (tCO2-e)

2.2 Setting a base year

The period January 2022-December 2022 (FY22) has been identified as a suitable emissions base year for Te Pūkenga, as it is the earliest year for which emissions data was able to be captured across the Te Pūkenga group, and it is the latest period that can realistically be used as a base year when setting emissions reductions targets for 2025 (as required by CNGP).

It is therefore recommended that 2022 is used as the base year for Te Pūkenga to track emissions reductions against.

3. Emissions Reduction Strategy | Rautaki Whakaiti Tuku Haurehu Kati Mahana

3.1 Methodology

The steps undertaken for this project were to:

1. Identify gross emissions reduction targets.
2. Carry out data analysis and research existing emissions sources.
3. Investigate current operations and relevant plans, including interviews with key Te Pūkenga kaimahi.
4. Develop a long list of emissions reduction opportunities and ideas in conjunction with Te Pūkenga kaimahi.
5. Shortlist the most suitable reduction opportunities and then analyse in more detail.
6. Complete technical and financial analysis to evaluate opportunities based on the emissions reduction potential and their marginal abatement cost (MAC) – refer to section 3.2.
7. Develop a model that can be used to present a feasible reduction pathway to achieve the required emissions reduction targets.

The general approach is to sequence actions in the order of Avoid, Optimise, Switch as this prioritises the actions that provide the greatest emissions reductions for the least cost.

For instance, when considering emissions from business travel, the lowest cost emissions reductions will come from not travelling at all (avoid), followed by completing more meetings in each trip (optimise), and then potentially by choosing a lower-emissions travel mode (for instance travel by train instead of air, if this is feasible, acknowledging that it will have a high time cost).

An example of the Avoid, Optimise, Switch methodology flowchart is presented in Figure 6.

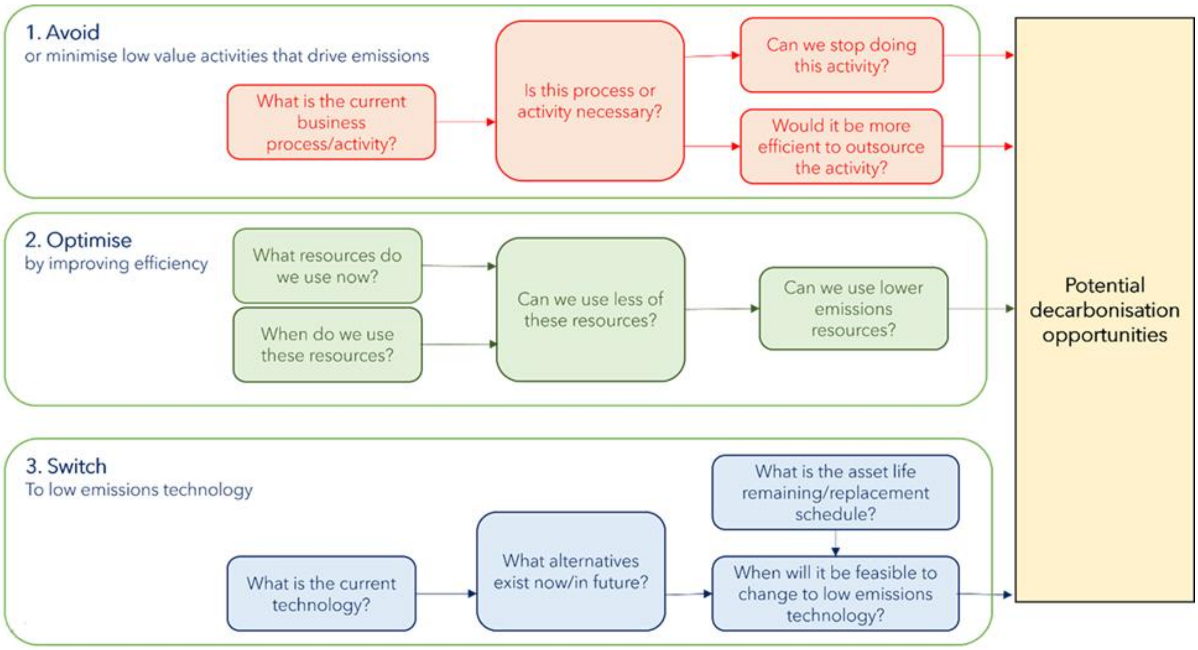

Figure 6: Avoid, Optimise, Switch methodology flow map

3.2 Marginal Abatement Cost

Calculating a marginal abatement cost (MAC) for initiatives is a useful way to compare the financial aspects of initiatives and can be used to identify the lowest cost pathway to achieve a carbon reduction target.

The MAC is equal to the negative net present value (NPV) (with the cost of carbon removed) divided by the lifetime emissions reduction of the initiative. This provides a measure of the cost associated with reducing a tonne of carbon emissions for a particular initiative.

A project with a MAC less than or equal to the current cost of carbon (e.g. $70/t[2] at the time of preparing this plan) indicates that the project is currently financially viable and should be carried out now (i.e. it would deliver a better financial result than not doing it).

If we consider the situation for Te Pūkenga and the CNGP requirement for organisations to be carbon neutral by 2025, Te Pūkenga would, from 2025, need to buy offsets for any emissions that it is unable to reduce. So, essentially the 'break-even' MAC for Te Pūkenga would be twice the cost of carbon.

The forward market for carbon in Aotearoa New Zealand shows a carbon price forecast of $95 in 2028. For simplicity, in our analysis we have considered the cost of carbon for the period 2023-2030 to be $100. Therefore the 'break-even carbon cost for Te Pūkenga would be double this, or $200/t.

In other words, from a financial standpoint, Te Pūkenga should advance all initiatives with a MAC of less than $200.

[2] https://www.commtrade.co.nz/

4. Emissions Reduction Plan – major emissions sources | Mahere Whakaiti Tuku Haurehu Kati Mahana – ngā pūtake matua

The majority (91%) of emissions at Te Pūkenga are concentrated in five categories, leading to a concentrated effort in identifying opportunities to reduce emissions in these areas.

4.1 Electricity

Electricity is the largest source of emissions for Te Pūkenga, responsible for 8029 tCO_2-e, or 34% of the reported emissions. Note that this figure combines electricity consumption (Category 2) emissions, and transmission and distribution losses related to electricity (Category 4).

Electricity emissions were calculated using the latest Aotearoa New Zealand grid emissions factor (2020) available at the time of developing the inventory[3]. MfE updates this factor annually. However, there is usually a 1–2-year delay before the figure is published for any given year. The annual emissions factors for electricity since 2010 are shown in Appendix B.

A key point to note is that electricity factors in Aotearoa New Zealand fluctuate significantly from one year to the next due to the nature of our electricity system. If we have a lot of hydro generation in a year the factor is lower, while in a dry-hydro year more coal or gas generation is required to meet demand.

2020 was a relatively high emissions year due to the higher-than-normal use of coal in that year. Therefore, the emissions factor ($kgCO_2$-e/kWh) published for 2020 is relatively high. By contrast, the emissions factor for electricity in 2022 (which was only published in July 2023) is much lower.

This means the actual emissions from electricity used by Te Pūkenga in 2022 are lower than what has been calculated in the verified inventory, which may necessitate a base-year recalculation (refer to section 7) when Te Pūkenga compiles its 2023 inventory, in 2024.

The grid factor is projected to reduce further in time as the proportion of renewable generation in Aotearoa New Zealand increases, with an estimated reduction of 7% by 2030 (using CNGP's emissions reduction calculator) against the actual 2022 factor.

Consequently, in our emissions reduction modelling we have only factored in a 7% reduction in the grid emissions factor between the baseline for electricity and 2030.

[3] It is standard practice when developing a GHG inventory to use the available emissions factor that corresponds as closely as possible to the reporting period. At the time of developing Te Pūkenga GHG inventory, the latest available factor was 2020.

4.1.1 Overview

Electricity is used at all Te Pūkenga facilities, with the main users of electricity expected to be as follows:

Table 2: Electricity use expectations by percentage

Energy use application	Estimated % of electricity use
Heating, ventilation and air-conditioning (HVAC) systems Chillers, pumps, fans, heat pumps and electric heaters	60%
Lighting Lighting systems (internal and external)	25%
Domestic hot water heating Water heated electrically to 60 – 65 °C, used in kitchens and showers	5%
Miscellaneous other equipment Kitchen equipment, specialised equipment, plug loads (PCs, screens, server equipment, fridges and other small appliances)	10%

The major campus sites are the main users of electricity, with the top 30 sites responsible for 80% of total usage, as shown in Table 3.

Table 3: Electricity use and emissions by site

Site	Annual electricity consumption (kWh)	Annual emissions (t CO_2-e)	% of Total
Ara - Christchurch City	6,607,746	866	10.8%
MIT - Manukau	3,986,740	522	6.5%
Unitec - Mt Albert	3,581,130	469	5.8%
Wintec - Hamilton City	3, 100,025	406	5.1%
MIT - Otara	3,022,577	396	4.9%
Toi Ohomai - Tauranga	2,583,585	338	4.2%
UCOL - Palmerston North	2,515,869	330	4.1%
WelTec & Whitireia -Wellington City	2,456,969	322	4%
EIT - Taradale	2,350,359	308	3.8%
Otago - Forth Street	2,206,731	289	3.6%
Toi Ohomai - Rotorua	2,034,987	267	3.3%
SIT - Invercargill	1,989,893	261	3.2%
Wintec - Rotokauri	1,276,961	167	2.1%
NorthTec - Whangarei	I, 194,167	156	1.9%
WelTec & Whitireia - Petone	1,022,117	134	1.7%
Ara - Woolston	894,634	117	1.5%
NMIT - Nelson	870,592	114	1.4%
WelTec & Whitireia - Porirua	863,710	113	1.4%
WITT - New Plymouth	839,527	110	1.4%
EIT - Gisborne	741,031	97	1.2%
NorthTec - Future Trades	698,670	92	1.1%
Ara - Timaru	663,470	87	1.1%
Unitec - Waitakere	660,599	87	1.1%
Open Polytechnic - Lower Hutt	570,128	75	0.9%
Otago - Student Accommodation	514,254	67	0.8%
Unitec	490,033	64	0.8%
Ara - Accommodation	489,055	64	0.8%
UCOL - Wanganui	469,108	61	0.8%
SIT - Christchurch	387,765	51	0.6%
TPP - Greymouth	354,577	46	0.6%
All other ITP sites	9,443,254	1,237	15.4%
All WBL sites	2,411,019	316	3.9%
Total	**61,291,281**	**8,029**	

4.1.2 Strategy for reducing electricity emissions

Discussions with Te Pūkenga Assets and Property team have identified that a programme of facility rationalisation is expected to be undertaken across Te Pūkenga, with a few premises already exited during 2023 (when leases have expired). Reducing the number of facilities will lead to a reduction in energy use.

As a result, we have made the assumption that a 10% reduction in facility area (in square metres) will be attainable by 2025. We anticipate that the facilities to be rationalised are underutilised compared to other sites, and therefore we expect their energy consumption per square metre is lower than the average. Consequently, we have also assumed that a 3% reduction in electricity use can be realised.

By 2030 we have assumed that a 30% reduction in square metres can be realised, and this will result in a 11% reduction in electricity use across Te Pūkenga.

For those facilities that are to be retained, energy efficiency and demand reduction opportunities should be identified as early as possible, and any ‘quick wins’ should be implemented promptly. This is an important step to deliver upfront financial and emissions reductions as some savings will be able to be realised with minimal investment. Good examples of quick wins include reviewing air conditioning schedules and ensuring that building heating and cooling hours correspond with when buildings are utilised.

As each site is unique, the best way to identify and quantify the specific improvement opportunities for each site is to complete energy audits, focussing on the larger sites.

Energy audits have already been undertaken at some sites. Where this is the case, these reports will be reviewed and any easy-to-implement opportunities that have not been progressed will be actioned as quickly as possible.

Once energy efficiency and demand reduction opportunities have been implemented, then switching to lower emissions energy sources (such as on site solar) can be considered. However, as the Aotearoa New Zealand electricity grid moves closer to 100% renewable the emissions benefits of solar will become negligible.

The likelihood of achieving strong financial results from the installation of rooftop solar panels will need to be evaluated. Solar opportunities should be reviewed on a case-by-case basis.

This emissions reduction plan assumes that no solar rooftop installations occur between now and 2030, and if they did, the emissions reduction benefit would be immaterial.

4.1.2.1 Energy audits programme

Te Pūkenga has secured $150,000 in co-funding from EECA (75%) to progress energy audits in 2024.

The following sites have been identified as priorities for energy audits:

Table 4: Priorities for energy audits

Priority	Campus
1	Unitec - Mt Albert
2	Wintec - Hamilton City
3	Toi Ohomai - Tauranga
4	MIT - Manukau
5	MIT - Otara
6	EIT - Taradale
7	Toi Ohomai - Rotorua
8	UCOL -Palmerston North
9	WelTec & Whitireia -Wellington City
10	Wintec - Rotokauri

These sites have been chosen based on their energy consumption and whether they have recently undergone an energy audit or had energy efficiency initiatives implemented. The listed sites will undergo a thorough review in 2024 before the commencement of the energy audit programme. If other sites not included in the list are found to require an energy audit, they will be prioritised accordingly.

It is assumed that the audits will take place during 2024 and then the energy savings opportunities identified from the audits are implemented in 2025.

It is assumed that 15% savings in electricity use will be realised at the audited sites and 10% will be realised at other sites (on the basis that some opportunities can also be implemented at non-audited sites).

4.1.3 Actions to reduce emissions from electricity usage

Table 5: Recommended actions for electricity

Action	Responsible function	Target date
Coordinate an information sharing webinar, including all facilities managers, to share best practice in energy management	Sustainability and Facilities Management	Early 2024
Undertake energy audits at selected sites to identify specific opportunities to improve energy efficiency	Sustainability and Facilities Management	Completed in 2024
Implement findings of energy audits programme	Energy managers and Sustainability	2025 and then ongoing
Develop a formal emissions reduction plan by region	Sustainability and Business Divisions	Commence in 2024 Complete during 2025
Promote the importance of energy efficiency and energy conservation at campus sites (via regular communications)	Facilities Managers, Sustainability and Communications	Ongoing
Drive a culture that focusses on efficiency first and energy conservation	ELT and People and Culture	Ongoing

4.1.4 Electricity Supply Opportunities

It is expected that there will be a reduction in electricity related emissions for Te Pūkenga over the next 10-30 years as Aotearoa New Zealand moves towards 100% renewable electricity generation. This will likely result in significantly reduced carbon emissions from grid-supplied electricity consumption. Despite this, the rate at which the electricity grid emissions factor will decrease is uncertain and should not be relied on for emissions reductions.

Opportunities for onsite renewable generation (solar) are also available. However, it is recommended that energy efficiency and fuel switching opportunities are prioritised first.

4.2 Stationary Fuel

Stationary fuel refers to fossil fuel used at Te Pūkenga facilities (mainly for heating) and includes natural gas, LPG, coal and diesel.

Stationary fuel is the third largest emissions source for Te Pūkenga, responsible for 16% of total emissions.

4.2.1 Overview

Fossil fuel energy is primarily used at polytechnic sites to provide space heating for buildings, which is typically provided through centralised (or building-specific) boilers that distribute heat around the campus. No fossil fuel usage was identified at Work Based Learning premises.

North Island sites are typically heated by natural gas, while in the South Island a mixture of LPG, coal and diesel are used to heat campuses.

Based on previous energy audits undertaken on Te Pūkenga sites, a typical split of the fossil fuel usage at a site is approximately as follows:

Table 6: Typical split of fossil fuel usage

Energy use application	Estimated % of use
Space heating Generally, boilers heat water to 80°C to supply a hot water loop heating system (radiators, etc.)	63%
Boiler and system losses Energy lost through boiler inefficiencies and heat losses as hot water is piped around the site	25%
Domestic hot water heating Water heated to 60-65°C, used in kitchens and showers. Note: % will be much higher if student accommodation is provided on campus	4%
Kitchen and other equipment Gas cooking in cafes and in hospitality training areas	8%

Typically, fossil fuel energy use is higher during winter as the demand for heating is greater. The impact of this is more pronounced in the South Island where temperatures are cooler.

Sites with the highest stationary fuel emissions are listed in table 7.

Table 7: Fossil fuel energy use and emissions by site

Campus	Natural Gas (kWh)	LPG (kWh)	Coal (t)	Diesel (L)	Emissions (t CO_2-e)
Ara - Christchurch City		1,594,974		48,807	477
SIT - Invercargill			223,500		451
NMIT - Nelson				116,374	313
Ara - Woolston		1,409,914			306
Unitec - Mt Albert	1,286,605				250
Toi Ohomai - Tauranga	1,135,691				220
Wintec - Hamilton City	1,135,353				220
Toi Ohomai - Rotorua	1,054,219				205
EiT - Taradale	977,853				190
WITT - New Plymouth	900,000				175
WelTec & Whitireia - Petone	797,293				155
Wintec - Rotokauri	645,948				125
OP -Lower Hutt	631,145				122
MIT - Otara	629,813				122
WelTec & Whitireia -Wellington City	464,154				90
UCOL -Palmerston North	390,488				76
EIT - Gisborne	250,218				49
MIT - Manukau	197,232				38
All other sites	488,118				95
Total	**10,984,130**	**3,004,888**	**223,500**	**165,181**	**3678**

4.2.2 Strategy for reducing fossil fuel emissions

Energy efficiency and demand reduction opportunities (optimise) should be implemented prior (or in parallel) to progressing fuel switching (fossil fuel to electricity or biomass) opportunities. This is an important step to deliver upfront benefits.

Reduction of energy loads allows for the right sizing of capital-intensive fuel switching opportunities.

Additionally, installing thermal metering in advance of undertaking fuel switching projects can deliver significant value, as it allows for the actual energy demand (that needs to be switched) to be identified.

4.2.3 Targets

Phase One (2024-2025)

- Focus on facility rationalisation and improving energy efficiency.
- Undertake energy audits at key sites to identify specific energy efficiency opportunities and the optimal fuel-switching pathway.
- Identify a list of priority sites for fuel-switching, based on economics, emissions reduction potential and asset status.

Target: 12% reduction in energy related emissions by 2025 (via facility rationalisation, improved energy efficiency and committed fuel switching projects).

Phase Two (2026-2028)

- Continue improving efficiency.
- Switch out remaining LPG and diesel consuming sites by 2028

Target: 20% reduction in energy related emissions by 2028 (via facility rationalisation, improved energy efficiency and fuel-switching.

Phase Three (2029-2030)

- Continue improving efficiency.
- Electricity emissions factor reduction.

Target: 23% reduction in energy related emissions by 2030 (via facility rationalisation, improved energy efficiency and fuel-switching).

'Natural Gas Transition' projects, involving the shift from gas usage in Te Pūkenga buildings to more sustainable alternatives like electricity and woodchips, typically requires a significant capital expenditure (Capex) while delivering less favourable savings in both emissions and operational expenditure (Opex). Consequently, these projects have been excluded from the emission reduction pathway to achieve a 35% reduction by 2030. Nevertheless, as our facilities age, it is anticipated that several gas and diesel boilers will reach the end of their operational life. The replacement of these outdated assets with more sustainable options will be evaluated on a case by case basis in due course.

4.2.4 Switching from fossil fuel boilers to lower emissions alternatives

Once energy efficiency opportunities have been implemented and heating systems have been optimised, then the only way to further reduce energy emissions is to switch from fossil fuel to a lower emissions energy source, either biomass or electricity.

Essentially there are three main options for decarbonising space heating: electric heat pumps, electric boilers and biomass boilers. In some cases, a combination of these options may work best.

Each of the options has advantages and drawbacks, which are summarised in the following table.

Table 8: Summary of key comparison features of boiler replacement options

Parameter	Air source heat pumps	Electric boiler	Biomass boiler
Efficiency	~350%	~99%	~90%
Space requirements	Outdoor space required	Larger space required	Larger space required
Installation difficulty	Easy	Easy	Medium complexity
Emissions savings	High	Medium	High
Operating cost	Low	High	High (dependent on location, proximity to biomass source)
Capital cost	Highest	Lowest	Lowest
Maintenance cost	Medium	Low	High
Fuel delivery traffic management	None	None	Required
Health and Safety considerations	Introduction of more refrigerants	Nothing major	Biomass deliveries to site, fire risk, air quality
Key advantages	Most efficient option, provides heating and cooling		May be lowest cost in short-medium term
Key disadvantages	Up front capital cost	Less efficient than heat pump solution, does not provide cooling	Health and safety considerations
Key risks		Electrical capacity may not be available	Future cost and availability of biomass

Our assumption is that the best decarbonisation option for Te Pūkenga campus sites is most likely to be replacing the existing fossil fuelled boilers with heat pumps.

However, there may be some locations that (for financial reasons) may be better suited to a biomass solution, for example due to their proximity to biomass supply (e.g. Rotorua).

4.2.4.1 Coal

Coal is used only at SIT's Invercargill campus where it is primarily used to provide heating for the campus, across winter months only (usually April-October).

Over the course of 2022, the emissions from burning coal were calculated as 449 tCO_2-e or 1.9% of total measured emissions.

The coal boilers are currently in the process of being replaced with more sustainable options (this is taking place between October 2023 – April 2024), and consequently the site will not use any coal from 2024 onwards.

The emissions reductions from the coal replacement project at SIT have been included in the emissions reduction plan.

4.2.4.2 Natural gas

Natural gas is used in the North Island, at most of the larger sites. It is primarily used to provide for space heating and in some cases for hot water.

The unit cost of natural gas (per kWh) is relatively low compared to other fuel sources (electricity), which can make the business case for fuel-switching projects more challenging than other fossil fuels.

4.2.4.3 LPG

LPG is used as a heating source at Ara's main campus and the Woolston site. A small amount of LPG is used at other campus sites, mainly to provide gas for hot water.

The cost of LPG is higher than natural gas and LPG is mostly used in the South Island where electricity prices are lower.

This means that LPG fuel switching projects will typically have better financial outcomes than natural gas replacement projects, although this depends on the specific project and circumstances at the site. For instance, if a site requires a major electrical capacity upgrade to enable the fuel switching solution, this will be more costly.

4.2.4.4 Diesel

Diesel is used at NMIT, Ara and Otago (back up boiler only) sites. The unit cost of diesel is higher than that of both LPG and natural gas, and the unit cost of electricity is lower in the South Island which generally means that fuel switching projects for diesel boilers in the South Island have comparatively good financials.

An energy audit for NMIT (Nelson campus) conducted in 2023 identified that the optimal solution for replacing the diesel boilers would be to convert to air source heat pumps. The financial assessment from this audit is provided in Appendix D. The preferred option delivers an estimated MAC of $188/t, which is relatively good compared to the MAC estimates at other locations (see table 9).

Additionally, it has been identified that there are significant performance risks with the diesel boilers at NMIT and these will need to be replaced as soon as possible.

It is therefore recommended that the business case for diesel replacement at NMIT is prioritised and the project is undertaken in 2024/2025.

4.2.5 Estimated costs and financial assessment of fuel switching projects

A preliminary financial estimate for decarbonising each of the sites with significant fossil fuel usage is outlined in Table 9, based on a heat pump solution. While the natural gas projects have not been incorporated into the reduction roadmap, this still equips Te Pūkenga with an understanding of the potential costs associated with undertaking fuel switching projects. This information can be used for comparison against other emissions reduction projects.

To pinpoint the optimal decarbonisation option for each site and obtain a more precise assessment of costs, a detailed feasibility study should be conducted for each site.

The financial estimates are based on the following assumptions:

- relatively high level of capital investment ($2700 per kW of installed heat pump capacity)
- relatively low utilisation of natural gas boilers through the year (natural gas is predominantly used for heating which is not required year-round)
- cost of electricity in the upper North Island assumed at 17c/kWh, lower North Island at 15c/kWh and South Island at 12c/kWh to reflect realistic electricity pricing
- natural gas rate was assumed to be starting at 9.1c/kWh, based on the last four quarters of energy price data from MBIE[4], and escalating at 1% a year above inflation
- imported fossil fuels (diesel, petrol) are assumed to escalate at 3% above inflation.

The detailed financial estimates are provided in the following table:

[4] https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-statistics/energy-prices/

Table 9: Estimated costs and financial assessment of fuel switching projects

Site	Capex	Annual opex savings (year 1)	Annual opex savings (average)	Annual emissions savings (average)	Lifetime emissions savings	Marginal abatement cost
Ara Christchurch LPG & Diesel Transition	$3,200,000	$ 240,000 /yr	$ 330,000 /yr	410 tCO_2-e/yr	8,100 tCO_2-e	$ 100 /tCO_2-e
SIT Coal Transition	$1,200,000	$ 6,700 /yr	$ 40,000 /yr	330 tCO_2-e/yr	6,500 tCO_2-e	$ 400 /tCO_2-e
Ara Woolston LPG Transition	$2,400,000	$ 160,000 /yr	$ 200,000 /yr	260 tCO_2-e/yr	5,200 tCO_2-e	$ 200 /tCO_2-e
NMIT Diesel Transition	$1,400,000	$ 150,000 /yr	$ 230,000 /yr	240 tCO_2-e/yr	4,800 tCO_2-e	-$ 200 /tCO_2-e
Unitec Mt Albert Natural Gas Transition	$2,100,000	$ 50,000 /yr	$ 77,000 /yr	180 tCO_2-e/yr	3,700 tCO_2-e	$ 800 /tCO_2-e
Toi Ohomai Tauranga Natural Gas Transition	$1,900,000	$ 44,000 /yr	$ 68,000 /yr	160 tCO_2-e/yr	3,200 tCO_2-e	$ 800 /tCO_2-e
Wintec Hamilton City Natural Gas Transition	$1,900,000	$ 44,000 /yr	$ 68,000 /yr	160 tCO_2-e/yr	3,200 tCO_2-e	$ 800 /tCO_2-e
Toi Ohomai Rotorua Natural Gas Transition	$1,900,000	$ 42,000 /yr	$ 64,000 /yr	150 tCO_2-e/yr	3,000 tCO_2-e	$ 900 /tCO_2-e
EIT Taradale Natural Gas Transition	$1,600,000	$ 45,000 /yr	$ 65,000 /yr	140 tCO_2-e/yr	2,800 tCO_2-e	$ 700 /tCO_2-e
WITT New Plymouth Natural Gas Transition	$1,600,000	$ 40,000 /yr	$ 59,000 /yr	130 tCO_2-e/yr	2,600 tCO_2-e	$ 800 /tCO_2-e
W&W Petone Natural Gas Transition	$1,300,000	$ 38,000 /yr	$ 55,000 /yr	110 tCO_2-e/yr	2,300 tCO_2-e	$ 800 /tCO_2-e
Wintec Rotokauri Natural Gas Transition	$1,100,000	$ 28,000 /yr	$ 41,000 /yr	92 tCO_2-e/yr	1,800 tCO_2-e	$ 800 /tCO_2-e
Open Polytechnic Lower Hutt Natural Gas Transition	$1,100,000	$ 30,000 /yr	$ 43,000 /yr	90 tCO_2-e/yr	1,800 tCO_2-e	$ 800 /tCO_2-e
MIT Otara Natural Gas Transition	$1,100,000	$ 28,000 /yr	$ 41,000 /yr	90 tCO_2-e/yr	1,800 tCO_2-e	$ 800 /tCO_2-e
UCOL Palmerston North Natural Gas Transition	$800,000	$ 23,000 /yr	$ 33,000 /yr	67 tCO_2-e/yr	1,300 tCO_2-e	$ 800 /tCO_2-e
W&W Wellington City Natural Gas Transition	$800,000	$ 23,000 /yr	$ 33,000 /yr	66 tCO_2-e/yr	1,300 tCO_2-e	$ 800 /tCO_2-e
Remaining Fossil Fuel Energy Transitions	$400,000	$ 27,000 /yr	$ 37,000 /yr	48 tCO_2-e/yr	970 tCO_2-e	$ 300 /tCO_2-e
EIT Gisborne Natural Gas Transition	$500,000	$ 10,000 /yr	$ 16,000 /yr	36 tCO_2-e/yr	720 tCO_2-e	$ 1,100 /tCO_2-e
MIT Manukau Natural Gas Transition	$300,000	$ 8,600 /yr	$ 13,000 /yr	28 tCO_2-e/yr	560 tCO_2-e	$ 600 /tCO_2-e

Considering the relatively high MACs of these projects when viewed independently, it is advisable to coordinate these initiatives with broader facilities upgrades or when existing assets are approaching the end of their operational life.

In practice, the most cost-effective strategy is to integrate emissions reduction opportunities during asset replacement or when assets are considered inefficient.

Therefore, it is crucial to synchronise emissions reduction opportunities with the asset replacement schedule, ensuring adequate lead time for investigation and project delivery.

4.2.6 Actions

Table 10: Recommended actions for stationary fuel

Action	Responsibility	Target date
Complete energy audits at 10 sites to identify specific opportunities to improve energy efficiency	Sustainability and Property team	Commence in 2024
Develop a formal emissions reduction plan by region	Sustainability and Business Divisions	Complete during 2025
Develop fuel-switching business cases for target sites	Sustainability and Property team	2025-2026

4.3 Vehicle fuels

Fuel used in vehicles is the second largest emissions source for Te Pūkenga, responsible for 4662 tCO_2-e, or 20% of the measured emissions.

4.3.1 Overview

Te Pūkenga has a large vehicle fleet, with approximately 1300 vehicles across the group (refer to Appendix C for more details).

Most vehicles are powered by internal combustion engines (ICE), with a low penetration of battery electric vehicles (BEVs) across the group at this stage.

Currently around 60% vehicles across the network are leased, while the other 40% of the vehicles are owned.

Lease terms vary. However, a three-year lease term is most common, which is advantageous from an emissions reduction perspective as this allows Te Pūkenga to take advantage of improvements to vehicle technology as these emerge. For example, newer models of the same vehicle are more fuel efficient (a 2023 model will be roughly 5-10% more efficient than a 2020 model), and hybrid technology is leading to substantial improvements to fuel efficiency (a hybrid is ~ 30% more fuel-efficient than an equivalent ICE vehicle).

The annual km per vehicle is, on average, much higher for WBL vehicles than ITP vehicles.

Vehicles are typically assigned to individuals in WBL roles (and are therefore ‘taken home’ outside of work hours), while most ITP vehicles are pool cars. This presents a logistical challenge for converting WBL vehicles to electric, as BEV charging options need to be considered.

For example, should an employee be required to charge the vehicle at home (which raises health and safety considerations, and reimbursement questions), or at a charging station (which may take some time out of the employee's day).

The logistics of BEV charging for pool vehicles are (at least in theory) simpler, as charging facilities can be provided at Te Pūkenga facilities.

Given these challenges it makes sense to start converting pool cars to electric vehicles before converting personally assigned vehicles.

A second key challenge with electric vehicles (for the time being) is their greater up-front and lease cost compared to an equivalent ICE vehicle. However, over time it is expected that this cost differential will reduce, with some predictions that BEVs will reach cost-parity with ICE vehicles sometime between 2026 and 2030[5]. In our modelling we have assumed that cost-parity occurs in 2028.

Even with a higher upfront cost currently, the business case for BEVs has improved markedly in recent times because of increases in the cost of fossil fuel (petrol and diesel). With fossil fuel costs at high levels now and likely to increase in future, the Total Cost of Ownership (TCO) of BEVs relative to ICE vehicles will only improve and is expected to make the economics of BEVs favourable before 2030.

Currently, a slight premium is paid for buying or leasing hybrid vehicles compared to non-hybrid models. However, because the fuel savings are significant (~30%) for a hybrid vehicle then a hybrid will have a lower total cost over a period of time. The operating savings are a function of the kms travelled (the more kms travelled, the greater the fuel savings for a hybrid). Additionally, hybrids do not require any additional (charging) infrastructure, making them a great first step towards decarbonising the fleet.

Plug-in hybrids (PHEVs) are typically not recommended for fleet vehicles as they require additional infrastructure and provide limited emissions reduction potential. Studies[6] have found that their real-world fuel consumption can be up to five times more than the WLTP[7] values when used as fleet vehicles.

4.3.2 Strategy and Targets to reduce emissions from fuels

Short-term (2024-2026)

- Replace end-of-lease vehicles with more fuel-efficient alternatives. Prioritise hybrids and offer long range BEV alternatives where suitable.
- Replace 15 pool vehicles each year with BEV alternatives.

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[5] https://www.sciencedirect.com/science/article/pii/S1364032122009558#sec4

https://www.mdpi.com/2032-6653/12/1/21

[6] https://theicct.org/wp-content/uploads/2022/06/real-world-phev-use-jun22-1.pdf

[7] The Worldwide harmonized Light vehicles Test Procedure (WLTP) is a global standard for determining the levels of pollutants, CO_2 emissions and fuel consumption of traditional and hybrid cars, as well as the range of fully electric vehicles.

Mid-term (2027-2030)

- Replace end-of-lease vehicles with other BEV options. Replace with hybrid only if BEV is not suitable.
- Replace remaining pool vehicles with BEVs.

Target: 50% of vehicles in fleet electric by 2030

4.3.3 Actions

Table 11: Recommended actions for vehicle fuels

Action	Responsibility	Target date
Develop Te Pūkenga vehicle policy	Fleet and Assets Operations Manager	2024
Start replacing end-of-lease fossil-fuelled vehicles with lower emissions vehicles – focus initially on hybrids and move towards electric vehicles over time	Fleet and Assets Operations Manager	Commence in 2024
Develop fleet optimisation plan*	Fleet and Assets Operations Manager	2024

*Note: a fleet optimisation plan is not strictly a part of the emissions reduction plan. However, it is a key enabler of the plan. This is because if there are fewer vehicles in the fleet, then it will be more straightforward and cost-effective to transition to lower emissions replacement vehicles.

4.4 Flights

Emissions from flights are the fourth largest emissions source for Te Pūkenga, with emissions measured at 2982 tCO_2-e for 2022. This represents 13% of measured emissions.

4.4.1 Overview

Emissions arise from flights via the combustion of the fossil fuels jet fuel or kerosene.

In line with CNGP reporting guidance, Te Pūkenga flight emissions have been calculated with a radiative forcing multiplier of 1.9 applied. Radiative forcing helps organisations account for the wider climate effects of aviation, including water vapour and indirect GHGs.

The Ministry for the Environment provides emissions factors for a range of aircraft sizes (large, medium and small), as well as a national average which is weighted based on the contributions of each aircraft type to the mix of flights (Appendix B – Air Travel).

Generally, the larger the plane, the lower the emissions per passenger. When the aircraft type is unknown, it is standard practice to use the national average factor when calculating emissions.

In the case of calculating the GHG inventory for 2022, the type of plane flown was not identified in the supplier data and therefore the national average flight emissions factor was used.

However, it is likely that many flights taken by Te Pūkenga staff are on larger (jet) planes and therefore it would be useful to capture this in reporting moving forward.

It is recommended that Te Pūkenga chooses a travel provider who can provide details of the plane type. This will allow more accurate reporting of emissions in future. Additionally, wherever possible, Te Pūkenga staff should aim to take direct flights to destinations and choose to fly on lower emissions planes where such options are available.

We expect that there might be an increase in travel emissions in the short term due to 'deferred travel' and as Te Pūkenga organisational structure becomes more established. Therefore, it will be crucial for Te Pūkenga to closely monitor flight emissions in the coming years.

4.4.2 Strategy and targets to reduce travel emissions

A revised travel policy, developing an emission budget and improving flight emissions data capture will be the main tools to manage travel emissions.

As business travel is usually made up of interconnected elements – for example, many taxi rides are to and from airports and much accommodation occurs in conjunction with flights – reducing the number of flights should have a flow on effect and reduce emissions from accommodation and taxi trips.

By 2025: Reduce flight emissions 10%

By 2030: Reduce flight emissions 40%

Note that the second target will be realised largely through improving emissions data capture and ensuring that when flights are booked, the lowest emissions flight option is selected by Te Pūkenga kaimahi. The difference in emissions by aircraft type can be in the order of 40%, so it is important to consider (and record) the details of the aircraft chosen when flying.

4.4.3 Actions

Table 12: Recommended actions for flights

Action	Responsibility	Target Date
Choose a national travel provider who can provide emissions reporting, including plane type	Procurement and sustainability	End 2023
Choose the lowest available emissions flight option when booking flights (e.g. fly direct to destination, choose the largest plane available)	All staff	Ongoing
Develop an emissions budget process for travel	Finance and Sustainability functions	Mid 2024
Review travel policy, including approvals process	Finance and Sustainability functions	End 2024
Drive a culture that ensures decisions to travel consider emissions, costs, wellbeing and alternative options (such as video conferencing)	ELT, People and Culture and Communications	Ongoing

4.5 Waste to landfill

Waste to landfill is responsible for 2047 tCO_2-e and represents 9% of measured emissions.

4.5.1 Overview

Waste disposal emissions account for the GHG emitted from end-of-life waste disposal (predominantly methane). The anaerobic decomposition of organic waste in landfills generates methane.

Materials that have a high organic component generate the highest emissions per weight of material as they decompose. This includes food waste, paper and garden waste.

Substances such as plastics, metals and glass are inert because their decomposition in landfills does not directly produce GHG emissions.

To minimise waste-related emissions, the primary focus should be on reducing the disposal of organic matter in landfills. For Te Pūkenga, key materials to address are expected to include food waste, paper and wood/sawdust associated with trade sites.

As a first step, waste audits should be undertaken at several sites to understand exactly what materials are being collected. Appropriate interventions can then be established.

It is also important to consider the destination of landfill waste. Some landfills collect and destroy methane through flaring, resulting in lower emissions per unit of waste. Te Pūkenga should collaborate with waste management providers to ensure that waste is directed to landfills with flaring to minimise emissions.

4.5.2 Strategy and Targets

By 2025: Reduce waste-to-landfill emissions 16.5%

By 2030: Reduce waste-to-landfill emissions 42%

4.5.3 Actions

Table 13: Recommended actions for waste to landfill

Action	Responsibility	Target date
Run an information sharing webinar, including all facilities managers to share best practice in waste management	Sustainability	Early 2024 then ongoing
Choose a waste management provider/s who can provide waste data by landfill and material type	Procurement	Mid 2024
Conduct waste audits to understand the composition and volume of waste generated on campus sites	Property and sustainability	End 2025
Reduce contamination of organic waste and recycling through better education and signage	Facilities Managers	Ongoing
Implement composting or food scrap recovery programmes (e.g. animal feed) for organic waste and any green waste	Facilities Managers	ASAP
Encourage the use of digital technologies to reduce paper consumption	Digital team	Ongoing
Promote behaviour change across Te Pūkenga (kaimahi, ākonga and businesses that operate on Te Pūkenga sites) by: • encouraging the use of reusable items such as water bottles and coffee mugs • making it a requirement for cafés to offer discounts to customers bringing reusable cups, takeaway containers and cutlery	Sustainability, Communications and People and Culture	Ongoing
Ensure that any remaining waste is disposed of at landfills that have gas recovery	Procurement and Facilities Managers	End 2024

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Other emissions sources make up a total of 2062 tCO_2-e and represent 9% of measured emissions.

A summary of these emissions and recommended reduction targets for each are provided in the following table.

Table 14: Other emissions and reduction targets

Emissions source	Emissions (tCO_2-e)	2025 Emissions target	2030 Emissions target
Wastewater	823	Maintain	Reduce 80%
Water use	64	Maintain	Reduce 80%
Refrigerants	372	Maintain	Maintain
Paper use	276	Reduce by 30%	Reduce by 50%
Other travel			
Mileage claims	153	Maintain	Reduce by 10%
Accommodation	149	Reduce 10%	Reduce 30%
Taxis	117	Reduce 10%	Reduce 30%
Rental cars	41	Reduce 10%	Reduce 30%
Employee work from home	66	Maintain	Maintain
Total	2062		

5.1 Wastewater and Water

Wastewater is responsible for 823 tCO_2-e and represents 3.5% of measured emissions, while water usage emissions make up 64 tCO_2-e.

A key reason for the difference is that far greater emissions (per quantity of water) are incurred from the break-down of biological material found in wastewater, whereas the emissions associated with water supply relate mainly to the energy required to pump water around a network.

Water and wastewater metering is currently limited to only the sites that are required to pay for their actual usage (notably Auckland sites). Most campus sites do not have water metering currently. As such, the emissions calculated in the inventory are based on per capita estimates for most sites. For ITPs the number of kaimahi and ākonga are used, while for WBL entities only kaimahi numbers are used (as ākonga do not attend WBL controlled facilities).

It is advisable for Te Pūkenga to consider installing water metering in advance of potential water-user charges, as many New Zealand councils may introduce such charges before 2030. Metering is also essential to measure actual water and wastewater use, providing evidence of any reduction in water-related emissions.

5.1.1 Targets

By 2025: Maintain water and wastewater emissions at current levels.

By 2030: Reduce measured water and wastewater emissions by 80%.

5.1.2 Actions

Table 15: Recommended key actions for water and wastewater

Action	Responsibility	Target Date
Develop a water and wastewater conservation policy	Property and Sustainability	End 2025
Install water metering at key campus sites to gain visibility of water and wastewater use	Property and Sustainability	By end 2026

5.2 Refrigerants, medical and other gases

Refrigerant leaks are responsible for 372 tCO_2-e and represent 1.6% of measured emissions.

Refrigerants

GHG emissions from refrigerants, usually Hydrofluorocarbons (HFCs) are associated with unintentional leaks and spills from refrigeration units, HVAC systems, air conditioners and heat pumps.

Quantities of HFCs may be small, but HFCs have very high GWPs so emissions from this source can be material.

For Te Pūkenga, the bulk of emissions arising from refrigerants in 2022 relates to refrigerant leaks associated with air conditioning units at a small number of sites (notably Ara and Unitec). Meanwhile, several Business Divisions reported no refrigerant leaks during 2022, which highlights the 'lumpy' nature of emissions in this category. For instance, a Business Division may have no leaks for several years and then have a year where an air conditioning system failure occurs and there is significant leakage. This makes it hard to forecast future emissions.

A key challenge for emissions reporting in this category is the lack of easily available data, with air conditioning contractors typically required to manually check their records to identify when refrigerant top-ups occurred. Over time, Te Pūkenga should work with its suppliers to improve the level of reporting.

Additionally, as facilities are upgraded and HVAC systems are replaced, Te Pūkenga should aim to use low-GWP refrigerant options.

Medical gases

Anaesthetic medical gases (Sevoflurane, Isoflurane and Desflurane) can be a significant source of emissions in hospitals and other medical facilities. These gases may be used by Te Pūkenga ākonga as part of training programmes. However, use of these gases occurs at facilities not controlled by Te Pūkenga. Therefore, no emissions associated with the use of these gases by ākonga have been included in the inventory.

5.2.1 Targets

By 2025: Maintain refrigerant leakage emissions at current levels.

By 2030: Aim to reduce (no target set).

5.2.2 Actions

Table 16: Recommended actions for refrigerant management

Action	Responsibility	Target date
Complete a refrigerant audit across ITP sites to identify GHG liabilities, and where risks of leakage are the highest	Facilities managers and Sustainability	Mid 2025
Undertake preventative maintenance at locations where leakage risks are deemed to be the highest	Facilities Managers	Ongoing
Ensure that any HVAC system replacements incorporate low-GWP refrigerants.	Facilities and Procurement	Ongoing

5.3 Paper use

Paper use is responsible for 276 tCO_2-e and represents 1.2% of measured emissions. Reducing paper usage also represents a significant opportunity for cost savings.

5.3.1 Targets

By 2025: Reduce paper use by 30%.

By 2030: Reduce paper use by 50%.

5.3.2 Actions

Table 17: Recommended actions for paper management

Action	Responsibility	Target date
Develop a nationwide paper-use policy	Procurement and sustainability	End 2024
Ensure the default preference for any printing is black and white double-sided printing	Digital	Immediately
Drive a culture that ensures decisions to print materials consider emissions, costs, wellbeing and alternative options (such as digital learning)	ELT	Ongoing

5.4 Other travel

Other travel includes accommodation, rental cars, taxis and personal mileage claims. It is responsible for 461 tCO_2-e and represents 1.9% of measured emissions.

Like flights, the main opportunities to reduce other travel emissions will be achieved through a revised travel policy and developing the option of carbon budgets. As there is generally a strong correlation between flights and accommodation, an approach to take fewer flights will result in less accommodation.

Additionally, there are already low emissions options available for rental cars (e.g. BEVs are available in most airport locations in Aotearoa New Zealand). Similarly, there are options to use low-emissions taxis or rideshare services. Therefore, the travel policy should require staff to choose low-emissions options as a first preference.

5.4.1 Targets

By 2025: Reduce other travel emissions by 10%.

By 2030: Reduce other travel emissions by 30%.

5.4.2 Actions

Table 18: Recommended actions for travel management

Action	Responsibility	Target Date
Ensure that preferred travel providers can offer low emissions options for kaimahi to select (e.g. rental car providers should provide BEV options)	Procurement	End 2024
Develop a sustainable travel policy that incorporates the following elements: • kaimahi required to book BEV rental cars, unless there is specific business need for an alternative vehicle type • kaimahi to use low emissions taxis and rideshare services only • Low emissions accommodation options to be booked as a priority	Sustainability and procurement	End 2024
Drive a culture that ensures decisions to travel consider emissions, costs, wellbeing and alternative options (such as video conferencing)	ELT	Ongoing

6. Plan management and governance | Whakahaerenga mahere me te kaitiakitanga

The CNGP requires information on the GHG emissions of Te Pūkenga and progress against reduction plans to be included in each year's annual report and directly reported to the CNGP by December of each year.

6.1 Accountability and responsibility

A function within Te Pūkenga should be responsible for the coordination of the annual emissions reporting process and delivering the overall reduction plan. Typically, in a large organisation such as Te Pūkenga this task sits with a sustainability function. This will be a considerable ongoing task for a large organisation. Therefore it will be important to ensure that sufficient resources are allocated to manage the process and to drive progress towards achieving the emissions reduction targets.

6.2 Annual emissions reporting

The CNGP requires information on the GHG emissions of Te Pūkenga and progress against reduction plans to be included in each year's annual report and directly to the CNGP by December of each year. These emissions need to be independently verified by a qualified third party before being submitted to CNGP.

The annual report is produced in April/May and will need to include the emissions from the previous year. This will be known as Te Tuku Haurehu Kati Mahana: He Whakarāpopoto | Greenhouse Gas Emissions Summary.

Given the complexity of emissions for Te Pūkenga and the large number of emissions sources involved, the use of emissions management software, such as the ESP/Bravegen package currently utilised by Te Pūkenga, supports the task of compiling the GHG inventory. It is recommend that this continues.

6.3 Updating the plan

This is a living plan and as such, should be amended from time to time to incorporate new opportunities as they arise and to address matters affecting the plan's implementation and delivery.

It is recommended that the plan is updated at least annually and is formally reviewed by the Executive Leadership Team on an annual basis.

Ideally the Executive Leadership Team should receive performance reports on the plan's progress twice each year.

7. Baseline recalculation policy | Kaupapa-here tātaitanga pūtaketake

To accurately track progress towards GHG reduction targets, organisations can adjust base year emissions inventory to account for significant changes that may occur over time.

Under international standards, organisations are required to develop a base year recalculation policy. A key consideration is to set a recalculation significance threshold. This is triggered when the cumulative total of changes reaches the significance threshold that the organisation has set.

The CNGP recommends a significance threshold between 5% and 10% of the total measured emissions. This threshold applies to both increases and decreases in GHG emissions.

CNGP's guidance is that the administrative and financial implications of recalculating base year emissions should be considered, along with the impact of material changes to inventory.

Given this guidance, it is recommended that Te Pūkenga sets a 10% threshold for recalculating its emissions.

The following events should be considered when evaluating whether a recalculation is warranted.

7.1 Structural changes

Structural changes including acquisitions, divestitures or mergers. When significant structural changes occur in the middle of a year, the current and baseline year should be recalculated for the entire year.

7.2 Calculation methodology changes

Methodology changes that could trigger the adjustment of the baseline include updated emission factors, improved data quality or updated calculation methods or protocols. For example, over time some emission factors or activity data accuracy may be improved – for example, where an estimated assumption is supplanted by actual data.

7.3 Data errors or other changes

Emissions may be recalculated in the event of discovery of a significant error, or several cumulative errors that together are significant.

7.4 Inclusion of emissions sources not previously measured

As the emissions reporting matures for Te Pūkenga and the focus is extended into the supply chain, some emissions sources may be included (that previously existed) but were not measured. For instance, emissions from goods and services that Te Pūkenga purchases, kaimahi commuting and ākonga travel (optional to measure).

7.5 Timeline for adjustments

It is recommended that base year adjustments should be made at the end of an emissions reporting period if the extent of changes reaches the threshold level.

8. Emissions reduction assumptions | Pūmāramarama whakaiti tuku haurehu kati mahana

This section outlines the key assumptions that have been used for modelling the emissions reduction opportunities available. In the Executive summary of this document, Figure 2 shows the Emissions Reduction Roadmap to 2030 for Te Pūkenga. The assumptions in this section are intended to be read in conjunction with Figure 2, which, for the reader's convenience, has been reinserted at the end of this section.

8.1 Common Assumptions

The following common assumptions have been used for calculations throughout this report unless stated otherwise.

Financial analysis

- It is assumed that from the end of 2025, Te Pūkenga will be required (per CNGP) to purchase off-sets for any emissions it incurs.

Table 19: Key emissions reduction assumptions

Assumption	Value	Unit	Source
Cost of carbon	$70 rising to $100 by 2030	$/t	CommTrade[8]
Real discount rate	5	%	Treasury[9]
Standard NPV period	20	years	

For Energy initiatives (electricity and fossil fuels used onsite)

- All emissions factors are sourced from MfE 2022 guidance (consistent with verified Te Pūkenga 2022 GHG inventory).
- Assumed that facility rationalisation results in net energy savings (that is, a move out of facilities does not result in a corresponding additional energy usage in other locations).
- Energy efficiency savings opportunities (identified through audits) will be equal (in percentage reduction terms) for electricity and any fossil fuel used on site.
- Only those energy efficiency opportunities (identified in audits) with a positive NPV will be progressed.
- Cost of implementing energy efficiency opportunities (identified in audits) is estimated based on a four-year payback assumption.
- Assumed that the NMIT diesel boiler replacement project is implemented during 2024, which results in 12-months of emissions savings in 2025.

[8] https://www.commtrade.co.nz/

[9] https://www.treasury.govt.nz/information-and-services/state-sector-leadership/guidance/financial-reporting-policies-and-guidance/discount-rates

- All fuel switching (e.g. natural gas boiler replacement) projects are assumed to be heat pump solutions.
- Heat pump solution capacity (in kW) is estimated based on boiler utilisation.
- Capital cost of heat pump assumed as $2,700/kW of heat pump capacity.
- Solar has not been modelled as it is assumed that solar investments are unlikely to be progressed due to minimal impact on emissions.
- New Zealand electricity grid factor (including T&D losses) assumed to reduce 7.5% between 2022 and 2030.

8.2 Unit cost assumptions

Table 20: Energy unit cost assumptions

Assumption	Value (incl. ETS charges)	Unit	Source
Electricity consumption – North Island	17	c/kWh	Based off ASX electricity futures for 2027 (Otahuhu)
Electricity consumption – South Island	13	c/kWh	Based off ASX electricity futures for 2027 (Benmore)
Electricity connection charges	5	c/kWh	Based on the average contribution of total electricity cost
Natural gas cost	9.1c/kWh in 2023, rising at 1% above inflation annually	c/kWh	Commercial average nominal rate, from Q2 2023 MBIE energy prices*
LPG cost	14	c/kWh	Based on average costs
Diesel cost	159	c/L	Commercial average nominal rate, from Q2 2023 MBIE energy prices
Natural gas connection charges	5	c/kWh	Based on the average contribution of total gas cost

For vehicles

- Assumed that Te Pūkenga will upgrade its entire vehicle fleet between 2024-2030.
- In 2024, 234 leased vehicles need to be replaced as they are at end-of-lease. Based on an indicative lease roll-over plan for the first six months of 2024, our model assumes that in 2024:
    - 140 vehicles will be replaced by hybrid vehicles
    - 84 will be by a newer version of the same model (like-for-like)
    - 15 will be replaced by electric vehicles.
- Assumed that 15 ‘owned’ vehicles will be replaced with new electric vehicles.

- For 2025 and 2026, it is assumed that the same number of vehicles (234) as 2024 will come to end-of-lease during the year and will be replaced, with the proportion of hybrid and electric vehicles increasing each year compared with 2024.
- From 2027-2029, it is assumed that the remaining vehicles in the fleet (approx. 600) that have not had a lease roll-over in 2024-26 are also replaced by a mixture of hybrid and electric vehicles.
- The result of this is that by 2030, approximately 45% of the vehicle fleet will be electric and 50% will be hybrid with the remaining 5% still traditional ICE vehicles.

Table 21: Cost assumptions for vehicles

Assumption	Value	Unit	Source
Petrol cost	260	c/L	From Q2 2023 MBIE energy prices
Diesel cost	239	c/L	From Q2 2023 MBIE energy prices
Cost to charge electric vehicle	17	c/kWh	Based off ASX electricity futures for 2027 (Otahuhu)
Installed capital cost – BEV charger	4500	$/vehicle	Market rate

For other emissions:

Table 22: Cost assumptions for other emissions

Assumption	Value	Unit	Source
Flight costs	0.4	$/pkm	Based on travel agency estimates for AKL-WLG
Waste disposal costs	60	$/tonne	Waste levy[10]
Cost of paper products	3.18	$/kg	Based on 2022 paper quantity and 2021 General ledger (GL) expenditure
Cost to install water and wastewater metering	15,000	$/site	Inflation adjusted figures from MfE[11]

[10] https://environment.govt.nz/what-government-is-doing/areas-of-work/waste/waste-disposal-levy/expansion/

[11] https://environment.govt.nz/assets/Publications/Files/cost-benefit-analysis-nes-water-measuring-devices-may08.pdf

Category	Opportunity	Year	Annual savings (t CO_2-e)	(%)	Remaining emissions	Capex ($k)	Opex savings ($k/yr) (Year 1)	(Avg)	MAC ($/t)
Baseline emissions		2022			100% (23,697 t CO_2-e/yr)				
Fuel switching	SIT Coal Transition	2024	308	1.3%	99%	$1,200	$7	$40	$400
Process change	10% Reduction in Domestic Flights	2024	260	1.1%	98%	$0	$400	$420	-$1,400
Fuel switching	Fleet Transition 2024	2024	176	0.7%	97%	$700	$48	$150	-$200
Energy efficiency	Energy Audits	2025	1,165	4.9%	92%	$4,000	$1,200	$1,300	-$600
Fuel switching	NMIT Diesel Transition	2025	228	1.0%	91%	$1,400	$150	$230	-$200
Building utilisation	Site Rationalisation 2025	2025	305	1.3%	90%	$0	$330	$370	-$900
Process change	Reduce Waste Emissions by 16.5% (Organics Diversion)	2025	340	1.4%	88%	$0	$28	$45	$0
Process change	Reduce Paper 30%	2025	83	0.4%	88%	$0	$290	$300	-$3,500
Fuel switching	Fleet Transition 2025	2025	201	0.8%	87%	$600	$83	$210	-$400
Phase 1 sub totals			3,067	13%		$7,900	$2,536	$3,065	-$534
Fuel switching	Ara Christchurch LPG & Diesel Transition	2026	396	1.7%	85%	$3,200	$240	$330	$100
Fuel switching	Ara Woolston LPG Transition	2026	265	1.1%	84%	$2,400	$160	$200	$200
Fuel switching	Fleet Transition 2026	2026	208	0.9%	83%	$500	$110	$250	-$600
Process change	40% Reduction in Flight Emissions (Data Quality)	2026	780	3.3%	80%	$0	$68	$110	$0
Other	Installing Water & Wastewater Metering	2026	720	3.0%	77%	$300	$63	$99	$0
Fuel switching	Fleet Transition 2027	2027	311	1.3%	76%	$1,000	$230	$440	-$700
Process change	Additional Travel Initiatives	2027	63	0.3%	75%	$0	$6	$9	$0
Fuel switching	Fleet Transition 2028	2028	312	1.3%	74%	$1,100	$310	$550	-$1,000
Process change	Reduce Waste Emissions by 42% (Organics Diversion)	2028	520	2.2%	72%	$0	$52	$77	$0
Process change	Reduce Paper 50%	2028	55	0.2%	72%	$0	$200	$200	-$3,500
Building utilisation	Site Rationalisation 2028	2028	642	2.7%	69%	$0	$1,100	$1,100	-$1,500
Phase 2 sub totals			4,272	18%		$8,500	$2,539	$3,365	-$400
Fuel switching	Fleet Transition 2029	2029	300	1.3%	68%	$900	$290	$540	-$1,100
Fuel switching	Remaining Fossil Fuel Energy Transitions	2029	48	0.2%	68%	$400	$27	$37	$300
Energy supply	Electricity Emissions Factor Reduction - 2030	2030	359	2%	66%	$0	$0	$0	$0
Fuel switching	Fleet Transition 2030	2030	286	1%	65%	$700	$280	$550	-$1,300
Phase 3 sub totals			993	4%		$2,000	$597	$1,127	-$1,055
Total			**8,330**	**35%**		**$18,000**	**$5,700**	**$7,600**	**-$500**

Roadmap to 35% emissions reduction by 2030 for Te Pūkenga

Glossary

Building Utilisation	Building utilisation relates to changes in how a facility is used. By scheduling activities to take place in energy-efficient facilities as opposed to inefficient facilities, savings in energy use and emissions can be realised.
Carbon Dioxide Equivalent (CO_2-e)	A standard unit for measuring GHG Inventories. The impact of each different GHG is expressed in terms of the global warming potential (GWP) of one unit of carbon dioxide (CO_2). Typically expressed in kilograms ($kgCO_2$-e) or tonnes (tCO_2-e).
Carbon Neutral Government Programme (CNGP)	The CNGP has been set up to accelerate the reduction of emissions within the public sector in Aotearoa New Zealand. Organisations participating in CNGP are required to measure and reduce their Greenhouse Gas emissions.
Category 1 Emissions (Scope 1)	Direct emissions arising from sources that are owned or controlled by the company (e.g. vehicles, fossil fuel used on site, refrigerant leakage).
Category 2 Emissions (Scope 2)	Indirect emissions from the generation of purchased electricity, heat and steam consumed by the company.
Category 3 Emissions (Scope 3)	Indirect emissions from transportation that occur because of the company's activities but are from sources not owned or controlled by the company (e.g. business flights).
Category 4 Emissions (Scope 3)	Indirect emissions from products (and services) used by the organisation that occur because of the company's activities but are from sources not owned or controlled by the company (e.g. contractors, waste to landfill).
Category 5 Emissions (Scope 3)	Indirect emissions associated with the use of products from the organisation (e.g. a vehicle manufacturer would include the energy associated with the use of vehicles they make).
Category 6 Emissions (Scope 3)	Indirect GHG emissions from other sources
EECA	The Energy Efficiency and Conservation Authority. A New Zealand Crown Agency responsible for promoting energy efficiency and decarbonisation. Te Pūkenga has a collaboration agreement with EECA through which Te Pūkenga has opportunities to access funding for energy-related projects to support decarbonisation.
Emission Factor	A metric that converts a specific emission source - such as a litre of diesel - into terms of CO_2 or CO_2-e.
Energy Audit	An energy audit, or review, is a detailed analysis of all facets of a facility's energy use. It involves a comprehensive review and analysis of the equipment, systems, and operational characteristics of the whole facility, and makes quantified energy savings recommendations.
Fuel Switching	Fuel switching refers to changing the energy source (or fuel) of an asset. It generally relates to switching from higher emissions energy sources e.g. fossil fuel, to lower emissions sources such as renewable energy. For instance, converting a natural gas boiler to electricity.
GHG Emissions Inventory	The sum of GHGs emitted by an organisation in a continuous 12-month period. Sometimes referred to as a Carbon Footprint.

	Typically expressed in terms of tonnes of carbon dioxide equivalents (tCO_2-e), and for a 12-month reporting period.
Global Warming Potential	A measure of a gas's ability to cause radiative forcing in the atmosphere (or climate change) relative to the ability of CO_2. For example, methane (CH_4) has a GWP of 28, thus 1kg of CH_4 emitted is 28 times more potent than 1kg of CO_2.
Greenhouse Gas (GHG)	Greenhouse gases (GHG) are gases that influence the way in which the Earth's atmosphere traps heat. Increasing levels of GHGs in the atmosphere are causing the phenomenon of climate change.
Marginal Abatement Cost (MAC)	MACs help to compare cost-effectiveness of carbon reduction options in a consistent way. In this report, MACs are used to show the cost (present value using an NPV) of reducing one more tCO_2-e. A negative MAC implies that the reduction project is lower cost than business as usual and positive MAC represents the additional cost against business as usual. These calculations are performed without any emissions charges so that they can be compared against the cost of offsetting in addition to other potential carbon reduction projects.
Net present value (NPV)	NPV is used in capital budgeting and investment planning to analyse the profitability of a projected investment or project. NPV is the result of calculations used to find the current value of a future stream of payments, including projected investment capital and cost savings. In this report, NPVs are calculated using a common timeframe of 20 years and with the recommended discount rate from Treasury (Treasury, 2023).
Transmission and distribution losses (T&D)	In the context of electricity, these refer to the dissipation of electrical energy as heat during the transportation of electricity from power generation sources to end-users. Transmission losses occur in high-voltage lines over long distances, while distribution losses occur in local networks. In the context of gas, transmission and distribution losses refer to the unaccounted-for or lost volume of gas during its transportation from the source (e.g., gas fields or processing plants) to end-users. These losses can occur due to factors such as leakage, evaporation, or inefficiencies in the gas distribution system.

Appendix A – GHG sources required to be reported under CNGP | Āpitihanga A – Ngā pūtake GHG me mātua whakapūrongo i raro i te CNGP

Table 23: GHG emissions sources reported under the CNGP

All scope 1 emissions	All scope 2 emissions	Mandatory scope 3 emissions and material scope 3 emissions
Category 1 Direct GHG emissions	**Category 2** Indirect GHG emissions from imported energy	**Categories 3, 4, 5 and 6** Indirect GHG emissions from transportation, products an organisation uses or supplies, or other sources
Examples: • Fuel use (eg, aviation fuel, biofuel and biomass (N2O, CH4), coal, diesel, light and heavy fuel oil, LPG, natural gas, petrol) • Refrigerant and other gas use (eg, HVAC, medical gases) • Composting • Wastewater treatment plant (owned) • Solid waste facilities (owned) • International operations (scope 1) • Agriculture and forestry (eg, enteric fermentation, fertiliser use, forest growth, forest harvest)	**Examples:** • Purchased electricity • Purchased heat or steam • International operations (scope 2)	**Mandatory scope 3 emissions:** • Staff travel for work (eg, domestic and international air travel, hotel stays, taxis, private cars, public transport, rental vehicles) • Freight transport • Staff working from home • Transmission and distribution losses • Water supply • Wastewater services • Waste to landfill **Material scope 3 emissions:** • All other scope 3 emissions material to the organisation

Examples:

- Biodiesel (the CO_2 from the biofuel proportion)
- Bioethanol (the CO_2 from the biofuel proportion)
- Biomass (the CO2 from the biomass proportion)

Note: CH4 = methane; CO2 = carbon dioxide; HVAC = heating, ventilation, and air conditioning; LPG = liquid petroleum gas; N2O = nitrous oxide.

Biogenic emissions mandatory to report but separated from scope 1

Appendix B – Selected emissions factors (MfE) | Āpitihanga B – He tīpakonga āhuatanga tuku haurehu kati mahana (MfE)

Table 24: Emission factor for purchased grid-average electricity – annual average

Emission source	Unit	kg CO_2-e/unit	kg CO_2/unit	kg CH_4/unit (kg CO_2-e)	kg N_2O/unit (kg CO_2-e)
2022	kWh	0.0742	0.0721	0.00194	0.0002
2021	kWh	0.115	0.112	0.00301	0.00025
2020	kWh	0.120	0.117	0.00311	0.0002
2019	kWh	0.110	0.107	0.00324	0.0002
2018	kWh	0.0947	0.0913	0.00330	0.0001
2017	kWh	0.0996	0.0959	0.00367	0.00008
2016	kWh	0.0885	0.0845	0.00398	0.00007
2015	kWh	0.112	0.108	0.00439	0.0001
2014	kWh	0.118	0.114	0.00419	0.0001
2013	kWh	0.141	0.137	0.00409	0.0002
2012	kWh	0.167	0.163	0.00385	0.0003
2011	kWh	0.135	0.131	0.00366	0.0002
2010	kWh	0.1457	0.142	0.0036	0.00016

Table 25: Waste disposal to municipal (class 1) landfills with gas recovery

Emission source	Waste type	Unit	kg CO_2-e/unit	CO_2 (kg CO_2-e/ unit)	CH_4 (kg CO_2-e/ unit)	N_2O (kg CO_2-e/ unit)
Waste (known composition)	Food	kg	0.674	n/a	0.674	n/a
	Garden	kg	0.552	n/a	0.552	n/a
	Paper	kg	0.981	n/a	0.981	n/a
	Wood (combined)	kg	0.380	n/a	0.380	n/a
	Wood (treated)	kg	0.0613	n/a	0.0613	n/a
	Wood (untreated)	kg	0.858	n/a	0.858	n/a
	Textile	kg	0.490	n/a	0.490	n/a
	Nappies	kg	0.245	n/a	0.245	n/a
	Sludge	kg	0.153	n/a	0.153	n/a
	Other (inert)	kg	n/a	n/a	n/a	n/a
Waste (unknown composition)	General waste	kg	0.232	n/a	0.232	n/a
	Office waste	kg	0.666	n/a	0.666	n/a

Table 26: Composition of typical office waste

Waste component	Percentage
Paper	53.6%
Food	20.8%
Inert	25.6%

Table 27: Domestic air travel emission factors without a radiative forcing multiplier

Emission source	Unit	kg CO_2-e/unit	CO_2 (kg CO_2-e/unit)	CH_4 (kg CO_2-e/unit)	N_2O (kg CO_2-e/unit)
National average	pkm	0.164	0.158	0.0011	0.0044
Large aircraft	pkm	0.097	0.093	0.0007	0.0026
Medium aircraft	pkm	0.128	0.124	0.0009	0.0034
Small aircraft	pkm	0.352	0.341	0.0029	0.0090

Table 28: Domestic aviation emission factors with a radiative forcing multiplier

Emission source	Unit	kg CO_2-e/unit	CO_2 (kg CO_2-e/unit)	CH_4 (kg CO_2-e/unit)	N_2O (kg CO_2-e/unit)
National average	pkm	0.306	0.300	0.0011	0.0044
Large aircraft	pkm	0.180	0.177	0.0007	0.0026
Medium aircraft	pkm	0.239	0.235	0.0009	0.0034
Small aircraft	pkm	0.670	0.647	0.0055	0.0172

Table 29: Emission factors for international air travel without radiative forcing multiplier

Emission source	Travel class	Unit	kg CO_2-e/unit	CO_2 (kg CO_2-e/unit)	CH_4 (kg CO_2-e/unit)	N_2O (kg CO_2-e/unit)
Short haul (<3700 km)	Average passenger	pkm	0.0812	0.0804	0.00001	0.0008
	Economy	pkm	0.0798	0.0791	0.00001	0.0008
	Business	pkm	0.120	0.119	0.00001	0.00112
Long haul (>3700 km)	Average passenger	pkm	0.102	0.101	0.00001	0.0010
	Economy	pkm	0.0782	0.0774	0.00001	0.0007
	Premium economy	pkm	0.125	0.124	0.00001	0.00117
	Business	pkm	0.227	0.225	0.00002	0.00212
	First	pkm	0.313	0.310	0.00002	0.00293

Table 30: Emission factors for international air travel with radiative forcing multiplier

Emission source	Travel class	Unit	kg CO_2-e/unit	CO_2 (kg CO_2-e/unit)	CH_4 (kg CO_2-e/unit)	N_2O (kg CO_2-e/unit)
Short haul (<3700 km)	Average passenger	pkm	0.154	0.153	0.00001	0.0008
	Economy	pkm	0.151	0.150	0.00001	0.0008
	Business	pkm	0.227	0.225	0.00001	0.00112
Long haul (>3700 km)	Average passenger	pkm	0.193	0.192	0.00001	0.0010
	Economy	pkm	0.148	0.147	0.00001	0.0007
	Premium economy	pkm	0.237	0.235	0.00001	0.00117
	Business	pkm	0.429	0.427	0.00002	0.00212
	First	pkm	0.591	0.589	0.00002	0.00293

Appendix C – Te Pūkenga vehicle fleet | Āpitihanga C – Ō Te Pūkenga waka

Table 31: High-level summary of Te Pūkenga fleet, as of September 2023

Entity	Vehicle Count	Annual emissions (tCO2-e)	Emissions/ vehicle	Owned/ Leased	Replacement policy
BCITO	325	1,690	5.2	Leased	Replaced at end of lease. (Term not stated).
CareerForce	49	40	0.8	Leased	48 months/60,000km
Competenz	69	367	5.3	Leased	200,000 or 5 years
Connexis	31	105	3.4	Leased	Not stated
EarnLearn	28	29	1.0	Move to leasing	Not stated
HITO	10	11	1.1	Leased	Not stated
MITO	42	53	1.3	Leased	100,000 or 5 years
Primary ITO	122	754	6.2	Leased	36 months
ServiceIQ	41	139	3.4	Leased	36 months
WBL Total	**717**	**3,187**	**4.4**		
Ara	67	108	1.6	Owned	100,000 or 5 years
EIT	54	178	3.3	Owned	100,000 or 3 years
MIT	32	37	1.2	Owned	No criteria defined
NMIT	50	100	2.0	Owned	No criteria defined
NorthTec	42	140	3.3	Mix	200,000 or 5 years
Open Poly	4	5	1.3	Owned	50,000 or 3 years
Otago	40	69	1.7	Owned	No criteria defined
SIT	41	66	1.6	Owned	No criteria defined
Toi Ohomai	91	405	4.5	Owned	150,000 or 5 years
TPP	26	84	3.2	Owned	Not stated
UCOL	32	82	2.6	Owned	No set replacement criteria
Unitec	33	70	2.1	Owned	No criteria defined
Weltec & Whitirea	34	25	0.7	Owned	No criteria defined
Wintec	27	71	2.6	Leased	3 year lease term
WITT	17	36	2.1	50/50 mix	100,000 or 5 years
ITP Total	**590**	**1,475**	**2.5**		
Total	**1307**	**4,662**	**3.6**		

Appendix D – Financials for NMIT | Āpitihanga D – Taha Ahumoni mō NMIT

Table 32: Financial comparison of decarbonisation options against business as usual for NMIT

Option	BAU	Air source heat pumps	Air source heat pumps and electric boilers	River-sourced heat pump and air source heat pump	Electric Boilers	Biomass boiler and electric boiler for M block
Capex	$0	**$1,400,000**	$1,900,000	$2,300,000	$1,000,000	$2,500,000
Annual opex (year 1)	$ 146,000 /yr	**$ 41,000 /yr**	$ 41,000 /yr	$ 38,000 /yr	$ 85,400 /yr	$ 104,600 /yr
Annual opex savings (year 1)	N/A	**$ 105,000 /yr**	$ 105,000 /yr	$ 108,000 /yr	$ 60,600 /yr	$ 41,400 /yr
Annual opex (average)	$ 165,000 /yr	**$ 56,000 /yr**	$ 59,000 /yr	$ 55,000 /yr	$ 127,400 /yr	$ 109,300 /yr
Annual opex savings (average)	N/A	**$ 109,000 /yr**	$ 106,000 /yr	$ 110,000 /yr	$ 37,600 /yr	$ 55,700 /yr
Annual emissions (year 1)	216 tCO_2-e/yr	**34 tCO_2-e/yr**	19 tCO_2-e/yr	18 tCO_2-e/yr	54 tCO_2-e/yr	6 tCO_2-e/yr
Annual emissions savings (year 1)	N/A	**182 tCO_2-e/yr**	197 tCO_2-e/yr	198 tCO_2-e/yr	162 tCO_2-e/yr	210 tCO_2-e/yr
Annual emissions (average)	216 tCO_2-e/yr	**32 tCO_2-e/yr**	16 tCO_2-e/yr	15 tCO_2-e/yr	47 tCO_2-e/yr	6 tCO_2-e/yr
Annual emissions savings (average)	N/A	**184 tCO_2-e/yr**	200 tCO_2-e/yr	201 tCO_2-e/yr	169 tCO_2-e/yr	210 tCO_2-e/yr
Lifetime emissions	4,320 tCO_2-e	**640 tCO_2-e/yr**	330 tCO_2-e/yr	310 tCO_2-e/yr	930 tCO_2-e/yr	120 tCO_2-e/yr
Lifetime emissions savings	N/A	**3,680 tCO_2-e**	3,990 tCO_2-e	4,010 tCO_2-e	3,390 tCO_2-e	4,200 tCO_2-e
Lifetime cost	$2,030,000	**$2,060,000**	$2,590,000	$2,950,000	$2,470,000	$3,860,000
Net present value	N/A	**-$35,300**	-$563,000	-$919,000	-$447,000	-$1,830,000
Marginal abatement cost	N/A	**$ 188 /tCO_2-e**	$ 399 /tCO_2-e	$ 541 /tCO_2-e	$ 386 /tCO_2-e	$ 871 /tCO_2-e

Appendix E – Grant funding, loans and other incentives | Āpitihanga E – He pūtea tuku, pūtea taurewa me ētahi atu whakapoapoa

Some of the main funding, loan and other incentive schemes available for organisations wishing to invest in decarbonisation in Aotearoa New Zealand (at the time of writing this report) are detailed below.

8.2.1.1 EECA funding

The Energy Efficiency and Conservation Authority (EECA) aims to support and de-risk energy management and carbon abatement projects by providing support for:

- planning: feasibility studies and commercial building design advice
- optimisation: energy audits, energy system optimisation, monitoring and targeting
- capital investment: co-funding for large decarbonisation projects through the State Sector Decarbonisation Fund (SSDF).

The capital funding programme which Te Pūkenga may be eligible for is the SSDF.

Te Pūkenga has signed a collaboration agreement with EECA.

8.2.1.2 Electricity retailers

Some electricity retailers are becoming interested in helping New Zealand organisations decarbonise through electrification of process heat systems. The ways some electricity retailers are incentivising decarbonisation via electrification include:

- providing capex grants or loans
- providing long-term (10+ year) low-cost electricity contracts to enable price certainty and cost-effective electricity supply.