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ENERGY EFFICIENCY & CONSERVATION AUTHORITY

LUMEN

DIY Emissions Plan: User Guide

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Contents

Nomenclature

The following table provides a glossary of technical terms used throughout this report.

Technical Term	Abbreviation	Description
Biomass fuel switching	-	Conversion of existing solid fuel heat plant or installation of new heat plant to switch from the combustion of fossil fuels to the combustion of biomass for process heat
Business as usual	**BAU**	Continuing to operate a site, process, or equipment into the future the same way it currently operates
Capital expenditure	**capex**	Money invested by a company or organisation to acquire or upgrade physical assets
Carbon dioxide equivalent	**CO_2-e**	A measure used to compare the emissions from various greenhouse gases (GHGs) on the basis of their global warming potential (GWP) over a specified timeframe, by conversion to the equivalent amount of CO2
Demand reduction	**-**	Projects intending to reduce the overall demand for energy, including those focussing on energy efficiency, waste heat recovery, and process change
Discount rate	**-**	The rate used to discount future cash flows back to their present value, often relating to a company's required rate of return, or the minimum rate that investors expect to earn given to the degree of risk associated with the investment
Electrification fuel switching	-	Installation of new heat plant to switch from the combustion of fossil fuels to the use of electricity for supplying process heat
Emissions trading scheme	**ETS**	The market established for the pricing of GHG emissions in New Zealand
Energy Efficiency & Conservation Authority	**EECA**	The New Zealand Crown Entity that encourages, promotes, and supports energy efficiency and the use of renewable energy sources
Giga	**G**	A unit prefix denoting a factor of one billion (109)
Global warming potential	**GWP**	A measure of a gas's propensity to cause radiative forcing in the atmosphere (contributing to climate change), benchmarked to that of CO2.

Technical Term	Abbreviation	Description
Greenhouse gas	**GHG**	Gases that trap heat in the Earth's atmosphere and contribute to anthropogenic climate change, with the main gases being carbon dioxide, methane, nitrous oxide and halogenated gases
Heat pump efficiency effect	-	The use of heat pump technology to reduce process heat energy demand
High temperature heat	**-**	Heat supplied at temperatures above 300°C
High temperature heat pump	**HTHP**	Heat pumps supplying heat at temperatures higher than 60 °C
Joule	**J**	The standard unit of energy
Kilo	**k**	A unit prefix denoting a factor of one thousand (103)
Low temperature heat	**-**	Heat supplied at temperatures less than 100°C
Marginal abatement cost	**MAC**	An economic concept that measures the cost attributable to a reduction of one unit of pollution, specifically CO_2-e emissions for climate change mitigation, calculated as the – net present value (NPV; excluding the cost of carbon) for the competitive abatement method divided by the discounted associated lifetime CO_2-e reduction
Mechanical vapour recompression	**MVR**	MVR is type of open cycle heat pump technology which uses blowers to recover and upgrade low pressure steam for reuse, typically with very high COPs (10 – 40).
Medium temperature heat	**-**	Heat supplied at temperatures between 100°C and 300°C
Mega	**M**	A unit prefix denoting a factor of one million (106)
Net present value	**NPV**	The value of all future cash flows (positive and negative), over the lifecycle of an investment, discounted back to the present
Operating expenditure	**opex**	The ongoing costs of running a business, organisation, or plant (including expenditures such as labour and energy costs)
Optimal Marginal Abatement Cost	**Optimal MAC**	Refers to MAC if less than the forward 10-year rolling average ETS carbon price according to the Climate Change Commission (CCC) demonstration pathway forecast.

Technical Term	Abbreviation	Description
Process heat	**-**	Energy used in the form of heat, mainly by the industrial and commercial sectors for industrial processes, manufacturing, and warming spaces
Tera	**T**	A unit prefix denoting a factor of one trillion (1012)
Volt-amperes	**VA**	The unit for apparent power in an electrical circuit
Watt	**W**	The unit for real power in an electrical circuit
Watt-hour	**Wh**	Unit of energy, denoting a quantity equivalent to the consumption of 1 watt for a duration of 1 hour

1. Introduction & background

This user guide is intended to provide resources to support low complexity small to medium businesses or organisations to "DIY" an emissions plan for energy related greenhouse gas (GHG) emissions.

The objective is to create a pragmatic and actionable emissions plan tailored to your business or organisation that will drive emissions reduction over time. While some businesses or organisations may be able to develop highly detailed plans, leveraging previous studies, others starting from scratch may begin with a more high-level approach. In either case, it's crucial to view the emissions plan as a living document, continuously updated and improved over time as new information becomes available or as technology evolves.

This guide focuses on reducing fossil fuel emissions, as they have a bigger relative potential for emissions reduction compared to electricity emissions. This is because in New Zealand most of our electricity already comes from clean, renewable sources like hydro, geothermal, and wind. Also, as the share of renewable generation continues to increase over time, emissions from electricity are expected to decrease even further. Despite this, electricity emissions are considered in this guide and using electricity efficiently remains crucial and implementing energy efficiency and demand reduction initiatives is encouraged. Efficiency stretches our renewable resources, reduces costs, and makes switching from high-emission fossil fuels more feasible.

1.1 Other documents, tools & resources for use alongside this user guide

This guide is accompanied by two other documents and tools:

1. The "**DIY Emissions Plan – Calculations Spreadsheet**" – an Excel file to perform calculations and generate summary tables/figures for the Report Template

2. The "**DIY Emissions Plan – Report Template**" a Word Document to be filled out with relevant information and tables/figures from the Calculations Spreadsheet.

Links to other resources are provided throughout this document and a comprehensive list of further resources is also provided in Appendix C.

1.2 Next steps

If you already have detailed information from a previous study such as an energy audit, fuel switching feasibility study or similar study, or if you just want to calculate what your site emissions are based on your fuel usage, you can jump directly to the Step 1a: Annual consumption calculator (optional) and only reference this document as needed if you get stuck (see Appendix A – Calculations Spreadsheet walkthrough, tips, hints, and troubleshooting for a Calculations Spreadsheet walkthrough).

Otherwise, read on to learn how to create an emissions plan.

1.3 Using this guide for a resource consent application

The National Policy Statement for Greenhouse Gas Emissions from Industrial Process Heat 2023 (NPS) came into force on 27 July 2023. The NPS provides the national objective and supporting policy framework to implement and guide decision-making under the Resource Management (National Environmental Standards for Greenhouse Gas Emissions from Industrial Process Heat) Regulations 2023 (NES).

The Ministry for the Environment has developed an Industry Factsheet to help inform industrial process heat users on the national direction.

As a result of the NPS/NES, regional councils must now consider the effects of GHG emissions when assessing resource consent applications for the use of industrial process heat systems. This means industrial businesses in scope of the NPS/NES now need to apply for resource consent which includes an emissions plan. Sites within scope of the NPS/NES include:

- Sites with more than 500 t CO_2-e/yr of fossil fuel emissions from industrial process heat.
  - Sites with more than 2,000 t CO_2-e/yr of fossil fuel emissions require their emissions plan to be independently reviewed by a suitably qualified professional (SQP)
    - *Note: SQP's can be found at the Climate and Energy Professionals website at: https://cep.org.nz/find-an-expert/ by searching for the Process Heat Emissions Plan Reviewer (SQP) title under Certifications.*

Note: emissions from electricity, biomass, geothermal, or other renewable sources are not included in these emission thresholds.

Although this guide is intended to be a tool for supporting emissions plans generally, it could be used to develop an emissions plan for a resource consent application. However, there are specific requirements that need to be met for an emissions plan accompanying a resource consent application. Throughout this document there are subsections in each of the main sections which describe these specific requirements in more detail.

EECA has also developed a non-statutory Emissions Plan Guidance document that is useful for consent applicants developing emissions plans.

Note that EECA provides no guarantee that an emissions plan developed using this guide will result in a successful resource consent application. A pre-application meeting is recommended with regional councils to discuss the requirements of the consent application prior to submission. This guide is not the only option or official template for emissions plan resource consents.

2. What is an emissions plan?

An emissions plan is a document that sets out how a business or organisation will reduce emissions over time, often towards a defined reduction target(s).

An emissions plan typically consists of three main parts:

1. Existing situation
2. Emissions reduction opportunities
3. The plan to reduce emissions.

2.1 Existing situation

The first part of an emissions plan sets the scene and describes the existing situation for the business or organisation, including:

- A description of the business or organisation and site(s)
- Existing energy consumption/emissions
- A description of the key energy related equipment.

This foundational information sets the stage for the plan, providing essential context for the selected emissions reduction opportunities and the overall decarbonisation strategy.

Section 3 goes into more detail on how to find the required information and analyse it to develop this first part of your emissions plan.

2.2 Emissions reduction opportunities

The middle part of an emissions plan details the emissions reduction opportunities identified for the business or organisation. In the context of an energy related emissions plan, opportunities typically fit into the following categories:

- New technology & process change
- Energy efficiency & demand reduction
- Fuel switching.

It is important to cast a wide net when identifying opportunities to create a long list of all possible projects. Each of these opportunities can then be analysed for technical practicality and financial viability to create a shortlist of projects that are applicable to the specific business or organisation. Some projects, such as energy efficiency or demand reduction, may impact others in various ways such as reducing equipment size requirements. Considering these interacting effects is important to support selecting the most favourable group of projects to form a plan.

Section 4 goes into more detail on how to identify and quantify emissions reduction opportunities to develop the middle part of your emissions plan.

2.3 The plan

The final part of an emissions plan is the plan itself. This section of an emissions plan outlines the selected emissions reduction opportunities for implementation, including:

- The timeline for implementation, including next steps
- Implementation methods, including capital expenditure requirements
- The projected impact on emissions over time, including a comparison to any reduction targets.

Section 5 goes into more detail on how to pull together the plan, including how to prioritise emissions reduction opportunities and ways of illustrating your plan with tables and figures.

2.4 Specific requirements for resource consent applications

As mentioned in the Introduction section, there can be a range in the level of detail for an emissions plan, depending on a variety of factors in your business or organisation. However, for a resource consent application, your emissions plan will need to be at the highly detailed end of the range.

This is because the regional council assessing your application needs to be satisfied that (the exact language from the NES is as follows):

- The "best practicable option [BPO] to prevent or minimise any actual or likely adverse climate change effect" has been well assessed and is correct
- The "emissions reduction targets for the activity that are appropriate for the scale, type, and site-specific circumstances of the activity."

This requires the site to have had a comprehensive assessment of process change, energy efficiency, demand reduction and fuel switching opportunities. This should include detailed analysis of the technical and financial feasibility of each opportunity with supporting evidence.

EECA's Emissions Plan Guidance provides more detail on the recommended approach and level of detail required for a resource consent emissions plan.

3. Understanding your existing situation

The first step to develop an emissions plan is to gather, analyse and present information on your existing situation. This foundational information sets the stage for the plan, providing essential context for the selected emissions reduction opportunities and the plan.

This section details how to find the required information and analyse it to develop this first part of your emissions plan.

3.1 Organisational and site context

A high-level overview of your organisation and the site(s) is important to give an understanding of what your organisation does and how you are operating. It is also a good opportunity to discuss any potential changes in the short or long term to your organisation/sites(s) and the industry you operate in. If you have any organisational or site level emissions reduction or energy performance targets, these should also be mentioned.

This context helps shape an emissions plan and understand the broader picture before getting into the detail. The Report Template has a place in Section 1 to input this information.

3.2 Existing energy consumption and emissions

Understanding the annual energy consumption from all energy sources such as fossil fuels and electricity helps provide the context of where your site is at now. In other words, it provides a baseline to compare performance against in future years and to set targets against.

The Calculations Spreadsheet has a handy calculator for determining annual emissions from annual or monthly energy data or bills on the “Step 1-Emissions” tab. See the Step 1a: Annual consumption calculator (optional) section of this document for more details.

3.2.1 Monthly energy consumption data

One of the simplest ways to determine your annual energy consumption from a specific fuel source is to look at the most recent 12 months’ worth of energy bills. These bills will list the energy consumed each month in terms of typical units such as kilowatt-hours (kWh) or gigajoules (GJ). **The Calculations Spreadsheet** allows you to input data in various energy units and is then converted to a common unit (kWh).

Figure 3.1 shows an example of a natural gas bill with clearly shown energy consumption for the month in GJ (highlighted).

CURRENT GAS USAGE

Covers the **31 day** period from **1 Jan 2024** to **31 Jan 2024**
Your meter was **read on 31 Jan 2024**

Meter Number	Previous Reading	Current Reading	Read Type	Volume Used (M^3)	X	Meter Factor	X	Calorific Value (GJ/M^3)	= Energy (GJ)
[redacted]	174335	188988	Actual	14653		0.9958		0.0393	573

	Energy	Rate	Total
Gas Variable Rate	573 GJ	2,048.8611 c/unit	11,747.10
Daily Fixed Charge	31 days	12,715.7069 c/day	3,941.87
		Sub Total	**15,688.97**
		GST	**2,353.34**
TOTAL CURRENT NATURAL GAS CHARGES		**$**	**18,042.31**

Figure 3.1 – Example table from a natural gas bill listing the monthly total GJ consumption

If you do not have all your energy bills handy, call or email your energy retailers as they will typically provide them and/or a spreadsheet summary on request.

3.2.2 Interval energy consumption data & sub-metering

Retailer level energy consumption data is also sometimes available in daily, hourly, or sub-hourly intervals (commonly referred to as interval data) depending on the size of your connection and meter type. Interval data is especially useful for determining exactly when energy is used and the maximum demand for energy at a site level. Determining where and when energy is used, known as a mass and energy balance, is an important first step in identifying efficiency opportunities.

The easiest way to determine whether interval data is available from your energy retailer is to call or email them and ask. If it is available, they can typically send you a file via email if you request it. This data may also be available to download from within your account on your energy retailer's website. It is more common for interval data to be available for electricity than for thermal fuels (typically only for large piped natural gas connections).

Finally, some sites have sub-meters installed on various large energy using pieces of equipment or sub-sections of a building or site. Sub-meter data is especially useful for determining exactly when energy is used and the maximum demand for energy at an equipment or sub-section level.

Given thermal fuel interval data at a retail level is uncommon, sub-meters installed on heat devices and downstream users are particularly useful. This is because most heat devices are oversized and when it comes to fuel switching (the last step of decarbonisation), it is essential to size new low carbon heating equipment for the actual required heat load to minimise capital expenditure.

3.3 Existing equipment

Equipment is typically the thing that uses fuel or energy to generate some useful outcome or other source of energy such as steam, cooking, chemical reactions, space heating/cooling, lighting etc. It is helpful to make a list of all significant energy-using equipment at a site as part of an emissions plan as the equipment is typically needed for the site to function well.

Detailed information about the equipment and system(s) that is typically useful includes items such as the following:

- Equipment name: (e.g. west furnace #2)
- Equipment type: (e.g. boiler)
- Fuel type: (e.g. coal)
- Existing resource consents (e.g. discharge to air consent expiring June 2034)
- Equipment rating: (e.g. 1,000 kW output)
- Equipment age: (e.g. installed or manufactured in 2005 and due to be replaced in 2030)
- Equipment operating temperature, pressure, etc.: (e.g. 85 °C hot water or 10 bar steam)
- Equipment typical operating hours: (e.g. Monday - Friday 8:00 -17:00 first shift, 17:00 - 00:00 second shift and occasional Saturday shift during peak season 8:00 – 13:00)
- Equipment typical load: (e.g. 100% fire for morning warmup each day then varies with production)
- Describe the end use(s) of this equipment (e.g. canning line, pasteurisation, drying, etc.)
- End use temperature requirement: (e.g. what is the minimum temperature or conditions this process could theoretically be achieved?)

Places to gather this information include (if they exist) equipment name plates, temperature, pressure gauges, control systems and setpoints, and manufacturer specification or data sheets. An example of what some of these look like is provided in Figure 3.2.

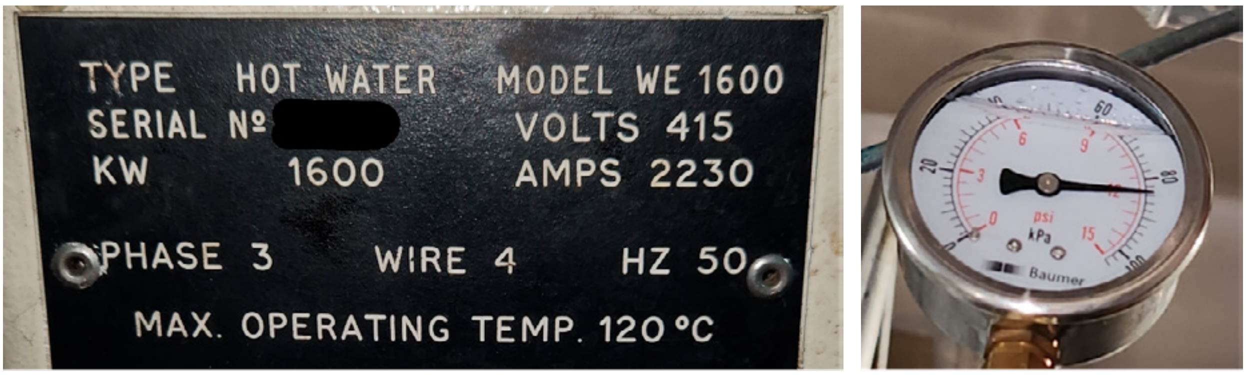

Figure 3.2 – Example equipment nameplate (left) and pressure gauge (right)

The Report Template has a place in Section 2 to input this information.

3.4 Checking whether you require a resource consent

Once you understand your existing situation, you should check to see if the NPS/NES will impact the consent requirements of your site(s).

Firstly, are you an industrial site? The NPS/NES only applies to industrial process heat users as defined by heat used in industrial processes, including in manufacturing and in the processing of raw materials or to grow plants or other photosynthesising organisms indoors. It does not include thermal energy used in the warming of spaces for people's comfort (for example, heating of commercial offices).

Next, do you meet the threshold for requiring a consent (excluding back-up heat devices)?

- Sites with more than 500 t CO_2-e/yr of fossil fuel emissions from industrial process heat require a consent with an emissions plan
  - Sites with more than 2,000 t CO_2-e/yr of fossil fuel emissions from industrial process heat require a consent with an emissions plan and the plan needs to be independently reviewed by a suitably qualified professional (SQP).
    - *Note: SQP's can be found at the Climate and Energy Professionals website at: https://cep.org.nz/find-an-expert/ by searching for the Process Heat Emissions Plan Reviewer (SQP) title under Certifications.*

Note: emissions from electricity, biomass, geothermal, or other renewable sources are not included in these emission thresholds.

Lastly, check when the changes will impact you:

- Heat devices with existing discharge to air consents will need to include an emissions plan as part of the reconsenting process at the expiry of the existing consent
- Heat devices without an existing discharge to air consent with process heat fossil fuel emissions greater than 500 t CO_2-e/yr at a site level can continue until 26 January 2025 after which they have a period of six months to apply for a consent
- New heat devices – immediately (on the date of enactment of the NPS and NES of 27 July 2023).

The emissions threshold in terms of fuel usage is shown in the following table by fuel type:

Fuel type	Emissions factor applied (kg CO_2e/unit)	Annual fee consumption (approx.)	Units
Fossil gas	53.7	9,311	GJ
LPG	2.97	168,350	kg
Waste oil	3.00	166,667	litre
Diesel	2.68	186,567	litre
Coal (sub-bituminous)	2.00	250,000	kg
Coal (bituminous)	2.66	187,970	kg
Coal (ignite)	1.43	349,650	kg

The **Calculations Spreadsheet** can be used to assess whether your site requires a resource consent. Enter your thermal fuel data in the “Step 1–Emissions” tab and your sites thermal fuel emissions will be displayed in cell F31. Use this value with the above guidance to determine whether you require a consent. However, it is recommended that you also contact your local regional council to confirm your requirements.

3.5 Specific requirements for resource consent applications

If you provide all the information from the previous section, you should comply with the resource consent requirements. The exact language from the NES is as follows:

> *"The content must include the following matters:*
>
> > *(a) the purpose of the activity and the 1 or more services to which it relates:*
> >
> > *(b) the number of heat devices that are not back-up devices and are on, or proposed for, the site of the activity, and their age and fuel source (if any):*
> >
> > *(c) both the thermal energy that is, or is to be, produced, and the thermal energy that is able to be produced, by—*
> >
> > > *(i) the heat device on or proposed for the site, if there is 1 such device; or*
> > >
> > > *(ii) the heat devices on or proposed for the site, in total but separated by fuel source (if any), if there are 2 or more such devices:"*

As shown above on the prior page, the requirements of the NES are fairly basic. However, the more information you can gather and provide, the more context you can give in your emissions plan. This will also make it easier to carry out the emissions reduction opportunities and planning sections of your plan. To satisfy the NES, the emissions reduction targets should be based on the best practicable option(s) assessment for the site. EECA's Emissions Plan Guidance provides a more comprehensive list of information you could gather.

4. Identifying and quantifying emissions reduction opportunities

The next step to develop an emissions plan is to identify and quantify emissions reduction opportunities. It is important to cast a wide net when identifying opportunities to first create a long list of all possible opportunities.

Note that any potential savings provided in this guide are typical and indicative only. Unless you have specialist technical expertise in-house, you will likely need to engage a consultant or contractor help identify or confirm the suitability of opportunities and quantify potential savings.

4.1 Types of emissions reduction opportunities

In the context of an energy related emissions plan, opportunities typically fit into the following categories:

- New technology & process change
- Energy efficiency & demand reduction
- Fuel switching.

4.1.1 New technology & process change

New technology and process change opportunities are those that fundamentally change the way a process operates. Often these opportunities eliminate the need for energy or significantly reduce the amount required.

An example of a new technology and process change opportunity is ultraviolet (UV) light knife sterilisers for the meat processing industry. Traditionally, the meat processing industry uses hot water above 82 °C to sterilise knives. Hot water sterilisation is a relatively energy intensive method that has historically been heated by burning fossil fuels. UV light technology is a new technology and process change opportunity as it has the potential to replace the requirement for hot water sterilisation entirely.

Another example would be simply consolidating production hours and running a longer batch production over fewer days to reduce energy related with startup, shutdown, clean-in-place, etc.

Scanning the market for new technology and process change opportunities is an important first step when identifying emissions reduction opportunities. This is because these opportunities can deliver cost effective upfront benefits while reducing energy demands. Another key benefit is that these opportunities reduce the requirement and capital cost for energy efficiency opportunities and allow for smaller sizing of more capital-intensive fuel switching opportunities.

EECA has resources for technology scans for certain sectors in the Sector Decarbonisation Programme.

4.1.2 Energy efficiency & demand reduction

Energy efficiency and demand reduction opportunities are those that enable a site to use less energy and lower peak energy demands, respectively, to perform the same process. Some opportunities improve energy efficiency and reduce peak demand, whereas others only improve energy efficiency or reduce peak demand.

An example of an energy efficiency and demand reduction opportunity is an air compressor heat recovery system. Around 90% of the electrical energy input into an air compressor is converted to heat. Air compressor heat recovery systems work by capturing this heat, which is otherwise vented to atmosphere and wasted. A heat exchanger can be used to heat air or water for various purposes within a facility, such as space heating or preheating water for industrial processes. This then reduces the requirement for heat generation from the heat plant on site.

This is an important step to deliver cost effective upfront benefits while reducing electricity and process heat energy demands, allowing for the right sizing of more capital-intensive fuel switching opportunities. These opportunities should be implemented before or in parallel with any fuel switching.

EECA has optimisation and improvement checklists in the Sector Decarbonisation Programme.

4.1.3 Fuel switching

Fuel switching opportunities are those that replace fossil fuel heat plant with low carbon alternatives. The main two options for fuel switching in New Zealand are electrification and switching to biomass. There are several other fuel switching options available such as biogas and geothermal. However, these are relatively uncommon compared to electrification and biomass due to being location and site specific.

4.1.3.1 Electrification

Electrification is considered a low carbon fuel in New Zealand. This is because most of our electricity already comes from clean, renewable sources like hydro, geothermal, and wind. Also, as the share of renewable generation continues to increase over time, emissions from electricity are expected to decrease even further.

Two main types of electrification technologies for process heat are:

- Heat pumps
- Electric resistive.

Heat pumps

Heat pump technology uses electricity to transfer heat from a low-temperature heat source, such as ambient air, waste heat or the ground, to a higher-temperature heat sink, such as a hot air for a building or hot water for an industrial process. This process is accomplished using a refrigerant that absorbs heat at the low-temperature source and releases it at the high-temperature sink. The refrigerant typically undergoes a cycle of compression, condensation, expansion, and evaporation to achieve this heat transfer.

The main benefit of a heat pump is the extremely high efficiency. Heat pumps can typically provide 3 – 6 units of thermal energy for every unit of electricity used, depending on the heat sink and source temperatures. The ratio of output heat to input electricity is called the coefficient of performance (COP).

One of the drawbacks of heat pumps is that they are limited to providing heat at relatively low temperatures, with most current technology being limited to ≈ 80 – 100°C. However, higher temperature heat pumps are being developed and should be considered where higher temperature waste heat is available. Additionally, a site needs to determine whether the electrical capacity required is available at the distribution board, transformer, and possibly even site level.

As a result, heat pumps should be prioritised for low temperature heat requirements. In addition, sites should ensure that processes are heated with the lowest temperature heat practical for that application. This has the potential to move more of the thermal energy requirement into the low temperature band and unlock more efficiency through heat pumps. Ideally, if all your heat requirement is low temperature, heat pump technology can cover all your requirements.

Finally, there are some special types of heat pumps with the most common being mechanical vapour recompression (MVR). This is a technology that can take low pressure steam, typically in the form of evaporation off a process, and recompress it using a turbo-fan (driven by an electric motor) to a higher-pressure steam. The main benefit of MVR is that it can have very high COPs (up to 50) if the steam pressure required is low.

EECA has a detailed resource covering Industrial heat pumps for process heat

Electric resistive

Electric resistive technology relies on the direct conversion of electricity to heat, typically using resistive elements to heat a fluid such as water or air. Another type of electric resistance technology is an electrode. Electrodes are often limited to larger applications, such as a 5+ MW steam boilers. In an electrode boiler, the electricity uses water itself (with a specific chemistry) to conduct the electric current and produce steam.

The main benefits of electric resistive technology are that it can provide high temperature heat greater than 300°C and the equipment costs are often relatively low.

The main drawback of electric resistive technology is that the efficiency is relatively low compared to a heat pump (although higher than a fossil fuels due to no exhaust stack losses) with a typical efficiency of close to 100% or COP of 1 (i.e. all the electricity is converted to heat with only minor losses). This can result in relatively higher operating costs compared to heat pumps and potential electrical infrastructure upgrade requirements.

As a result, electric resistive technology should be prioritised for medium to high temperature heat requirements (i.e. temperatures greater than 100°C), and high temperature heat pumps for lower temperature heat requirements (i.e. temperatures less than 100°C).

4.1.3.2 Biomass

Biomass is organic material such as wood and wood waste, crops or animal manure that can be used as an energy source. The most common type of biomass used for fuel switching in New Zealand is woody biomass sourced from forestry waste. Biomass is part of the short carbon cycle and, if biomass is sustainable, plants recapture the same amount of carbon released when burnt when they grow back making it a low carbon fuel.

Biomass fuel switching typically involves conversion of solid fuel heat plant or installation of new biomass heat plant to allow for burning of woody biomass.

The main benefits of biomass technology are that it can provide high temperature heat greater than 300°C, no significant electrical infrastructure upgrades and the operating costs can be relatively low depending on your proximity to a supplier. In addition, the potential to convert existing solid fuel plant (i.e. coal) can result in low equipment costs.

The main drawbacks of biomass technology are that the efficiency is relatively low compared to a heat pump with a typical efficiency of 80 - 95% or COP of 0.8 – 0.95 (i.e. some of the biomass energy is lost through combustion), relatively high space requirements for the heat plant and fuel storage and logistics around fuel deliveries. In addition, new biomass plants can have relatively high equipment costs compared to electric resistive.

As a result, biomass technology should be prioritised for medium to high temperature heat requirements in locations with proximity to a good supply of sustainable biomass.

There are several types of woody biomass fuel types and the best fuel for your site will depend on your specific requirements and fuel availability in your area. The three main types are shown in Table 4.1.

Table 4.1 – Comparison of three main woody biomass types in New Zealand.

Parameter	Hogged	Chips	Pellets
Energy content	≈ 7 MJ/kg	≈12 MJ/kg	≈ 18 MJ/kg
Fuel storage requirements	Can be stored outside or in a shed	Can be stored outside or in a covered shed	Need water-tight storage (closed silo or building)
Fuel delivery frequency	Will need regular deliveries due to low energy content	Will need regular deliveries due to low energy content	Lower delivery frequency due to higher energy content
System efficiency	~70%	~80% - 85%	85% +
Comparative heat plant footprint	High	Medium	Low
Comparative fuel cost	Low	Medium	High

Finally, information from EECA's Regional Energy Transition Accelerator (RETA) may be useful for finding available biomass supply and cost by region.

And EECA has a detailed resource covering Biomass boilers for industrial process heat.

4.1.3.3 Other

There are several other fuel switching options available, however these are relatively uncommon currently compared to electrification and biomass due to being location and site specific.

Biogas

Biogas is a renewable energy source produced through the anaerobic digestion of organic matter such as agricultural residues, food waste, animal manure, and sewage. Biogas can be an excellent source of energy; however, it is typically location specific and requires proximity to a biogas source such as organic waste, an on-site wastewater treatment plant or landfill.

Geothermal

Geothermal can be an excellent source of relatively high temperature heat, however it is very location specific. Note that some geothermal wells contain significant amounts of carbon dioxide, and this may need to be managed to ensure it is used as a low carbon fuel.

4.2 Identifying emissions reduction opportunities

When identifying emissions reduction opportunities, it's important to recognise that there is a range of complexity, from very simple to very complex. By starting with simpler actions, you can often achieve significant savings with minimal investment and start developing a better understanding of your site and energy systems.

There are a variety of actions from simple through to complex (including engaging specialist professionals) for each of the emissions reduction opportunity types introduced in the previous section. The "Step 2a" tab of the Calculations Spreadsheet provides the functionality to input some of these opportunities with a typical savings percentage if you identify them as opportunities for your site.

4.2.1 New technology & process change

The following are some ideas for identifying new technology and process change opportunities.

4.2.1.1 Simple actions

These are basic actions that can be implemented with relatively low effort, cost, or training:

- Simple process optimisation: talk to production staff and review your process to identify any areas for optimisation such as ensuring process temperatures are no more than required, heating and cooling cycles are minimised, and any existing heat recovery is being maximised
- Contact trusted stakeholders: incorporating the insights and expertise of trusted stakeholders (such as equipment suppliers and maintenance contractors) with good knowledge of your site (and other sites) can often generate ideas for opportunities.

4.2.1.2 Further research & studies

Unless you have specialist technical expertise in-house, it is unlikely that you will be able to confirm the suitability of more complex opportunities. Despite this, carrying out further research will allow you to start familiarising yourself with the concepts and technology available.

For a comprehensive review of opportunities including more complex opportunities, the following resources are available for further research:

- EECA's Best Available Techniques (BAT) Reference Documents: provides guidance on process change and energy-efficient technologies and practices for various specific industries
- EECA's Sector Decarbonisation Programme: offers resources and support for decarbonising various sectors. Specifically see the energy efficiency checklists.
- EECA's International Technology Scan: provides insights into international best practices and technologies for process change, energy efficiency and process heat technology.

Process optimisation studies

For a comprehensive assessment of your new technology and process change opportunities, consider engaging a specialist consultant to conduct a process optimisation study. This would involve a detailed analysis of your processes to identify process change opportunities.

4.2.2 Energy efficiency & demand reduction

The following are some ideas for identifying energy efficiency & demand reduction opportunities.

4.2.2.1 Simple actions

These are basic actions that can be implemented with relatively low effort, cost, or training:

- Energy management: measuring and tracking energy consumption over time compared to a variable such as production levels can provide valuable insights into energy usage patterns and identify energy performance anomalies for further investigation
  - *Rule of thumb savings achievable are typically 10-20%*
- Operating hours: review operating hours of equipment to ensure they match actual production needs and do not run when not required (such as during staff breaks)
  - *Rule of thumb savings achievable are typically 5-10%*
- Insulation: assess equipment such as hot pipework and ensure good condition insulation is installed to reduce heat loss (and minimise health and safety risks)
  - *Rule of thumb savings achievable are typically 15-30%*
- Leaking hot water and steam: assess hot water and steam systems and identify any leaks for repair
  - *Rule of thumb savings achievable are typically 10-20%*
- Equipment maintenance: ensure that heating is regularly maintained and serviced as dirty or faulty equipment can be underperforming and less efficient.
  - *Rule of thumb savings achievable are typically 5-10%*

4.2.2.2 Low-cost studies & services

These are studies or services that typically require a small investment but can provide significant energy savings, particularly if they have not been carried out in several years:

- Boiler tuning: engaging your boiler maintenance contractor to optimise boiler operations through tuning can significantly improve efficiency and reduce fuel consumption
  - *Rule of thumb savings achievable are typically 1-10%*
- Steam trap survey: engaging a steam specialist to conduct a survey to identify and repair faulty steam traps can reduce wasted steam (if stuck open) and improve heating effectiveness and avoid system damage (if stuck closed)
  - *Rule of thumb savings achievable are typically 10-20%*

4.2.2.3 Further research & studies

Unless you have specialist technical expertise in-house, it is unlikely that you will be able to confirm the suitability of more complex opportunities. Despite this, carrying out further research into the resources above will allow you to start familiarising yourself with the concepts and technology available.

For a comprehensive review of opportunities including more complex opportunities, the following resources are available for further research:

- EECA's Best Available Techniques (BAT) Reference Documents: provides guidance on process change and energy-efficient technologies and practices for various specific industries
- EECA's Sector Decarbonisation Programme: offers resources and support for decarbonising various sectors. Specifically see the energy efficiency checklists.
- EECA's International Technology Scan: provides insights into international best practices and technologies for process change, energy efficiency and process heat technology.

Energy audits

For a comprehensive assessment of your energy use and potential savings, consider engaging a specialist consultant to conduct an energy audit. This will involve a detailed analysis of your energy systems and processes to identify energy consumption, cost, and emissions reduction opportunities.

Energy audits typically have an excellent return on investment. In most case, you can expect for the cost of the study and implementation of resulting opportunities to be paid off within 1 – 5 years. For budgeting purposes, a good rule of thumb for the cost of an energy audit study is 5% of your annual energy cost. Typical savings identified and the payback on opportunities from an energy audit depend on a variety of factors such as age of your site and level of activity on energy management in the past.

Table 4.2 shows ball-park figures for energy audit costs, savings, and paybacks for three scenarios for a site spending $400,000 p.a. on energy:

1. Older site and/or very little previous energy management initiatives (such as no previous energy audit and very little attention to energy efficiency)
2. Medium age site and/or some previous energy management initiatives (such as a previous energy audit in the last 10 years with some opportunities implemented)
3. New site and/or lots of previous energy management initiatives (such as established energy management programme with multiple energy audits over time and most opportunities implemented).

Table 4.2 – Ball-park energy audit cost, savings, and paybacks for three scenarios.

Type	Study cost	Annual savings	Savings payback	Implement cost	Total cost	Total payback
1	5% ($20k)	15% p.a. ($60k p.a.)	1-2 years	$90k	$110k	1.8 years
2	5% ($20k)	10% p.a. ($40k p.a.)	2-3 years	$100k	$120k	3 years
3	5% ($20k)	5% p.a. ($20k p.a.)	3-5 years	$80k	$100k	5 years

As described in the Introduction section, some businesses or organisations starting from scratch may begin with a more high-level approach for their emissions plan. In this case, a broader initiative to "carry out an energy audit and implement the findings" with typical savings expected would be fantastic step forward. Once the energy audit has been completed, the emissions plan could then be updated and improved to include specific initiatives and more accurate savings.

For resource consents, the EECA Emission Plan Guidance is for a process heat thermal energy audit performed within the last four years. This will ensure the NES requirement of assessing the best practices in energy efficiency over time is met.

4.2.3 Fuel switching

Fuel switching is typically the most complex emissions reduction opportunity for a business or organisation. Unless you have specialist technical expertise in-house, it is unlikely that you will be able to confirm the suitability of different fuel switching options. Despite this, there are some simple initiatives that you can carry out to begin understanding the options and provide any further studies with a head start.

4.2.3.1 Simple actions

These are basic actions that can be implemented with relatively low effort, cost, or training:

- Develop a site map and consider practicalities: a good aerial shot or schematic of your site is useful to start thinking about practicalities of fuel switching such as location of new plant or storage and identification of distances to key equipment such as transformers
- Develop a process flow diagram: even a basic diagram showing how your process works from start to finish is a great starting point and adding temperatures, energy and mass flows can be built up over time
- Identify any areas of waste heat: waste heat can be used as a heat source for a heat pump (if not used for heat recovery), so identifying potential sources such as refrigeration plants and exhaust air is a good idea
- Contact your local electricity distribution company: electrification can require additional electricity capacity and it is important to understand your existing electrical capacity, any constraints in your local network and
- Research biomass availability in your region: talking to biomass suppliers allows you to gauge the availability of biomass in your region and approximate price points
- Contact your energy retailers: many energy retailers, particularly electricity retailers are interested in supporting business or organisations to fuel switch and its worth understanding how they can help.

4.2.3.2 Low-cost studies & services

These are studies or services that typically require a small investment but can provide significant energy savings and data insights:

- Thermal energy sub-metering: engaging a sub-metering supplier to install sub-meters on heat devices and key downstream users is extremely useful for understanding your actual heat load profile and peak requirements whilst identifying energy efficiency opportunities.

4.2.3.3 Further research & studies

Unless you have specialist technical expertise in-house, it is unlikely that you will be able to confirm the suitability of more complex opportunities. Despite this, carrying out further research into the resources below will allow you to start familiarising yourself with the concepts and technology available.

For a comprehensive review of opportunities including more complex opportunities, the following resources are available for further research:

- Regional Energy Transition Accelerator: these assessments provide process heat users with coordinated information specific to a region to make more informed decisions on fuel choice and timing
- EECA's Sector Decarbonisation Programme: offers resources and support for decarbonising various sectors
- EECA's International Technology Scan: provides insights into international best practices and technologies for process change, energy efficiency and process heat technology
- EECA's Best Available Techniques (BAT) Reference Documents: provides guidance on process change and energy-efficient technologies and practices for various specific industries.

Feasibility studies

For a comprehensive assessment of your fuel switching options, consider engaging a specialist consultant to conduct a feasibility study. This would involve a detailed analysis of your equipment, heat load profiles and potential fuel switching opportunities. The results of the study would include determining the practical fuel switching opportunities for your site, the impact on energy consumption, operating costs, and emissions and an estimate of capital costs.

As described in the Introduction section, some businesses or organisations starting from scratch may begin with a more high-level approach for their emissions plan. In this case, a broader initiative to "carry out a fuel switching feasibility study and implementation the findings" would be fantastic step forward. Once the feasibility study has been completed, the emissions plan could then be updated and improved to include the optimal fuel switching opportunities (or opportunities if staged) and more accurate savings.

4.3 Quantifying emissions reduction opportunities

As with identifying emissions reduction opportunities, it's important to recognise that when quantifying opportunities there is also range of complexity, from very simple to very complex methodologies.

Unless you have specialist technical expertise in-house, it is unlikely that you will be able to quantify emissions reduction opportunities outside of rules of thumb percentage savings using average energy rates. Despite this, carrying out further research into the resources below will allow you to start familiarising yourself with the financial concepts and metrics.

Note: EECA has a financial "Cost Assessment Tool" available for free download on their website under the "Cost Assessment Tool" pulldown on Emissions Plan Guidance.

4.3.1 Determining operating cost savings and capital costs

The change in operating costs and the capital cost required to implement an emissions reduction project form the basis of any financial analysis.

4.3.1.1 Operating savings (opex)

Many emissions reduction opportunities will result in lower operating expenses, typically in the form of fuel and energy cost savings. The difference between the current operating expenses of a device or system (business as usual, BAU) and the expected operating costs after upgrading are the opex savings.

For example, if a site currently spends $100,000 per year for fuel for their process heat devices, and after a heat recovery project the annual fuel costs are expected to be $80,000 per year, the opex savings would be $20,000 per year.

Operational cost savings could also include things other than energy and fuel such as maintenance or labour hours.

Opex savings can be determined from annual energy savings by multiplying the savings by the rate paid for energy. A simple way to determine this rate is to divide the total energy bill by the total consumption units (i.e. $1,000 ÷ 5,000 kWh = $0.20/kWh). However, this approach often overestimates savings as many types of energy bills will have some type of fixed cost or costs that do not vary with consumption. For electricity specifically, transmission and distribution charges may only partially vary with consumption, and savings could depend on when the energy is used (i.e. time-of-use rates). A tariff breakdown is outside the scope of this guide, but it is recommended, at a minimum, to read and understand the various cost components of your fuel or energy costs when determining opex savings.

If a high-level estimate or range of savings is accurate enough for your purposes, a list of some common measures typically found in industrial facilities along with the range of typical or potential savings can be found in EECA's Energy Efficiency Checklist for Manufacturing

EECA also has a Non-fuel Operating Cost Tables available for several types of process heat devices.

4.3.1.2 Capital costs (capex)

Capital costs are the costs that must be spent to complete a project. Capital costs typically include the price of new equipment and the cost to install, upgrade electrical capacity or transformers, design the system and commissioning.

Capital costs can often be determined simply by obtaining a quote from a reputable vendor. For some larger, more complex projects, it may be necessary to employ a quantity surveyor to determine the number and size of all costs involved. Sometimes the 'equipment' is only a fraction of the total cost of a project. For example, if replacing a boiler requires removing it from the room, which required demolishing and rebuilding a wall, a crane rental, shutting down the site, etc., the cost of the new system itself may be minor relative to all the other expenses to accomplish the project.

EECA has a cost assessment tool which can provide a high-level capital cost estimate for various low emissions boilers on the Emissions Plan Guidance. The "Cost Assessment Tool" is available for free download on their website under the "Cost Assessment Tool" pulldown.

A note on stranded assets and equipment lifetimes

The capital costs of an energy efficiency or fuel switching project can sometimes be considered as the difference between a new standard piece of equipment and a new high efficiency or lower emissions equipment, especially if the existing equipment is near the end of its useful life. In other words, an investment needs to be made relatively soon one way or another, and the capital cost for more efficient or lower GHG equipment for financial considerations should only be the 'marginal cost' or the 'price premium' of the equipment relative to standard equipment (base case). Practically speaking, this requires obtaining quotes or determining total project capital costs for at least two options.

An example of this would be if a gas water heater was not working well any longer and needed to be replaced at the cost of $8,000. A heat pump water heater could be installed instead for $12,000. The 'marginal' cost of the heat pump is therefore $4,000 rather than the full $12,000. If the energy cost savings between the two options are $2,000 per year, the appropriate payback would be two years based on the 'marginal' cost of $4,000 (not six years based on the full $12,000).

See EECA's asset replacement strategy how-to guide.

4.3.2 Financial metrics

The typical financial metrics for quantifying emissions reduction opportunities are:

- Simple payback or return on investment (ROI)
- Net present value (NPV)
- Internal rate of return (IRR).

4.3.2.1 Simple payback or ROI

Simple payback is the ratio of the project capital cost divided by the project savings (typically annual). For example, if a project saved $100 per year and cost $500, the simple payback would be five years as it takes five years to pay back the capital cost spent before "profit" is made.

The return on investment looks at the same information, but is the project savings divided by the cost, expressed as a percentage. Using the same values as the simple payback example above, the ROI would be 20%.

These metrics are a simple way to gauge how quickly a project will pay for itself over time, however there are some downsides to simple payback. Simple payback ignores the time value of money, ignores savings after the project is paid back and consequently can bias decision makers towards short term investments.

4.3.2.2 NPV

NPV is a more sophisticated financial metric that helps to determine a projects value given the time-value of money, or that the value of money (and therefore savings) in the future will be less than today. If the NPV is positive, the project will result in a positive financial result, even when accounting for discounted future values. The discount rate refers to the rate of interest that is used to discount all future cash flows – for example 5%.

NPV is the sum of (typically) annualised cash flows discounted based on what year they occur in the future, less the initial investment. For example, if a project saved $100 per year for four years at a discount rate of 5% and an initial cost of $300, the NPV would be:

$$\frac{\$100}{(1+5\%)^\wedge 1}+\frac{\$100}{(1+5\%)^\wedge 2}+\frac{\$100}{(1+5\%)^\wedge 3}+\frac{\$100}{(1+5\%)^\wedge 4}-\$300$$

$95 + $91 + $86 + $82 - $300 = $54

Or in other words, the sum of the annual cash flows in today's dollars (present value), less the initial investment (the net), is $54.

This can be generalised for any discount rate, i, and number of years, t, to the formula:

$$\sum_{1}^{t} \frac{Annual\ Savings}{(1+i)^t} - initial\ investment$$

Note: the Calculations Spreadsheet *has a simple automated NPV calculator for projects.*

4.3.2.3 Internation Rate of Return

The internal rate of return is similar to return on investment but takes into account the discounted value of money over time. IRR is typically calculated assuming the capital spent on the initial investment is not recovered, although it is possible to have some remaining value at the end of the investment lifetime (i.e. the scrap value of a piece of equipment).

The IRR is defined as the return on investment in percent terms (i.e. 10%) that would be achieved when the net present value of the investment is set to zero. It is based on an initial investment (typically annualised) in year one and cash flows in the following years. IRR can be a useful metric for comparing investment options of various types against each other.

When comparing project options to decide which ones to include as part of an emissions plan, it is often helpful to rank them against each other to determine which are the most financially viable. This can be accomplished using any of the metrics previously described.

4.4 Specific requirements for resource consent applications

As mentioned previously, there can be a range in the level of detail for an emissions plan, depending on a variety of factors in your business or organisation. However, for a resource consent application, your emissions plan will need to be at the highly detailed end of the range.

Due to this, unless you have specialist technical expertise in-house, it is expected that most applicants would need to engage a specialist consultant to carry out the following studies (or a study that covers several or all three items):

- Process optimisation study
- Energy audit
- Fuel switching feasibility study.

EECA's Emissions Plan Guidance provides more detail on the recommended approach and level of detail required for a resource consent emissions plan.

5. Pulling together your plan

The final step to develop an emissions plan is to pull together a plan showing what opportunities will be implemented and when over a defined period. The opportunities chosen will depend on the specific business or organisation, however in most cases, opportunities that are technically feasible and financially viable should be implemented to reduce emissions. The resulting emissions plan can then be used to forecast emissions reductions into the future and either set reduction targets or compare to previously established targets.

This section outlines some of the ways to determine which opportunities should be implemented and how to present the information.

5.1 Choosing opportunities for implementation

Each emissions plan will be unique to the site, operations, and financial considerations of the organisation or business writing it. However, some common themes and requirements should be included in each plan, such as technical feasibility, financial viability, and carefully considering the order of project implementation to reduce the overall capital spend (efficiency first).

5.1.1 Technical feasibility

If an option could theoretically reduce emissions, but is not technically feasible for some reason, it is not a realistic option for the site. If it is believed that an option is not technically feasible, the option should still be included in the body of the emissions plan and carefully explain why it is not technically feasible. This ensures that the emissions plan is comprehensive and can be updated if technological improvements are made in the future.

An example of an option that is not technically viable is a furnace with half the throughput of a fossil-fuel powered alternative. Although the low carbon option is available, if it cannot provide an equivalent level of service, it is not technically viable. Other examples an option may not be technically feasible are:

- Insufficient electrical network capacity
- Low emission fuel (lack of) availability
- Physical limitations
- Contradictions with other regulatory constraints.

5.1.2 Financial viability

A project is financially viable if it meets the business or organisations financial criteria such as a short enough payback, a meaningful net present value, or an acceptable internal rate of return (as described in the previous section). It is encouraged that a business or organisation takes a long-term view of investment in decarbonisation and also considers the non-direct benefits such as reduced risk, improved brand identity and attracting talent.

5.1.3 Energy efficiency first

Energy efficiency and demand reduction projects should be implemented before or in parallel with fuel switching projects. If the demand is reduced, new equipment can potentially be sized smaller, which can reduce overall capital costs. For some projects, such as electrification, these impacts are sometimes critical to project success, for example, if electrical capacity is limited and demand reduction eliminates the needs for a new transformer or substation upgrade.

Similarly, if any process changes are possible, these should be implemented before or in parallel with either energy efficiency or fuel switching, as they could potentially eliminate the need for energy or equipment dramatically or entirely. For example, if a reheat furnace heats parts up for further processing, but the process is changed from batches to a continuous process such that parts arrive for further processing already hot, the reheat furnace could be eliminated entirely.

5.1.4 Sensitivity analysis

Sometimes the financial or savings aspects of a project are not certain, and it can be beneficial to consider a range of potential savings, costs, rates, etc. to determine whether the project is likely to be a success even if things change in the future. This analysis to determine the impact of various factors is called a sensitivity analysis. For example, predicting electricity prices several years into the future may not be highly accurate and it can be informative to consider whether a project will make sense even if rates change by more than expected.

The following table shows an example of sensitivity in fuel price escalation (and therefore savings from switching). For example, if natural gas prices continued to escalate at 10% per annum as has been seen recently, the financial benefit to switch to, for example, electric would be higher over the life of the project if the cost of electricity escalated at a lower rate (and therefore net annual savings increase over time) If the price difference between the energy sources is negligible over time, in this example the lifetime NPV is negative.

Initial Investment and Cash Flow Years 1-20	Net Annual Energy Cost Savings, 0% escalation	Net Annual Energy Cost Savings, 3% escalation	Net Annual Energy Cost Savings, 8% escalation
Initial Investment	-$1,000,000	-$1,000,000	-$1,000,000
Year 1	$75,000	$75,000	$75,000
Year 2	$75,000	$77,250	$81,000
Year 3	$75,000	$79,568	$87,480
Year 4	$75,000	$81,955	$94,478
Year 5	$75,000	$84,413	$102,037
Year 6	$75,000	$86,946	$110,200
Year 7	$75,000	$89,554	$119,016
Year 8	$75,000	$92,241	$128,537
Year 9	$75,000	$95,008	$138,820
Year 10	$75,000	$97,858	$149,925
Year 11	$75,000	$100,794	$161,919
Year 12	$75,000	$103,818	$174,873
Year 13	$75,000	$106,932	$188,863
Year 14	$75,000	$110,140	$203,972
Year 15	$75,000	$113,444	$220,290
Year 16	$75,000	$116,848	$237,913
Year 17	$75,000	$120,353	$256,946
Year 18	$75,000	$123,964	$277,501
Year 19	$75,000	$127,682	$299,701
Year 20	$75,000	$131,513	$323,678
NPV (5% discount rate)	-$62,223	**$187,961**	**$849,204**

5.2 Presenting your plan

The Report Template provides the structure for developing your emissions plan; however, it is worth highlighting some of the simple tables and figures from the Calculations Spreadsheet that can describe your plan in one image. Table 5.1 shows this key table.

Table 5.1 – Example project list summary table from the Calculations Spreadsheet

Project description	Annual emissions savings (tCO_2-e/year)	Annual emissions (tCO_2-e/year)	Year
Baseline		**207**	
Project 1	4		2025
Project 2	15	**188**	**2025**
Project 3	36		2026
Project 4	2	**151**	**2026**
Project 5	14		2027
Electric Boiler	71	**67**	**2027**

Figure 5.1 shows this key image.

			Annual savings		Annual emissions					
Project type	Project description	Year	(tCO_2-e)	(%)	(tCO_2-e)	(%)	Remaining emissions	Capex ($k)	Opex savings ($k/yr)	NPV ($k)
Baseline emissions					207					
Energy efficiency	Project 1	2025	4	2%		98%		$45,000	$8,664	$82,305
Demand reduction	Project 2	2025	15	7%		91%		$32,000	$10,370	$113,499
Demand reduction	Project 3	2026	36	17%		74%		$125,000	$24,196	$230,318
Energy efficiency	Project 4	2026	2	1%		73%		$4,500	$3,466	$42,179
Demand reduction	Project 5	2027	14	7%		66%		$54,000	$9,218	$83,365
Fuel switching	Electric boiler	2027	71	34%		32%		$740,000	-$6,907	-$597,637
Total			141	68%	67	32%		$1,001,000	$49,000	-$46,000

Figure 5.1 – Example emissions reduction roadmap figure from the **Calculations Spreadsheet**

5.3 Specific requirements for resource consent applications

The resulting plan for a resource consent application will form the BPO and emissions target. As detailed throughout this guide, it is important that the emissions plan is highly detailed for a resource consent as the conditions of the consent are legally binding and enforceable. Failure to comply could lead to fines or instructions to stop operating the heat device.

The exact language around the consent conditions from the NES is as follows:

- The first condition requires the holder to adopt the best practicable option described by regulation 17(1)(a), as assessed by the consent authority
- The second condition requires the holder to comply with an emissions plan for the activity that the consent authority has determined satisfies regulation 15
- The third condition requires the holder to monitor their compliance with the emissions plan, including any emissions reduction targets, and to report to the consent authority on their monitoring.

The emissions reduction target is typically set based on the expected emissions reductions of the various projects that make up the BPO. Monitoring emissions reductions could take many forms, the simplest of which would be a comparison of fossil fuel usage from one year to the next.

Appendix A – Calculations Spreadsheet walkthrough, tips, hints, and troubleshooting

The Calculations Spreadsheet includes three main steps:

1. **Step 1: Understanding emissions**

   Obtain your total annual energy usage and cost from your utility bills (or otherwise) and enter your fuel type(s)

2. **Step 2: Enter your demand reduction, energy efficiency, or process change options considered (actual values)**

   This tab takes general savings and financial information from energy efficiency and demand reduction opportunities your site has determined from an energy audit or similar study source (see Step 2a if you have not done an energy audit within the last 4-5 years)

3. **Step 2a: Enter your demand reduction, energy efficiency, or process change options considered (estimated values)**

   This tab takes estimated project savings and capital costs using the guidance provided in this How to Guide

4. **Step 3: Enter your fuel switching options considered**

   This tab takes general project and financial information from fuel switching opportunities your site has considered from a feasibility study, discussions with vendor(s), or otherwise.

Once all the information has been entered, it will be summarised in two tables and one graph on the following tabs:

- Projects Table located in the “Fuel Sw” tab
- Emissions Roadmap located in the “Roadmap” tab
- Fuel Switching Options Table(s) located in the “Sum Table” tab.

ReadMe

The "ReadMe" tab provides a general overview of the tool, as well as a cell and tab legend:

Cell Legend	
Add your data	
Locked cell	
Drop down list	
Tab Legend	
Input	You must complete these tabs to generate the required outputs for your emissions plan
Input	You may need to complete these tabs to generate the required outputs for your emissions plan and will be prompted to if required
Output	Copy and paste these outputs into the relevant section of the accompanying word document

Step 1: Understanding your emissions

Navigate to the "Step 1–Emissions" tab of the **Calculations Spreadsheet** file.

In Part 1 you are asked to enter your annual **electricity** consumption (kWh) and cost ($). These figures can be obtained from your electricity bills. For more information on how to source this data, head to Section 3.2 of this guide.

Note: if you are using this tool for a resource consent, electricity emissions are not a factor, and this section could simply be left blank.

1. Enter you annual electricity consumption and cost below:

	Electricity		GHG Emissions
Energy type	kWh	$	tCO2-e/year
Electricity			

Part 2 asks you to select your **thermal fuel type(s) and supply units**. If you do not use any thermal fuels, you can skip this section and move to Part 4. The tool allows you to select up to three different thermal fuels depending on your site. The supply unit refers to the unit on your bill(s).

2. Select your thermal fuel type(s) and supply units below:

Fuel type	Supply unit
Thermal 1	
Thermal 2	
Thermal 3	

Tip: Select your fuel type first then the options for "Supply unit" will become available. Only enter values for fuels you have on-site. I.e., if you have 1 thermal fuel you only need to enter data in the Thermal 1 row.

If your site does not consume thermal fuels you can skip this part of the spreadsheet.

Part 3 asks you to enter **thermal fuel(s)** consumption (supply unit) and cost ($). These figures can be obtained from your energy bill(s). The tool will automatically calculate your annual thermal energy consumption in kWh and the associated annual GHG emissions. For more information on how to source this data, head to Section 3.2 of this guide.

3. Enter your annual thermal energy consumption and cost by fuel type below:				
Thermal Fuel	Fuel Consumption and Cost			GHG Emissions
	GJ	$	kWh	tCO2 e/year
NaturalGas	1,000	$ 25,230	277,778	56
Thermal 2				
Thermal 3				
Total		**$ 25,230**	**277,778**	**56**

Part 4 asks to you to copy the generated table into Section 3 of the **Report Template**. Hide any unused rows in the table before you do this by right clicking the column header and selecting 'hide'.

4. Copy the table below into section 3.1 of the accompanying report template:			
Energy Type	**Energy Consumption**		**GHG Emissions**
	kWh	**$**	**tCO2-e/year**
Electricity	2,150,000	$ 408,500	168
NaturalGas	277,800	$ 25,200	56
Total	**2,427,800**	**$ 433,700**	**224**

Once you've have completed this step, move to the "Step 2–Demand Reduction" tab.

Step 1a: Annual consumption calculator (optional)

The **Calculations Spreadsheet** includes an annual consumption calculator from monthly data ("Step 1a" tab) if you do not already have this value. Enter the month of your **first** invoice and the 12-month period will auto-fill. The supply units specified in the "Step 1-Emissions" tab will pull through to this tab. Once you have entered 12 months of data copy and paste the values displayed in the **Total row** into the corresponding cells for each fuel type in the "Step 1-Emissions" tab.

1. Enter your monthly energy consumption and cost below:					
	Electricity		NaturalGas		
Month	kWh	$	GJ	kWh	$
Jan-23	67,176	$ 14,107	375	104,167	$ 12,487
Feb-23	47,539	$ 9,983	198	55,000	$ 6,612
Mar-23	56,848	$ 11,938	423	117,500	$ 14,091
Apr-23	52,449	$ 11,014	205	56,944	$ 6,837
May-23	20,245	$ 4,210	300	83,333	$ 9,985
Jun-23	76,675	$ 16,102	56	15,556	$ 1,865
Jul-23	43,377	$ 9,109	64	17,778	$ 2,145
Aug-23	37,272	$ 7,827	413	114,722	$ 13,760
Sep-23	75,536	$ 8,452	36	10,000	$ 12,106
Oct-23	40,248	$ 15,863	470	130,556	$ 15,679
Nov-23	59,043	$ 12,399	130	36,111	$ 4,333
Dec-23	25,963	$ 5,452	336	93,333	$ 11,186
Total	**602,371**	**$ 126,456**	**3,006**	**835,000**	**$ 111,086**

Step 2: Enter your demand reduction, energy efficiency, or process change options considered

Navigate to the "Step 2–Demand Reduction" tab. Part 1 of this section asks you whether you've had an energy audit (or similar) project completed recently. If you already have detailed project information such as savings and costs, you can enter it here. If you do not already have detailed project information, you can use "Step 2a" tab of the **Calculations Spreadsheet** to enter projects you have identified by using Section 4.2 of this guide (or otherwise) and the estimated percent (%) savings the project might achieve (see next section).

1. Has an energy audit or similar energy saving opportunities assessment been carried out for your site?	
Yes	Proceed to Section 3 below and use the table to enter the details of demand reduction and energy efficiency projects that were identified during the energy audit.

1. Has an energy audit or similar energy saving opportunities assessment been carried out for your site?	
No	Move to the "Step 2a - Demand Reduction" Tab

Part 2 includes a table that summarises your sites existing:

- Annual energy consumption (kWh/year)
- Annual energy cost ($/year)
- Energy rate ($/kWh).

While also tracking what your consumption and cost will be as you enter projects. Keep an eye on this to ensure your projects savings do not exceed your total consumption.

Energy Type	Fuel type	Annual consumption	Annual Cost	Energy rate	Remaining after efficiency	
		kWh/year	$/year	$/kWh	kWh/year	$/year
Electricity	Electricity	2,150,000	$ 408,500	$ 0.19	2,150,000	$ 408,500
Primary	NaturalGas	277,778	$ 25,230	$ 0.09	277,778	$ 25,230
Secondary	Thermal 2		$ -	N/A	N/A	N/A
Other	Thermal 3		$ -	N/A	N/A	N/A

Part 3 asks you to enter several projects specifics directly from your energy audit. The opportunities do not need to be entered in chronological order. Opportunities you have already implemented can be included, if you choose to do this then ensure you use annual consumption data from an earlier year in the "Step 1 – Understanding emissions" tab.

Project number	Project type	Project description	Energy type	Energy savings (kWh/year)	Operating cost savings ($/year)	Capital cost ($)	Include in plan?	Implementation year
Example	Energy efficiency	Heat recovery on exhaust stream to preheat boiler feed water	Coal	120,000	$ 10,000	$ 32,000	Yes	2026
1	Energy efficiency	Project 1	Electricity	45,600	$ 8,664	$ 45,000	Yes	2025
2	Demand reduction	Project 2	Natural Gas	14,010	$ 10,370	$ 13,000	Yes	2025
3	Process change	Project 3	Natural Gas	172,830	$ 24,176	$ 125,000	Yes	2026
4	Energy supply	Project 4	Electricity	18,745	$ 3,446	$ 4,500	Yes	2026
5	Demand reduction	Project 5	Natural Gas	656,880	$ 9,216	$ 54,000	Yes	2027

If there are opportunities, you'd like to include that were not included in your energy audit, you can enter them in the "Step 2a" tab.

Step 2a: Enter your demand reduction, energy efficiency, or process change options considered

If you have not recently completed an energy audit (or similar) project, or simply have additional opportunities not accounted for in your audit then the “Step 2a – Demand Reduction” tab in conjunction with Section 4.3 of this guide allows you to estimate potential savings from common projects.

Part 1 includes a table that summarises your sites existing:

- Annual energy consumption (kWh/year)
- Annual energy cost ($/year)
- Energy rate ($/kWh).

While also tracking what your consumption and cost will be as you enter projects. Keep an eye on this to ensure your projects savings do not exceed your total consumption.

Energy Type	Fuel type	Annual consumption	Annual cost	Average Cost	Remaining after efficiency	
		kWh/year	$/year	$/kWh	kWh/year	$/kWh
Electricity	Electricity	2,150,000	$ 408,500	$ 0.19	1,870,655	$ 355,424
Primary	NaturalGas	277,778	$ 25,230	$ 0.09	59,370	$ 4,889
Secondary	Thermal 2		$ -	N/A	N/A	N/A
Other	Thermal 3		$ -	N/A	N/A	N/A

Part 2 asks you define several project specifics and using the guidance in Section 4.3 of this guide and enter an appropriate savings percentage and capital cost:

Project number	Project type	Project description	Energy type	Energy savings (%)	Energy savings (kWh/year)	Operating cost savings ($/year)	Capital cost ($)	Include in plan?	Implementation year
Example	Energy efficiency	Heat recovery on exhaust stream to preheat boiler feed water	Natural Gas	5%	50,000	$ 4,500	$ 13,000	Yes	2026
1	Energy efficiency	Project 1	Electricity	10%	215,000	$ 40,850	$ 45,000	Yes	2025
2	Demand reduction	Project 2	NaturalGas	9%	25,000	$ 2,271	$ 13,000	Yes	2025

If you wish to enter site level projects such as energy audits there is an option to select all your fuels in the “Fuel Type” dropdown.

Step 3: Enter your fuel switching options considered

Navigate to the "Step 3–Fuel Switching" tab. Part 1 of this tab asks you whether you've had a feasibility study (or similar) project completed recently. If you have then continued to Part 2 of the "Step 3–Fuel Switching" tab. If you haven't, review Section 4.2.3 of this guide for tips on what to do next.

Part 2 shows your remaining consumption after your process change, demand reduction and energy efficiency opportunities have been implemented. Ensure that your fuel switching opportunities do not exceed the values displayed in this table i.e. your savings are greater than your remaining consumption.

2. Summary of energy consumption after demand reduction

Energy Type	Fuel Type	Annual Consumption Afte Efficiency
		kWh/year
Electricity	Electricity	1,870,655
Primary	NaturalGas	59,370
Secondary	Thermal 2	N/A
Additional	Thermal 3	N/A

Part 3 allows you to enter your own financial metrics if you wish these to differ from the default values used:

3. Standard project rates and factors

Real discount rate	5%	p.a.
Standard NPV period	20	years
Company tax rate	28%	

Tip: If your organisation does not provide specific guidance on project factors displayed to the left, use the default values as they are standard values.

For guidance on these metrics refer to Section 4.3 of this guide.

Part 4 asks you to enter project specifics from directly your feasibility study. The "Chosen Option" column of this table must be filled out with the replacement option you intend to proceed with. Option 2 – 5 can be filled out with options considered but not chosen in the feasibility study. Fill out these columns if you wish to use the tables from the "Fuel Switching Options Table" tab in your emissions plan.

Options		Example	Chosen Option
Technology		Biomass boiler	Heat Pumps
Existing energy type		Coal	NaturalGas
Existing energy consumption	(kWh/year)	1,000,000	300,000
Replacment energy type		Biomass	Electricity
Replacement energy consumption	(kWh/year)	750,000	150,000
Operating cost savings	($/year)	-$ 50,000	$ 12,600
Total capital cost	($)	$ 2,790,000	$ 800,000
Implementation Year		2026	2028

Parts 5 – 8 of this tab are exactly the same in function as Part 4 and are there to allow you to include multiple fuel switching projects in your emissions plan.

Move to the "Fuel Sw" tab once you have finished entering your fuel switching project(s).

Note: Operating cost savings should be entered as a negative value. If operating costs are expected to increase, enter them as a positive value.

Step 4: Fuel Switching Options Table

This table will automatically populate, hide the rows that are not used and then copy and paste the table into Section 4.4 of the word **Report Template**. Move to the "Roadmap" tab.

Fuel switching - System 1		**Chosen Option**
Technology		Heat Pumps
Existing energy type		NaturalGas
Existing energy consumption (kWh/year)		300,000
Replacement energy type		Electricity
Replacement energy consumption (kWh/year)		150,000
Annual operating cost savings ($/year)	$	12,600
Emissions savings (tCO2-e/year)		49
Capital cost	$	800,000
Implementation Year		2028
NPV		-$384,000

Step 5: Emissions Roadmap

This roadmap table/graph will automatically populate. Hide the rows that are not used and then copy & paste the table into both the Summary Section and Section 6 of the word **Report Template.**

Emissions Roadmap

Project Type	Project Description	Year	Annual Savings ($t\ CO_2$-e)	(%)	Annual Emissions ($t\ CO_2$-e)	(%)	Remaining emissions		Capex ($k)		Opex savings ($k/yr)		NPV ($k)
Baseline emissions					224								
Energy efficiency	Porject 1	2025	4	2%		98%		$	45,000	$	8,664	$	82,309
Demand reduction	Porject 2	2025	3	1%		97%		$	13,000	$	1,272	$	7,700
Energy efficiency	Project 1	2025	17	8%		90%		$	45,000	$	40,850	$	502,694
Demand reduction	Project 2	2025	5	2%		87%		$	13,000	$	2,271	$	20,744
Process change	Porject 3	2026	35	16%		72%		$	125,000	$	15,698	$	119,321
Energy supply	Porject 4	2026	1	1%		71%		$	4,500	$	3,562	$	43,438
Demand reduction	Porject 5	2027	1	1%		71%		$	4,500	$	1,100	$	11,282
Fuel Switching	Heat Pumps	2028	49	22%		49%		$	800,000	$	12,600	-$	384,000
Total			**115**	**51%**	**110**	**49%**		**$**	**1,050,000**	**$**	**86,000**	**$**	**403,000**

The roadmap shows the projects in the order you plan to implement them, the effect each project has on your emissions, and the key financial metrics associated with each project. Move to the "Sum Table" tab.

Step 6: Projects Table

This table will automatically populate, copy and paste the table into the Summary Section and Section 5 of the word Report Template.

Projects table

Project description	Annual emissions savings (tCO2-e/year)	Annual emissions (tCO2-e/year)	Year
Baseline		**224**	
Porject 1	4		2025
Porject 2	3		2025
Project 1	17		2025
Project 2	5	**196**	**2025**
Porject 3	35		2026
Porject 4	1	**160**	**2026**
Porject 5	1	**158**	**2027**
Heat Pumps	49	**110**	**2028**

Appendix B – Report Template walkthrough, tips, hints, and troubleshooting

The Report Template is intended to be a stand-alone emissions plan document built with the help of this guide and Calculations Spreadsheet. The report is intended to be a living document, continuously updated, and improved over time as new information becomes available or as technology evolves.

If you are using the document for a resource consent it is intended that the Report Template functions as the stand-alone document to be submitted to your regional council for consent consideration. However, you may wish to include any studies such as energy audits or fuel switching feasibility studies as appendices.

Overview

Fill out the boxes in the Report Template, including sections describing:

- Organisation, site, and process overview
- Process heat equipment and operations
- Opportunities explored and included/excluded from your plan
- A summary of your plan
- And any other information you deem relevant. Note: this template is intended to be an example of what an emissions plan could look like, but is non-statutory, meaning you can edit or add anything else as needed.

Organisation, Site, and Process Overview

This section asks you to provide a high-level overview of your organisation and the site(s) is important to give an understanding of what your organisation does and how you are operating. It is also a good opportunity to discuss any potential changes in the short or long term to your organisation/sites(s) and the industry you operate in. If you have any organisation or site level emissions reduction or energy performance targets, these should also be mentioned.

Enter this information in the text box provided and aim to provide enough detail that the reader could understand your site without having to visit it in-person.

ABC is … | ABC produces…

Equipment and Operations

This section asks you to enter in key details about your thermal energy-using equipment (boilers, dryers, ovens etc.) and large electricity-using equipment (chillers, heat pumps etc.) into the text box. A guide of what details to enter is provided in the document. If you are unsure about the details of your equipment refer to Section 3.3 of this guide for assistance.

Equipment #1 name: (i.e. south room heat)

Equipment type: (i.e. boiler)

Equipment fuel type: (i.e. coal)

Equipment age: (i.e. 27 years)

Equipment rating: (i.e. 1,000 kW output)

Equipment operating temperature, pressure, etc.: (i.e. 150°C)

Equipment typical operating hours: (i.e. M-F 8-5 first shift, 6-12 second shift, occasional Saturday)

Equipment typical load: (i.e. 100% fire for morning warmup each day then varies with production) [note: see load profile tab in the Calculations Spreadsheet for a more detailed way to answer this question]

Describe the end use(s) of this equipment (i.e. canning line, pasteurisation, drying, etc.):

End use temperature requirement: (i.e. what is the minimum theoretical temperature this could operate at?)

Other end-use specifics as relevant:

Equipment #2 name:

Equipment type:

Equipment fuel type:

Equipment age:

Equipment rating:

Equipment operating temperature, pressure, etc.:

Equipment typical operating hours:

Equipment typical load:

Describe the end use(s) of this equipment:

End use temperature requirement:

Other end-use specifics as relevant:

Energy Usage and Associated Greenhouse Gas Emissions

This section asks you to summarise the energy types you have at your site and their associated greenhouse gas emissions. Insert the table generated in the "Step 1-Emissions" tab of the Calculations Spreadsheet into the text box provided.

Thermal Fuel	Fuel Consumption and Cost			GHG Emissions
	GJ	$	kWh	tCO2-e/year
NaturalGas	1,000	$ 25,230	277,778	56
Thermal 2				
Thermal 3				
Total		**$ 25,230**	**277,778**	**56**

If you would like to provide any further context around your energy usage (such as why it may be uncharacteristically high or low) or if you were unable to summarise your energy usage, a text box is provided.

Emissions Reduction Opportunities Explored

This section asks you to provide details on process change, energy efficiency, demand reduction and fuel switching opportunities you have explored and/or included in your plan. Using the process change section as a guide, enter your projects along with a brief description of what they are in the first text box.

The process change options we considered were:
- 1:
- 2:
- 3:

In the second text box provide and explanation of why the corresponding project was included/ excluded in the plan.

- 1:
- 2:
- 3:

In both cases the description can be brief but should clearly state what the project was aiming to achieve, and what were the merits/drawback that resulted in it being included or excluded.

Repeat the above steps for the energy efficiency, demand reduction and fuel switching opportunities you have explored.

Emissions plan summary

Once you have completed the above sections of the emissions plan it's time to write your summary. This section of the report will give a brief overview of the previously described sections, and clearly show the reader your plan.

In the first text box provide an overview of the key projects in your plan, the expected outcomes of these projects such as the expected emissions reduction potential (%) and the capital investment required ($) to see these reductions realised.

> Our emissions reduction plan is to…
>
> These projects combined will reduce our total site-level emissions by __% for an investment of $__.
>
> It was decided this was the best approach for our site because…

Finish this section with a description of why you've decided to pursue the direction and projects in your plan. This can include the merits of your chosen options, and the drawbacks of opportunities explored but not included.

In the next text box copy and paste the Projects Table generated in the "Sum Table" tab of the **Calculations Spreadsheet:**

Projects table

Project description	Annual emissions savings (tCO2-e/year)	Annual emissions (tCO2-e/year)	Year
Baseline		**224**	
Porject 1	4		2025
Porject 2	3		2025
Project 1	17		2025
Project 2	5	**196**	**2025**
Porject 3	35		2026
Porject 4	1	**160**	**2026**
Porject 5	1	**158**	**2027**
Heat Pumps	49	**110**	**2028**

And the Emissions Roadmap generated in the "Roadmap" tab of the **Calculations Spreadsheet** into the final text box:

Emissions Roadmap

Project Type	Project Description	Year	Annual Savings ($t\ CO_2$-e)	Annual Savings (%)	Annual Emissions ($t\ CO_2$-e)	Annual Emissions (%)	Remaining emissions	Capex ($k)	Opex savings ($k/yr)	NPV ($k)
Baseline emissions					224					
Energy efficiency	Porject 1	2025	4	2%		98%		$ 45,000	$ 8,664	$ 82,309
Demand reduction	Porject 2	2025	3	1%		97%		$ 13,000	$ 1,272	$ 7,700
Energy efficiency	Project 1	2025	17	8%		90%		$ 45,000	$ 40,850	$ 502,694
Demand reduction	Project 2	2025	5	2%		87%		$ 13,000	$ 2,271	$ 20,744
Process change	Porject 3	2026	35	16%		72%		$ 125,000	$ 15,698	$ 119,321
Energy supply	Porject 4	2026	1	1%		71%		$ 4,500	$ 3,562	$ 43,438
Demand reduction	Porject 5	2027	1	1%		71%		$ 4,500	$ 1,100	$ 11,282
Fuel Switching	Heat Pumps	2028	49	22%		49%		$ 800,000	$ 12,600	-$ 384,000

Appendix C – Comprehensive list of support resources

National Policy Statement for Greenhouse Gas Emissions from Industrial Process Heat 2023

Resource Management (National Environmental Standards for Greenhouse Gas Emissions from Industrial Process Heat) Regulations 2023

National Direction for Greenhouse Gas Emissions from Industrial Process Heat, Industry factsheet (June 2023)

Climate and Energy Professionals website

EECA Emissions Plan Guidance (March 2024)

Emissions Plan Guidance, Non-statutory (March 2024)

Climate and Energy Professionals website

Sector Decarbonisation Programme

Industrial heat pumps for process heat (January 2023)

Regional Energy Transition Accelerator

Biomass boilers for industrial process heat (April 2023)

Best Available Techniques Reference documents (March 2024)

International Technology Scan (2019)

Non-fuel operating cost tables (March 2024)

Asset replacement strategy (August 2024)