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Whitehorse City Council

# Gas to Electric Business Case

## Summary Report

September 2025

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# Gas to Electric Business Case
# Summary Report

Whitehorse City Council

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WSP acknowledges that every project we work on takes place on First Peoples lands.
We recognise Aboriginal and Torres Strait Islander Peoples as the first scientists and engineers and pay our respects to Elders past and present.

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# Executive summary

Whitehorse City council is committed to climate action, with the aspiration to achieve net zero emissions, 100% renewable electricity procurement, and ongoing monitoring and reporting on carbon emissions.

To support the transition of Council buildings and assets from gas to electricity as part of the Council's broader Climate Response Strategy and Plan, the Council has engaged WSP to develop a roadmap and business case which is summarised in this report. This transition aligns with broader state and federal policies which acknowledge the need to transition away from the combustion of fossil fuels such as natural gas to meet net zero emission targets by 2045 and 2050 respectively.

To develop this roadmap and business case, a desktop review of available information for 38 existing assets which currently use natural gas was undertaken. In the process a range of information in relation to existing gas equipment was not available which required site visits by Council staff to develop registers of gas equipment at each site. In addition, 5 sites were inspected by an experienced WSP engineer to further inform the proposed roadmap.

Based on the range of gas equipment identified as currently in use within the existing council assets, electric alternatives were identified and qualitatively assessed to recommend equipment that would form the basis of this roadmap. An approach of planning all electrification works as a combined project is recommended due to anticipated efficiency and the need for electrical infrastructure upgrades to consider the increased electrical demand associated with replacement of all existing gas equipment.

For each site and based on the existing and proposed equipment types, high level estimates of capital costs, operating costs, and greenhouse gas emission impacts were developed for the purpose of the overall roadmap and business case, however all costs should be verified by site specific investigation and design.

The anticipated life of existing gas equipment was then used to propose the year of electrification for each site while also seeking to limit the number of projects undertaken each year, to make the overall programs of work more manageable and smooth out capital expenditure.

The analysis and resulting impacts of the roadmap have been developed in a spreadsheet intended to be used as a tool by the Council as the overall transition is undertaken.

Based on the different asset classes in the Council's portfolio, a breakdown estimated net emission savings illustrated in the graph below suggests that the major leisure facilities included in this roadmap scope will provide the greatest emission saving through electrification.

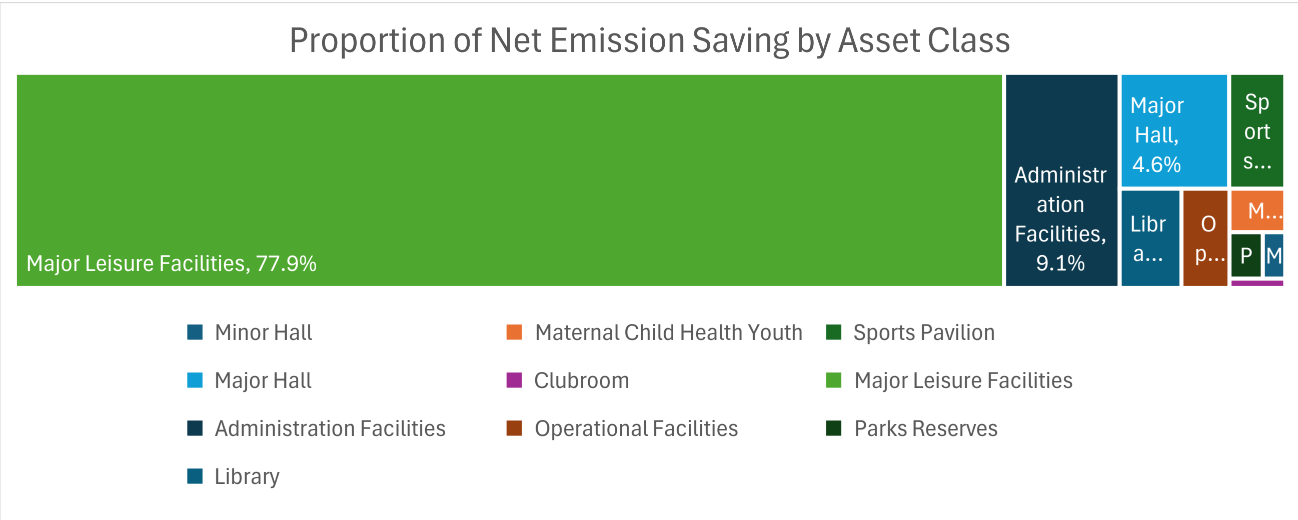



Figure ES.1: Breakdown of natural gas GHG emission savings by asset class

A breakdown of cost by asset class suggested that sports pavilions represent the highest share of capital costs which is due to it being the class with greatest number of sites (14) and the extent of gas domestic hot water equipment typically used for shower facilities at these sites. Domestic hot water equipment costs have the greatest opportunity by optimising storage volumes as part of the design process and so actual capital costs for sports pavilions may decrease accordingly.

The overall roadmap includes majority of sites being electrified by 2031 which will result in:

- Over 90% reduction in natural gas consumption across council assets
- Net emission saving of approximately 1,440 TCo2e/year compared to 2024/25 baseline.
- Net operating cost savings of approximately $190,000 / year in 2025 dollars, or approximately $230,000 when adjusted for assumed inflation.
- Cumulative capital cost investment in the order of $21 million in 2025 dollars, or $24 million when adjusted for assumed inflation.

By the end of 2040, the proposed roadmap will result in:

- All remaining natural gas use in Council assets being removed.
- Net emission saving of approximately 1,515 TCo2e/year compared to 2024/25 baseline.
- Net operating cost savings of approximately $190,000 / year in 2025 dollars, or approximately $290,000 when adjusted for assumed inflation.
- Cumulative capital cost investment in the order of $28 million in 2025 dollars, or $34 million when adjusted for assumed inflation.

The overall trajectory of net GHG emissions, capital cost, and operating costs associated with the proposed roadmap is illustrated in the graph below with costs adjusted for assumed inflation.

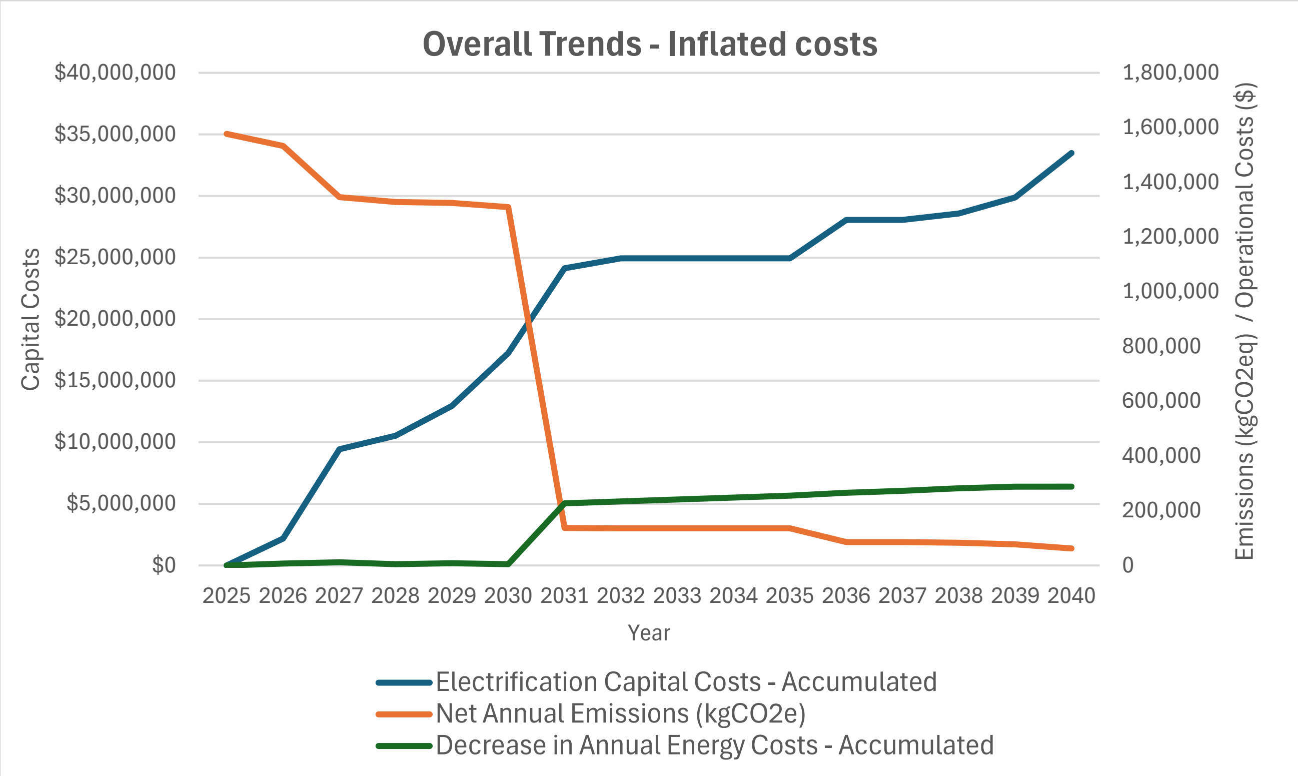



Figure ES.2: Proposed cost and emission trajectory

In addition to the overall roadmap a range of recommendations have been made in relation to the gas to electric transition as summarised in the table below. Refer to the related section of this report for further details.

Table ES.1: Summary of Recommendations

| Section | Recommendations |
|---|---|
| Section 1.2<br>Information Provided | — Develop and update an asset register for all engineering services and gas cooking equipment confirming details of equipment, associated condition and anticipated end of life;<br>— Engage maintenance contractors to maintain the register assessing the remaining life of equipment each year;<br>— Require electronic as-built drawings, O&M manuals and equipment schedules for new construction and refurbishments and maintain records in a central location. |
| Section 3.13.2<br>Electric Equipment Efficiency | — For split reverse cycle units, select equipment with the highest cold zone energy star rating and as a minimum require a cold zone energy star rating of 2.<br>— For air to water heat pumps use for space heating, investigate strategies for operating the system with the lowest water temperature possible to maximise energy efficiency. Consider upgrading other elements of the heating system to enable low heating water temperatures.<br>— For domestic hot water units, consider additional hot water storage which may both reduce capital cost and ongoing peak electrical demand costs.<br>— For cooking equipment utilise induction units where available. |
| Section 3.2<br>Refrigerant emissions | — Select new heat pumps with refrigerants that utilise the lowest global warming potential (GWP) possible and with a maximum GWP of 700;<br>— Where possible utilise packaged air conditioning units or packaged air to water heat pumps located in well-ventilated locations to minimise refrigerant charge and the risk of refrigerant leaks. |
| Section 3.3<br>Implementation Approach | — Undertake electrification of all gas equipment at each site as a single package of works to minimise disruption and allow for construction efficiencies.<br>— Use each project as learning opportunity to further refine and improve the approach for subsequent sites.<br>— For smaller sites, consider undertaking procurement of design consultants and contractors in packages with a group of assets to be electrified concurrently to benefit from economies of scale.<br>— For larger sites utilising gas boilers, undertake preliminary performance testing to determine capacity and temperature requirements to inform electrification design.<br>— Engage design consultants and quantity surveyors to develop and optimise design, confirm budgets and to provide tender documentation to allow for contractor implementation. |
| Section 3.4<br>Implementation Timing | — Proactively plan for replacement of gas equipment nearing end of life. Undertake electrification at each site at the anticipated end of life of the oldest gas equipment while also avoiding electrification of an excessive number of sites in a single year.<br>— If tenant gas cooking equipment cannot be upgraded concurrently with other gas equipment, allow for additional electrical demand in any electrical infrastructure upgrades and agree strategy with tenant for eventual electrification.<br>— Where possible integrate electrification works into broader refurbishment plans so that they can be undertaken concurrently for improved efficiency.<br>— Require all new construction to be fully electric and embed requirement into design standards.<br>— Communicate approach to ensure all relevant council staff so electrification requirements are considered in maintenance, refurbishment and new construction projects. |

# 1 Project Background

## 1.1 Project Context

### *1.1.1 Whitehorse City Council Policy*



The Whitehorse City Council adopted a Climate Response Strategy and Climate Response Plan in November 2023 which included a range of commitments and targets to address climate change.

The plan included the following;

- Procure 100% renewable electricity for council owned or operated assets. This is now in place and will support significant emission reduction as the council transitions from gas to electric equipment used in council assets.
- Develop of a business case to transition Council buildings and assets off gas to electric.

Whitehorse City Council (Council) has engaged WSP to develop a strategy and business case, to support the transition of Council buildings and assets from gas to electric.

In May 2025, the council passed a resolution to revise the climate response strategy and plan to stop purchasing carbon offsets and apply a greater focus on direct emission reduction. This approach is intended to prioritise investment in direct emission reductions such as the transition from gas to electric equipment in existing buildings. This roadmap and business case will contribute to projects selected for emissions reduction.

The council is committed to climate action, with the aspiration to achieve net zero emissions, maintaining 100% renewable electricity procurement, monitoring and reporting on carbon emissions and maintain an aspiration to achieve net zero carbon emissions.

### ***1.1.2*** *State and Federal Policy*

The Victorian state government has an overall target for the state to achieve net zero emissions by 2045. The state government strategy highlights the transition away from natural gas as being a key step to achieving this target.

The federal government has a legislated target to achieve net zero greenhouse gas emissions by 2050. The federal Climate Change Authority review of the building sector pathway to net zero released in September 2024 noted that in the long-term complete electrification of buildings is the optimal decarbonisation approach.

### *1.1.3 National Construction Code Update*

The national construction code sets minimum standards for new buildings and major refurbishments including requirements related to energy efficiency. While yet to be formally released, the public draft of NCC 2025 includes a range of provisions which effectively discourages the use of natural gas in non-residential new buildings and refurbishments including the following;

- The need to offset emissions associated with any proposed natural gas with on-site solar PV or other measures.
- Requirements for electrical infrastructure, heating system design, and spatial allowance to accommodate the future installation of air source heat pumps.

### 1.1.4 Gas Infrastructure Operational and Maintenance Costs

As the number of users on the gas network falls over time, the costs to maintain and operate the existing gas network will need to be met by fewer customers. This means higher gas bills for customers remaining on the network in the long term.

Eventually when the number of customers falls below a certain threshold the network costs will become uneconomical, and the distribution system will likely be switched off.

An early example of this is the announcement by Solstice Energy in August 2025 that they will cut gas supply to 10 regional Victorian towns which is understood to be driven by the cost of maintaining and operating the infrastructure becoming uneconomical. Solstice Energy have given customers an 18 month transition period to switch to electric or bottled gas and are providing financial support to affected customers. While this is a unique situation as the Solstice Energy gas network is small and isolated from the rest of the gas distribution system, it is an early example of the issue with operating gas infrastructure as the number of customers falls over time.

## 1.2 Info / data provided to the consultant

The following information was provided via online transfer to inform development of the business case and roadmap:

- Annual gas and electricity consumption and costs for each site.
- Electrical interval data for most sites used to determine existing electrical demand.
- Details of existing and new gas and electricity contracts.
- Schedule of gas heating equipment – based on previous asset register with updates based on site inspections by council staff for this project.
- Schedule of gas domestic hot water and cooking – based on inspection by council staff for this project. Some details have been assumed or estimated where it could not be verified through nonintrusive visual inspection.
- Photos of each building and selected gas equipment taken as part of site inspections by council staff.
- Available as built and design architectural and engineering services drawings. Completeness of drawings varied significantly with majority of sites having no drawings available while other sites having comprehensive documentation available.

### 1.2.1 Challenges and Recommendations for Asset Management

Key documentation that was requested was unable to be provided by the Council as the information has presumably been lost since the respective buildings were constructed or refurbished. This required council staff to visit each site to provide the minimum level of information required to develop this business case and roadmap.

Key documentation that should be provided as part of any new build or refurbishment project that was not available included:

- Operation and maintenance manuals and as-built drawings for mechanical, electrical, and hydraulic engineering services.
- Architectural equipment schedules which would typically include gas cooking equipment.

In addition to documentation that should be available from the original construction or refurbishment project, equipment asset registers are often used by facility management teams to understand the number, manufacturer, model, condition, capacity and anticipated end of life of existing equipment.

An existing asset register was available for mechanical equipment and while this was not up to date with information for every site, it was a highly valuable tool for developing the road map and business case.

In the absence of as-built documentation or asset registers, information for gas domestic hot water, gas cooking equipment, and gas heating equipment not included in the original asset register was populated based on site inspections by council staff for this project. In some instances, important details such as the capacity of ceiling concealed heating could not be verified as part of this process and so has been estimated based on the provided information.

To support future refurbishment projects and ongoing maintenance the following is recommended:

- For any new construction or refurbishment projects, as-built drawings and operation and maintenance manuals in electronic format are provided by the contractors prior to releasing final payments. This documentation should be stored electronically in a central organised location with suitable backup process.
- Asset registers are developed and updated regularly (i.e. every 5 years) to cover all engineering services (i.e. mechanical, electrical, hydraulics) confirming key details of equipment on each site, and associated condition and anticipated end of life.

Maintaining a good understanding of the council's existing assets will also be beneficial for general asset management and the transition to low emission refrigerants in existing and new equipment.

## 1.3 Emission Factors

Greenhouse Gas GHG emission savings associated with electrification will be directly linked to the emission factors of gas and electricity. As the council is procuring 100% renewable electricity, emissions from electricity consumption are effectively 0. Emission saving estimates associated with the reduction in natural gas use are based on the combined Scope 1 and 3 emission factors of 55.53 kg Co2e/GJ for metropolitan Victoria from the National Greenhouse Gas Accounts – 2024.

## 1.4 Limitations

Findings and recommendations are limited to the information provided (described above), a non-intrusive site survey of selected sites, discussions with council staff, and reasonable assumptions based on engineering judgement and experience.

Recommendations assume no material changes to future energy tariffs, capital costs, and gas emission factors based on currently available information.

Except as otherwise stated in the Report and to the extent that statements, opinions, facts, conclusion and / or recommendations in the Report (Conclusions) are based in whole or in part on information provided by the Client and other parties identified in the report (Information). Those Conclusions are based on assumptions by WSP of the reliability, adequacy, accuracy, and completeness of the Information and have not been verified.

WSP has prepared the Report without regard to any special interest of any person other than the Client.

# 2 Methodology

## 2.1 Desktop Review

To develop the roadmap and business case, extensive information on each sites' buildings, systems, and operation was requested. A summary of all information provided is outlined in section 1.2.

The primary information was summarised in a master spreadsheet which was then used to understand the range of different assets, equipment, and gas usage across the Council. Where information in the master spreadsheet was insufficient, supporting photos, drawings, and correspondence was used to confirm critical information for each site. Where information was unable to be provided, assumptions were made.

## 2.2 Options Workshop

Following a desktop review, the types of different gas consuming equipment were identified, and a range of potential replacement options were considered. Based on qualitative consideration of energy efficiency, whole of life costs, refrigerant types, and flexibility to be applied to the variety of different council buildings, an electric replacement equipment type was recommended for each type of existing gas equipment.

The options and recommendations were presented as part of a workshop with Council stakeholders in June 2025 with slides presented as included in Appendix A with recommended system types following this workshop outlined in section 3.1.

## 2.3 Site Audits

The following 5 sites were identified by the Council as requiring more detailed audits:

- Box Hill Town Hall and Hub (Inc Migrant Info Centre + Citizens Advice Bureau)
- Sportlink Vermont South
- Civic Centre, Council Chambers and Nunawading Library
- Aqualink Box Hill
- Parkswide Nursery & Horticultural Centre

For each of these sites, a site inspection was undertaken to verify existing systems, conditions, and available space for new electric replacement systems. The outcome of these site inspections is outlined in section 4.

## 2.4 Roadmap and Dashboard Development

### *2.4.1 Gas Usage Breakdown*

Gas consumption for each type of equipment (space heating, domestic hot water, and cooking) was estimated by taking the sites' historical gas usage and estimating the percentage for each type of equipment. The percentages were estimated based on reviewing the number and type of equipment, the descriptions, and operating hours of each site provided. For example, a sport facility with gas domestic hot water and cooking equipment would be estimated to have a high proportion of gas used for domestic hot water due to the usage of showers. Commentary on the basis for the breakdown is provided in the roadmap spreadsheet for each site.

The estimates gas usage for each type of equipment was then used to estimate the net energy impact of electrification with consideration of the efficiency of different types of equipment proposed.

### 2.4.2 Mechanical Equipment

**Energy and Demand Estimates**

Based on the recommended electrification system type outlined in section 3.1, typical coefficients of performance (COP) have been estimated for each equipment type. As the COP of heat pumps varies with temperature and load, a COP at peak load and an annual average COP are used.

The existing gas system capacity and peak COP of electrical replacement is used for each item of gas equipment to estimate the impact on electrical demand.

The estimated gas use for heating and annualised COP is used to estimate the annual electrical consumption of the electrical replacement equipment. Where a site uses more than one system type a capacity weighted average annualised COP is used.

**Opinions of costs for typical system**

Opinion of cost has been made on the basis of WSP's experience and qualifications and represents our best judgement as experienced familiar with the construction industry. To estimate costs across multiple sites, a scalable modelling approach using two reference air-conditioning systems—a small and a large unit—as benchmarks for each replacement system type. These system types included Reverse Cycle Heat Pump – Wall Split, Reverse Cycle Heat Pump – Ducted, Electric Infrared Heat Pump, Air-to-Water Heat Pump, and Electric Kiln. Baseline costs were developed using recent project data and supplier pricing. By interpolating between the small and large system benchmarks, we generated cost estimates for each site.

Opinions of cost excludes:

- Replacement existing heating hot water pipework except where specifically noted
- Structural works and associated builder works
- Any other ancillary costs not directly related to the installation of the replacement systems

### 2.4.3 Domestic Hot Water (DHW) Equipment

**Energy and Demand Estimates**

Based on the recommended electrification system type outlined in section 3.1, typical coefficient of performance (COP) has been estimated for each equipment type. As the COP of heat pumps varies with temperature and load a COP at peak load and an annual average COP are used.

The existing gas system capacity and peak COP of electrical replacement is used for each item of gas equipment to estimate the impact on electrical demand.

The estimated gas use for domestic hot water and annualised COP is used to estimate the annual electrical consumption of the electrical replacement equipment. Where a site uses more than one system type a capacity weighted average annualised COP is used.

**Opinions of costs for typical system**

Typically gas hot water systems were provided with low storage as the heating output from gas was relatively low cost relative to electric heat pumps.

Replacing a like for like gas hot water system with an air to water heat pump system with similar storage volumes will be expensive and require electrical power. An efficient replacement design would aim to increase the storage volumes giving the heat pump system more time to recover the hot water storage temperature. This in turn reduces the size of heat pumps, power supply, and overall cost.

An exercise on the Sportslink site demonstrated that the difference in cost for a like for like replacement of the hot water system to a bespoke design with increases storage led to savings of 60-70% on capital costs.

A similar exercise on the Aqualink site demonstrated much reduced savings, approximately 5%, as this facility with lots of showers requires a large stored volume and a hot water system that requires rapid heat recovery. Opinions of cost for typical sites assumes no increase in storage volumes which is a conservative approach for the purpose of the overall business case.

As part of the design process, engineers should undertake a review of the potential for additional storage and lower heating capacity of heat pumps to reduce total costs. This standard design process should allow for lower capital costs than estimated in this business case for some sites.

### 2.4.4 Cooking Equipment

**Energy and Demand Estimates**

Based on the recommended electrification system type outlined in section 3.1, typical efficiency has been estimated for each equipment type. As heat pumps are not utilised for cooking, a single efficiency value is used for estimating the impact on electrical maximum demand and consumption.

The existing gas system capacity and electrical efficiency is used for each item of gas equipment in order to estimate the impact on electrical demand, while the estimated gas use for cooking and electrical efficiency is used to estimate the annual electrical consumption of the electrical replacement equipment. Where a site uses more than one type of cooking equipment, a capacity weighted average efficiency is used.

**Opinions of costs for typical system**

Costs for new electric cooking equipment is based on the price of the same type of electric commercial grade replacement equipment from an Australian supplier's online store. An additional 50% allowance was then applied to the equipment cost to cover delivery, removal of the old gas equipment, and installation of the new units.

### 2.4.5 Solar PV

Opportunities for Solar PV were considered for sites that:

- Do not already have existing Solar PV arrays installed.
- Have daytime operation on weekdays

Sizing was based on the total roof area, an assumption that at least 25% of the roof area would be suitable for PV and limiting the system size so that total generation did not exceed total consumption after electrification to maximise on-site self-consumption.

**Energy and Demand Estimates**

Energy generated with each new PV system was estimated based on typical annual output and cost data for Melbourne assuming flat installation in an unshaded location. A self-consumption factor of 75% was assumed for all sites when estimating the associate operating cost saving impact.

Solar PV is assumed not to reduce the sites' electrical demand due it's variability.

**Opinions of costs for typical system**

The cost for new solar PV systems has been based on:

- Systems being less than 100kW and are eligible for small-scale technology certificates under the renewable energy target, resulting in a reduction in upfront costs.
- Systems are roof mounted flush against existing roofs without tilt frame systems, and the PV inverter and switchboard are in reasonable proximity to the available roof areas.
- The Solar Choice commercial PV price index (August 2025) which suggest an average cost of $970/kW for 10kW systems in Melbourne, which is based on the total cost of installation from contractors for standalone PV system installations. This has been rounded up to $1000/kW for the purpose of the roadmap development.

### 2.4.6 Electrical Infrastructure Upgrades

**Estimated Demand Increase**

For each site the estimated electrical demand from domestic hot water and cooking equipment is assumed to directly impact the sites' maximum electrical demand on the assumption that utilisation of these systems is uniform throughout the year.

For heating, as demand will typically be negligible in summer but significant in winter, the sites' electrical demand in winter is used to assess if the additional demand from electric heating equipment will increase the sites' annual maximum electrical demand.

**Opinions of costs for typical system**

The cost for electrical infrastructure systems has been based on estimates for 10 sites considering the following:

- Existing incoming electrical Maximum Demand (MD) supply and existing Site Main Switchboard (SMSB) rated capacity compared with the estimated final MD for the works.
- Location of existing SMSB and likely spatial ability for upgrade of supply with an additional cubicle annexed to the existing SMSB or a new SMSB required to be established due to spatial constraints.
- A new SMSB will generally require a new Electrical Supply Authority connection, Supply Authority Retailer metering with / without Current Transformer (CT), in-ground conduits and pits, reconnection of new SMSB to existing SMSB. Modifications or additions to existing electrical switchboards downstream of the existing SMSB to suit the electrification works are excluded as there is no electrical MD profile data downstream of the existing SMSB.
- Electrical Supply Authority connection costs are a rough order of cost estimate based on similar other projects, however it is very much subject to the extent the Supply Authority is required to augment their network to enable the increase of the estimated final MD for the works offset by the increase in revenue the Electrical Supply Authority will receive.
- Final SMSB supply capacity is the estimated final MD for the works + 25% for future spare capacity on the SMSB.
- New in-ground conduits and pits for incoming supply upgrade and reconnection of existing SMSB to new SMSB as required.

The result of estimates for the 10 representative sites has then been used to provide a high level estimate of the remaining 28 sites being assessed based on the estimated new maximum demand for the respective site.

As not all sites will require a complete electrical infrastructure upgrade, and existing infrastructure constraints could not be confirmed for all sites based on desktop review, a risk weighted cost factor has been applied to determine the overall cost used in the business case as summarised in the table below.

Figure 2.1: Electrical Infrastructure Risk Factors

| Category | Cost Factor Applied | Criteria |
|---|---|---|
| High – Full upgrade required | 100% | Sites estimated electrical demand after electrification exceed the rating of the existing main switchboard or electrical supply if known. Upgrade to electrical infrastructure will be required. |
| Medium – Upgrade uncertain | 70% | Sites existing electrical supply is uncertain based on desktop review and is to be confirmed as part of design to determine extent of upgrade required. |
| Low – upgrade not required | 30% | Sites estimated electrical demand is less than the rating of the existing main switchboard. Infrastructure upgrade not anticipated, localised electrical works only are anticipated. |

### 2.4.7 Other project costs

Please note that WSP is not a Quantity Surveyor. Cost estimates given by us are opinions of cost only, based on historical data and our experience with similar projects. Actual tender costs may vary markedly, depending on market conditions at the time of tender.

The individual costs outlined for replacement of different types of equipment described above do not allow for the following:

- Rectification or upgrade of other building elements not directly related to existing gas equipment.
- Professional fees for engagement of design consultants (services, building surveyor, architect, acoustic, structural, heritage, access) and project management.
- Acoustic, structural or general builders work that may be required subject to detailed design.
- Asbestos or other hazardous material inspection, report or removal.
- Cranage and lifting of equipment, excavation, backfill and make good of existing surfaces for conduits and pits.
- Site Mobilisations, Site Allowances, Wage Indexation, Escalation, out of hours/overtime work

While these other costs will be highly variable based on the individual site, a general allowance of 30% has been applied in addition to the cost estimated for the individual equipment electrification costs.

In addition, as capital and operating costs are based on current 2025 costs, an allowance of 3% inflation per year is applied to costs as part of the overall roadmap.

### 2.4.8 Equipment Life / Replacement Years

The remaining life of existing gas equipment and estimated end of life has been estimated based on:

- The provided mechanical equipment register included an estimated remaining life and year of assessment. This has been used to estimate the estimated year of replacement where this information has been provided.
- For other equipment types, and mechanical equipment not included in the register, and average economic life of 18 years has been assumed from the year of installation.
- Where the original installation year of equipment could not be verified, it has been assumed that equipment was installed in 2010.

The recommended year for electrification, for each site is based on the earliest year that gas equipment is estimated to require replacement.

# 3 Electrification Considerations and Strategy

## 3.1 Equipment Types

The existing Council assets utilise a variety of different gas equipment types which could be replaced by a range of different types of electric equipment.

To develop this roadmap, for each type of equipment a range of options were considered, and an electric equipment type for replacement was recommended with consideration of capital cost, operating costs, and flexibility to be applied to the range of council assets. The options and recommendations were presented as part of a workshop with Council stakeholders in June 2025 with slides presented as included in Appendix A.

For each type of gas equipment, the recommended replacement type and any alternatives that should be considered subject to site specific factors are summarised in the table below.

Table 3.1: Recommend Electric Equipment Types

| Category | Existing Gas Equipment Type | Recommended Electric Equipment Type | Electric Equipment for consideration |
|---|---|---|---|
| Space Heating | Ducted gas heaters | Split ducted reverse cycle units | Packaged Reverse cycle ducted units if feasible. |
| | Wall Furnaces | Wall split reverse cycle units | n/a |
| | Radiant Gas Heaters | Electric Infrared Heaters | n/a |
| | Gas Boilers | High Temperature Heat Pumps | Low Temperature Heat Pumps recommended if feasible. |
| Domestic Hot Water | Gas Storage | Heat Pump with Storage | Electric Storage or<br>Point of use instantaneous<br>if consumption is low. |
| | Gas Continuous Flow | | |
| Cooking | Gas Stoves | Induction Cooktop | Electric Resistance Equivalent if usage is very low. |
| | Deep friers | Induction deep fryer | |
| | Griddle | Induction griddle fryer | |
| | Ovens | Electric Resistance Equivalent | |
| | Salamander | Electric Resistance Equivalent | |
| Other | Gas Kiln | Electric Resistance Kiln | n/a |

The recommended alternatives have been used as the basis for the business case development, however the final electrification design for each site should be developed with consideration of site specific opportunities and constraints, and to reflect the ongoing and rapid development of low carbon technology.

### 3.1.1 Electric Equipment Efficiency

**Ducted and Wall Split reverse cycle units**

Ducted and wall split reverse cycle air conditioning unit energy efficiency is rated by the energy star rating system with all systems required to achieve specific a minimum efficiency to comply with the federal government's Minimum Energy Performance Standards (MEPS).

For Melbourne the SEER Cold zone star rating would apply. As of May 2025, based on the online energy rating database (https://reg.energyrating.gov.au/comparator/) the available wall split air conditioning unit cold zone heating SEER star ratings included:

— Worst available star rating was 1 star

— Average available star rating was 2 star

— Best available star rating was 3.5 star

The best rated 3.5 star unit is anticipated to use approximately 50% of the annual energy consumption when compared to the worst rated 1 star unit.

As a minimum it is recommended new units are specified with a minimum cold zone star rating of 2 stars to ensure at least average energy efficiency is achieved, and this is the basis of energy estimates included in the roadmap and business case. An example of an energy rating label showing the different zone star ratings is shown in the image below.

A 2 star system operating in heating mode achieves a heating season performance factor of 3.5 which has been used for estimating annual energy consumption in the roadmap. At peak load a COP of 2.5 is assumed for the purpose of assessing electrical demand impacts to reflect the lower efficiency of heat pumps when operating at peak load and with low ambient air temperatures.

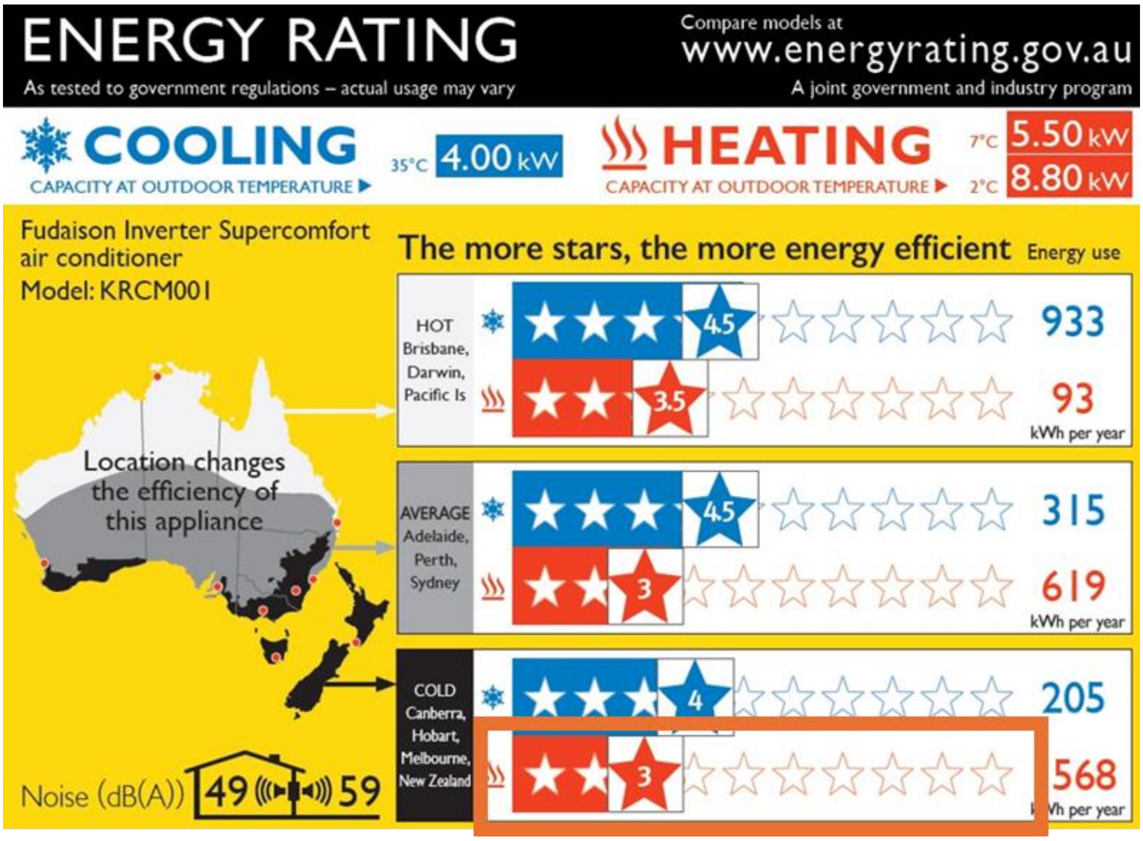



Figure 3.1: Example Split Unit Energy Rating Label

**Air Source Heat Pumps**

Where replacing existing boilers, air to water heat pumps are proposed as the most feasible electric replacement. Generally, as existing boilers operate at high heating water temperatures (typically 80-60°C), the simplest replacement strategy would be to replace with a heat pump capable of operating at similar heating water temperatures however if the system can operate at lower temperatures, the heat pump would operate with significantly lower energy consumption.

Depending on the site this may require replacement or modification to existing air handling units, fan coil units, and/or heat exchangers to ensure the heat output required is still achieved when operating at the lower water temperatures. While this has additional costs for modification of the system, the cost of heat pumps that can operate at high temperatures is typically also significantly higher than an equivalent heat pump designed to operate at low water temperatures. Depending on system details and weather conditions, a heat pump operating at high temperatures can use between 25%-70% more energy.

Generally high temperature heat pumps are the basis of this roadmap and business case as they can be applied to all sites without an understanding of all the components in the heating system, however feasibility of low temperature operation should be assessed as part of site-specific detailed design. For the purpose of assessing peak electrical demand which would occur at low ambient temperatures, a COP of 2.5 has been assumed while an annual average COP of 3 has been used for high temperature heat pumps in assessing energy impacts in the roadmap.

**Domestic Hot Water Heat Pumps**

Typical data sheets for DHW heat pumps claim a coefficient of performance of over 4, however this is typically based on the system operating with an ambient air temperature of 20°C, and when heating cold water up to 65°C. In practice domestic hot water systems operate at a range of ambient temperatures and also provides heating to offset heat losses from tanks and circulating loops. Electric resistance heaters are commonly uses in combination with heat pumps to address storage and circulating loop heat losses. DHW heat pumps can be used to directly maintain circulating loop temperatures, when heating warm water from 60°C to 65°C their efficiency is significantly lower than when heating cold water.

To address the real world efficiency of domestic hot water heat pumps when operating at lower air temperatures and when offsetting storage and circulating losses, a COP of 2.0 is assumed for estimating maximum electrical demand impacts, and an annualised average COP of 2.5 has been used for estimating annual energy consumption impacts.

**Cooking Equipment**

Electric cooking equipment generally uses either induction or electrical resistance heating elements. Electrical resistance heaters are marginally more efficient than existing gas heat due to the losses associated with combustion. Induction electric cooking equipment heats the cooking surface directly making them even more efficient than electrical resistance cooking equipment.

The Green Building Council of Australia (GBCA) reference guide "A practical guide to electrification' included results of a study comparing the annual energy use of gas and induction for different types of cooking equipment which ranges from 58%-78%. For the roadmap, a more conservative assumption has been used to reflect the variability in equipment type and usage across the Council assets.

Table 3.2: Summary of electric cooking equipment efficiency

| Cooking Equipment Type | Energy use reduction compared to gas | |
|---|---|---|
| | GBCA Guidance | Assumption Used for Roadmap |
| Induction Stove | 59% | 50% |
| Induction Deep fryer | 58% | |
| Induction Griddle (hot plate) | 78% | |
| Resistance Oven or Salamander | n/a | 85% |

## 3.2 Refrigerant Greenhouse Gas Emissions

As part of the transition from gas heating to electric heating equipment, the use of heat pumps is recommended due to their significant energy efficiency over alternative electric heating systems.

While heat pumps do use significantly less energy than alternative heating systems, heat pumps utilise refrigerants which can contribute to global warming and in 2022, refrigerant leaks in Australia were responsible for 6.9 Mt of CO2-e emissions. To reduce the emission impact of refrigerants, the Australian government has committed to phasing out 85% of traditional HFC refrigerants consumption by 2036 as part of the Montreal Protocol as illustrated in the graph below.

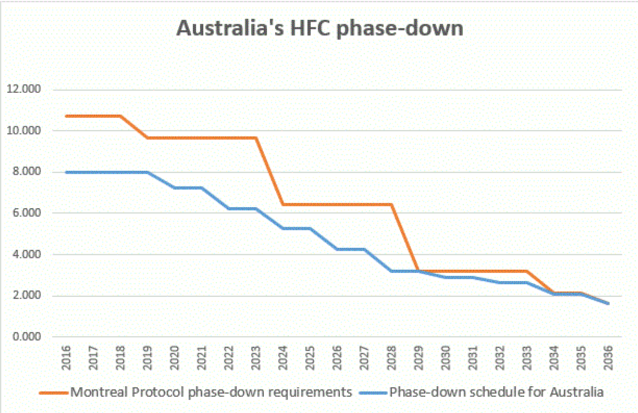



Figure 3.2: Australia's HFC phase-down commitment

While greenhouse gas emissions from refrigerants are significant, the net impact of transitioning from gas to electric heating systems powered by renewable electricity still provides a significant net emission savings. The type of heat pump equipment used can also allow the GHG emissions from refrigerants to be significantly reduced.

<u>Selection of equipment with refrigerants with lower global warming potential</u>

By selecting equipment with refrigerants with lower global warming potential, the associated GHG emission reduction can be reduced. The global warming potential of a refrigerant represents the equivalent Co2 emissions associated with 1kg of refrigerant leakage.

- Equipment is still available utilising traditional refrigerants such as R410a which have a global warming potential (GWP) of over 2000. This type of equipment will be affected by the federal governments phase down of high GWP refrigerants which may also make long term maintenance more costly. Equipment with these traditional high GWP refrigerants with a GWP greater than 1,000 are not recommended.
- Equipment is now commonly available which utilises moderate GWP refrigerants such as R32 which has a GWP of less than 700 which provides significantly lower emissions without any significant cost or limitations for most applications.
- Equipment utilising very low GWP refrigerants such as R1234yf or Co2 have a GWP as low as 1 but depending on the application may have limited availability or significantly higher cost than traditional equipment. Where possible equipment using very low GWP refrigerants should be used, particularly over time as refrigerant availability increases and cost premiums are anticipated to fall.

Selection of equipment that utilises less refrigerant and reduces risk of leakage.

The quantity of refrigerant and the risk of leakage is also influenced by the type of equipment used. By utilising equipment that utilises less refrigerant and with lower risk of leakage, the associated GHG emission impact can be reduced.

- Variable Refrigerant Flow (VRF) equipment utilises the greatest quantity of refrigerant and has the greatest length of pipework, and connections of any type of heat pump system contributing to a greater risk of leakage. To minimise refrigerant emissions these types of heat pump / air conditioning systems are not recommended.
- Reverse cycle split air conditioning units can be designed to reduce refrigerant quantity and pipework length compared to VRF systems but do require a greater number of outdoor units to be distributed throughout a building. The use of reverse cycle split air conditioning should be considered as an option to reduce refrigerant emissions particularly when compared to VRF systems.
- Packaged air conditioning units or packaged air to water heat pumps typically have the lowest quantity of refrigerants and as the refrigerant system is factory assembled and tested without any field installed refrigerant pipework, typically have the lowest risk of leakage. Where possible packaged air conditioning units or heat pumps are recommended to minimise refrigerant emissions.

## 3.3 Implementation Approach

In order to implement electrification across all of the Council's assets, the approach to procurement and implementation can be optimised to minimise risk, cost, and disruption to Council operations based on the nature of the sites.

For smaller sites which have relatively low complexity and consistent equipment types, the following implementation approach is recommended:

- Undertake electrification of all heating, hot water, and cooking equipment at the same time. This approach minimizes disruption and improves construction efficiency.
- Consider packaging similar sites together to improve consistency, quality, and gain economies of scale.
- Engage consultants to confirm electrical infrastructure, optimize design, and project budgets, and prepare documentation for design and construct tender.
- Utilize each project as a learning opportunity to enhance future electrification packages. Use final construction costs, occupant feedback, and actual operational energy consumptions to refine roadmap and procurement of future packages.

For larger sites which utilise gas boilers, electrification is more complex and has more significant capital and operational cost so a staged approach should be considered:

- Undertake a preliminary round of testing and measurement to confirm peak system loads, and system performance at lower heating water temperatures during the winter. This will allow the replacement heat pump capacity to be correctly sized (as many gas boilers are oversized due to their relatively low cost) and to determine if replacement of other components in the system are required to allow for low temperature heat pump operation. A consultant would likely need to be engaged to outline the required scope of testing and measurements for contractors to undertake.
- Following the outcome of the initial measurement and testing, consultants should develop detailed design documentation to allow the works to be tendered with reduced risks and to ensure that the balance of capital cost and operating cost associated with the final design is properly considered.
- Undertake monitoring and tuning of the systems every quarter for the first year of operation, to ensure the systems operate as efficiently as possible.

## 3.4 Implementation Timing

Transition from gas to electric equipment should at a minimum consider the remaining life of existing gas equipment. For the roadmap and business case, timing of electrification is proposed based on:

- Estimates of existing equipment life for mechanical equipment included in the mechanical equipment asset register provided by the Council.
- Estimates of hot water and cooking equipment age and an assumed typical economic life of equipment of 18 years.

Based on the above, electrification for each site is generally proposed when the first piece of gas equipment is estimated to require replacement. While this may result in some equipment being replaced slightly earlier than otherwise necessary, the associated benefits in implementation efficiency by undertaking works simultaneously are considered to outweigh slightly earlier than required replacement of some equipment.

Where the number of sites or capital cost in an individual year was unusually high based on existing equipment life, the proposed electrification year has been delayed by 1-2 years to smooth out the associated cost impact and to try group sites of the same asset class if possible.

All sites are proposed for conversion from gas to electric by 2040 to support the Council's aspiration for achieving net zero emissions, while also avoiding early replacement of existing equipment that has remaining economic life.

### *3.4.1 Tenant Gas Cooking Equipment*

For some sites, existing gas cooking equipment is understood to be managed by the existing tenants and is not under direct control of the council. In these circumstances the following is recommended;

- Existing tenants are engaged with to explain the drivers and benefits of electrification and if possible, get agreement for electrification cooking equipment alongside other equipment for the site.
- If the tenant is unwilling to transition their equipment to electric but other gas equipment is end of life and should be transitioned to electric alternatives, undertake electrical infrastructure review and upgrades to accommodate the additional electrical demand associated with cooking equipment alongside other electrical upgrades.
- At time of lease renewal agree a transition strategy for the tenant's cooking equipment and deadline for disconnection of the gas connection for the site.

### *3.4.2 Integration into refurbishments*

Where possible electrification should also be undertaken concurrently with other refurbishment works to minimise overall costs and disruption to site operations.

While planned refurbishments have not been specifically considered as part of this roadmap, the following is recommended to ensure electrification is integrated into other refurbishment works where possible:

- Prior to undertaking electrification of a site, stakeholders should be consulted to determine if any other refurbishment works are planned or required and an assessment made to establish if other refurbishment works can be delivered together with electrification.
- All council facility management and project delivery staff should be made aware of the overall intent for electrification and proposed timing for their site. Where a project is initiated at a site prior to its proposed electrification year, electrification should be integrated into the project unless existing gas equipment has significant remaining life (i.e. greater than 5 years).

### 3.4.3 Maintenance and Premature Equipment Failures

If gas equipment fails unexpectedly and is required for ongoing operation, it may not be feasible to convert to an electric alternative at short notice without extensive engineering design work.

If possible, temporary measures to provide time for design and procurement of electric replacements is recommended however this may not always be practical.

On this basis it is critical that the condition and status of all gas equipment is understood and regularly updated so that equipment that is showing signs of early failure are identified with enough time to plan and implement full electrification.

In line with the recommendations in section 1.2.1, engaging maintenance contractors to maintain gas equipment asset registers for each site is recommended on a yearly basis. By having contractors assess the remaining life of equipment each year, signs of premature failure can be identified and electrification planned in advance to avoid the need for emergency replacement.

Unlike heating systems and domestic hot water systems, gas cooking equipment may not be maintained by a contractor and so council staff may need to maintain the associated asset register and should regularly review the condition of gas cooking equipment accordingly.

### 3.4.4 Integration into new construction

Given the overall council strategy and broader net zero targets, new construction projects should not incorporate new gas equipment. This should be communicated to all council stakeholders and integrated into project processes, and any design standards or project briefs that the Council utilise.

## 3.5 Backup Power

As part of workshops with Council stakeholders, the need for backup power to allow for operational continuity in the event of a blackout was raised. While the existing gas systems do not have any backup, in the event of gas network failure it was agreed in the workshop that while new backup generators would not be provided, provision of a generator connection point for critical sites would be provided.

The Community Safety Team and Facilities Maintenance have confirmed that the Box Hill Town Hall and Hub, Civic Centre, Council Chambers and Nunawading Library, and Nunawading Community Hub, all have infrastructure for the plug-in generators already. Aqualink Box Hill was identified as a critical site which does not have an existing generator connection point, and so should be included as part of proposed electrification works.

## 3.6 Maintenance Costs

Input from existing council maintenance contractors on the maintenance cost difference between gas and electric equipment was requested to inform the business case and roadmap, however quantifiable advice on potential maintenance cost increases could not be provided to inform the business case.

A qualitative assessment undertaken by WSP suggested that routine and preventative maintenance costs are expected to have negligible differences between the existing gas and proposed replacement electric equipment. Generally new heat pump equipment can be maintained by refrigeration technicians that would already be engaged to undertake maintenance for existing chillers and split air conditioning systems, and so additional attendance of specialist technicians is not anticipated.

In contrast, costs associated with major failures or breakdowns are more difficult to predict due to the variability in failure types and affected components. In the short term, expenses may be higher owing to the increased capital cost of electric equipment. Over the longer term, however, relative costs could decrease as gas-powered equipment becomes less common, potentially leading to reduced availability of parts and specialist contractors.

Overall, maintenance costs are not considered significant in the broader context of capital and energy expenditures and have therefore not been quantified in this report or the overall roadmap accordingly.

## 3.7 Existing Energy Contracts / Tariffs

### 3.7.1 Electricity

In 2021 Whitehorse City Council entered a long term renewable electricity contract as part of the Victorian Energy Collaboration (VECO) which is understood to be a long term contract that will extend until the end of 2030.

Electricity consumption is charged for different sites based on their level of consumption. Sites are considered large market customers if they consume more than 160 MWh/year of electricity or small market customers if they consume less than 160MWh/year of electricity.

The table below summarises the total effective tariffs as of 2025 which have been used for the assessment of electricity costs based on the provide sample bills inclusive of network and regulatory charges that are charged based on energy consumption. Tariffs are reviewed every 2 years as defined in the VECO contract.

Table 3.3 VECO Electricity Tariffs (2025)

| Site Type | Time of use | Total effective Tariff (c/kWh) ex GST |
|---|---|---|
| Large Consumption Sites (>160MWH/year) | Peak | [redacted] |
| | Off Peak | [redacted] |
| Small Consumption Sites (less than 160MWH/year) | Anytime | [redacted] |

### 3.7.2 Gas

Gas costs generally consist of a daily connection charge and a gas consumption charge which has variable tariff which falls with increasing gas consumption. The table below summarises the typical tariffs prior to the latest contract renewal and the new tariffs that came into effect from July 2025.

Table 3.4: Gas Consumption Tariffs – Small Market

| Tariff Element | Old Gas Tariff before July 2025 | New Tariff - after July 2025) |
|---|---|---|
| Consumption Tariff (c/MJ) | [redacted] | [redacted] |
| Connection Charge (c/day) | [redacted] | [redacted] |

As historical gas costs used for estimating cost savings are based on the old contract, the total cost of the new contract has been estimated based on a 36% increase in gas consumption charges, and removal of the daily gas connection charge to reflect the new tariff.

For the purpose of the roadmap, as each site is proposed to be fully converted from gas to electric in a single year, the overall sites existing gas cost has been used to determine associated operational savings to account for both gas consumption tariffs and daily connection charges.

#### 3.7.2.1 Minimum Annual Quantities

Based on the provided information, Aqualink Box Hill is considered as large market gas consumer, with an associated gas contract that includes an annual contract quantity.

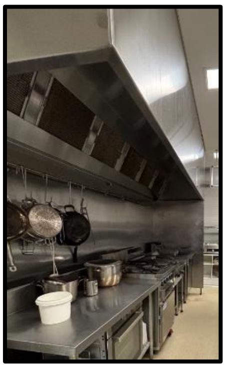
While specific details of the contract have not been provided, typically large market gas contracts include a minimum annual quantity that must be paid for even if actual gas consumption falls below the contract minimum.

As electrification will result in affected sites gas consumption falling below an existing minimum annual contract quantity, the timing of electrification of these sites needs to be considered and planned for in renewal of gas contracts to avoid any associated penalties.

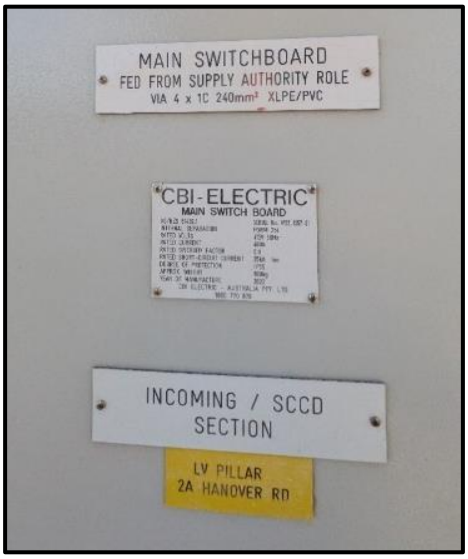
# 4 Summary of Site Audits

## 4.1 Sportlink Vermont South

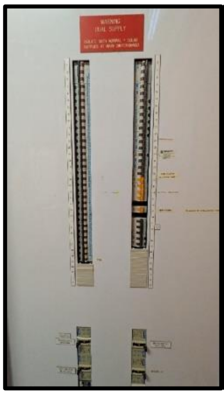
### *4.1.1 Existing gas equipment*

| Equipment Type | Photo | Comments / Condition | Indicative End of Life Replacement |
|---|---|---|---|
| Gas storage Domestic Hot Water System |   | The current domestic hot water system consists of a 300-litre gas storage tank supported by two (2) Rinnai HD200i gas water heaters, originally installed circa 2008. The system is housed within a service enclosure. | 2023-2028 |
| Gas Cooking |   | - 4 burner stove top<br>- gas griddle (hotplate)<br>- Deep fryer<br>Exact age not confirmed – assumed 2008 as per domestic hot water.<br>Ø50 gas pipe to kiosk cooking | 2023-2028 |

### 4.1.2 *Existing electrical SMSB*

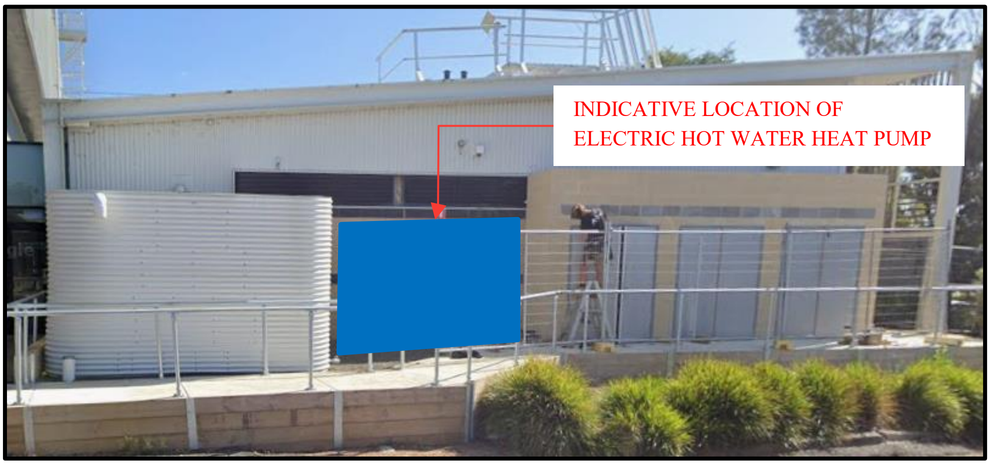
| Equipment Type | Photo | Comments |
|---|---|---|
| Site Main Switchboard (SMSB) |   | - Assume existing Annual Electrical Max Demand of 81kW = 138A, 3PH was taken at the external SMSB, and not the DB-MSB inside the building.<br>- Load increase from 138A, 3PH to 306A, 3PH at SMSB.<br>- Final SMSB supply capacity (including 25% future spare capacity) required for the electrification works at the SMSB is estimated at 306A, 3PH, and within the existing 400A, 3PH supply capacity of the SMSB.<br>- Existing incoming supply from street to roadside external SMSB is underground.<br>- Existing supply for the building MSB (DB-MSB) is to be confirmed at the SMSB. 160A, 3PH main isolator at DB-MSB is not the current limiting device for DB-MSB. |

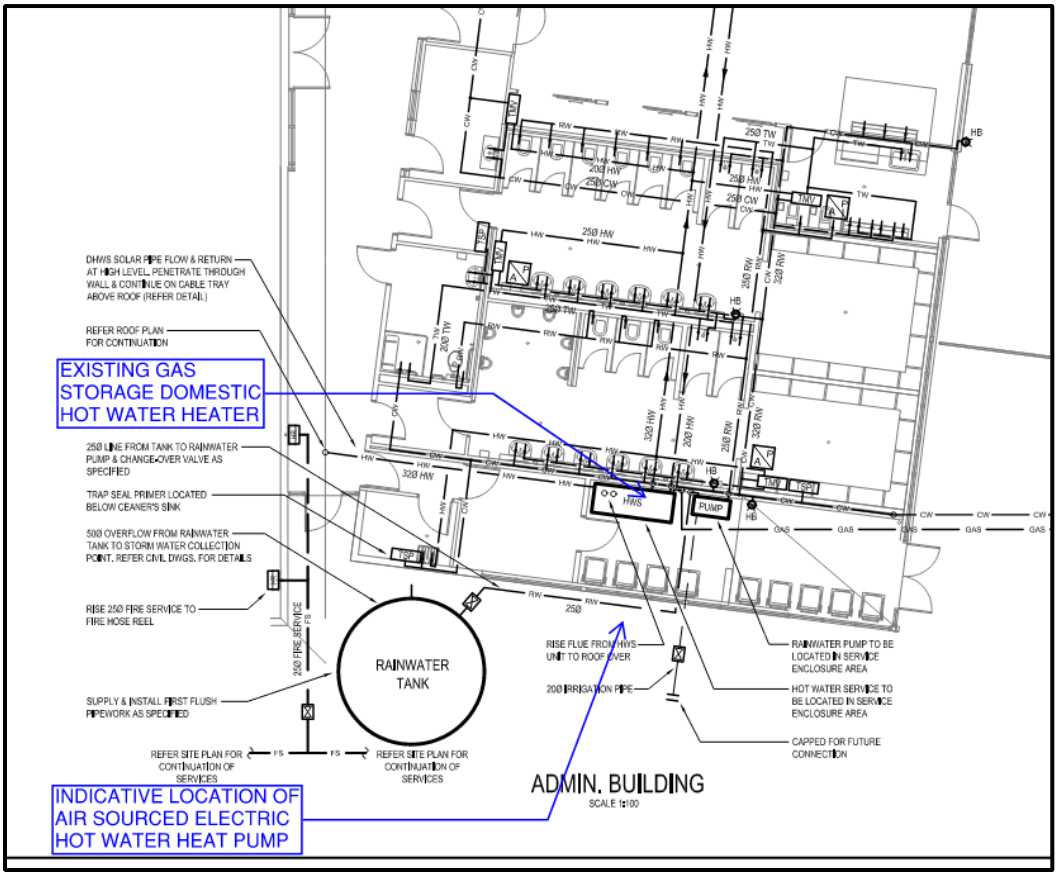
### 4.1.3 *Existing electrical serving electrification equipment*

| Equipment Type | Photo | Comments |
|---|---|---|
| DB-MSB serving Hot Water Unit (20A) |   | - Modifications or additions to existing electrical switchboards downstream of the existing SMSB to suit the electrification works requires detailed design to confirm associated scope and specific costs.<br>- DB-MSB from 160A, 3PH MSB to 300A, 3PH, unlikely to be upgradable.<br>- Area around DB-MSB appears congested. |
| Main Isolators 160A |   | - Upgrade to existing electrical switchboards downstream of the existing SMSB to suit the electrification works requires detailed design to confirm associated scope and specific costs. |

### 4.1.4 Recommended electrification approach

<table>
<tr><th>Equipment Type</th><th>Recommended electrification strategy</th></tr>
<tr><td>Gas storage Domestic Hot Water System</td><td>Electric Hot Water Heat Pumps. The hot water heat pump can likely be installed in the vicinity of the rainwater tank - see markup below.





</td></tr>
<tr><td>Gas Cooking</td><td>Replace existing stove with induction stove and replace existing griddle and deep fryer with electric equivalent.</td></tr>
</table>

| Equipment Type | Recommended electrification strategy |
|---|---|
| Site Main Switchboard (SMSB) | Electrification load increase of 107A, 3PH at SMSB from 138A, 3PH to 245A, 3PH is accommodated by the existing SMSB. No upgrade to incoming supply required or SMSB is required subject to Section 4.1.2of this report. The Supply Authority should be notified of the load increase at the earliest by the design consultants for the works.<br><br>Electrification load increase of 107A, 3PH in building will require at DB-MSB.<br><br>Either extend existing DB-MSB or provide new DB for the electrification works (both excluded from order of cost estimate).<br><br>Replacement of existing check metering, CT and breakers, etc. for DB-MSB at the existing SMSB, or provision of new check metering, CT and breakers, subject to future detailed investigation and determination if DB-MSB is sufficient for the electrification works.<br><br>New conduits and pits from existing SMSB to the building for either an upgrade to DB-MSB or new DB for the electrification works. |

### 4.1.5 Electrification Summary

Total site electrification implementation is recommended in 2027 based on the age of existing systems while limiting the number of sites electrified per year as part of the broader roadmap. The Capital cost is estimated to be in the order of $260,000 in 2025 or $280,000 in 2027 after adjusting for inflation. Electrification of this site is estimated to result in resulting in net emission savings of 6,025 kg Co2e/year.

## 4.2 Parkswide Nursery and Horticulture Centre

### *4.2.1 Existing gas equipment*

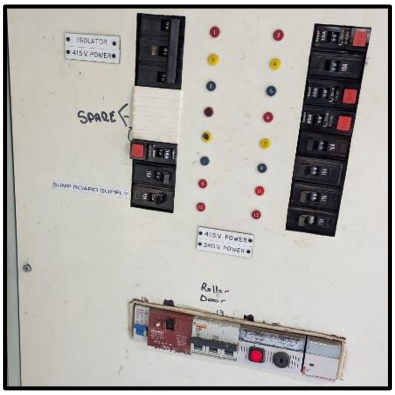
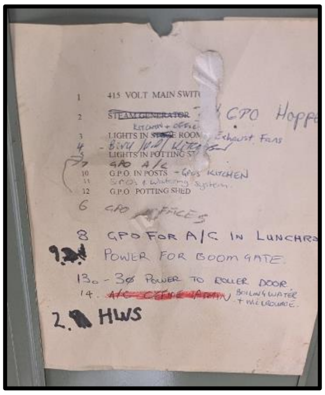
| Equipment Type | Photo | Condition | Indicative End of Life Replacement |
|---|---|---|---|
| Heating Hot Water Gas Boiler x 1 |     | **Boiler:** Significant surface corrosion, particularly on the top and corners of the boiler casing. The boiler capacity could not be confirmed as there is no visible nameplate. Based on the condition of the boiler it is estimated that the system is more than 15years old with an estimated capacity of 30kW-60kW and intended temperature range 40-60ºC. | 2026 |
| Gas Radiant Heaters x 3 |    | Gas radiant heaters are in reasonable condition reflective of their age but are approaching the end of their life.<br><br>Anticipate limited energy use compared to gas boiler heating greenhouse. | 2026 |

### 4.2.3 Existing electrical MSB

| Equipment Type | Comments |
| --- | --- |
| Main Switchboard (MSB) | - Could not confirm electrical supply based on site inspection, review of photos, or existing documents further investigation is required.<br>- Assume existing 64kW = 108A, 3PH load at the existing MSB and incoming supply.<br>- Load increase from 108A, 3PH to 178A, 3PH at existing MSB. |

### 4.2.4 Existing electrical serving electrification equipment

| Equipment Type | Photo | Comments |
| --- | --- | --- |
| DB1 Sub-board 2 |  | - Upgrade to existing electrical switchboards downstream of the existing SMSB to suit the electrification works requires detailed design to confirm associated scope and specific costs. |
| DB Sub-board 3 |  | |

| Equipment Type | Photo | Comments |
|---|---|---|
| DB Potting Shed |  | - Upgrade to existing electrical switchboards downstream of the existing SMSB to suit the electrification works requires detailed design to confirm associated scope and specific costs. |
| DB Potting Shed |  | |

### 4.2.5 Recommended electrification approach

| Equipment Type | Recommended electrification strategy |
|---|---|
| Heating Hot Water Gas Boiler x 1 and associated pipework system | Provide new high temperature hot water air source heat pump to replace existing boiler and associated pipework. No significant spatial constraints were identified. |
| Gas Radiant Heaters x 3 | Confirm need/utilization of heaters with site staff. Replace with electric infrared heaters as required. |
| Site Main Switchboard (SMSB) | Electrification load increase of 70A, 3PH at SMSB from 108A, 3PH to 178A, 3PH will require an incoming supply upgrade. Supply Authority application for increase of supply should be based on 178A, 3PH.<br>New SMSB rating (including 25% future spare capacity) for the electrification works should be based on 250A, 3PH.<br>Supply Authority Customer Contribution required for upgrade of incoming supply.<br>Expect direct street supply without substation on site for 178A, 3PH supply.<br>New external SMSB with new CT metering to reconnect to existing MSB and renamed as existing MSB as DB-MSB.<br>New conduits and pits to the new SMSB. Incoming mains by Supply Authority.<br>New submains cabling, conduits and pits from the new SMSB to the existing SMSB. |

### 4.2.6 Other site observations/recommendations

**Existing Heating Pipework**

The brush-like finned material on the pipe is detached or degraded in many sections. This is resulting in reducing heat transfer efficiency, uneven temperature distribution and increased energy consumption to maintain desired temperatures. There are also corroded/ aged pipe supports and frames.

This pipework should be replaced given its age and poor condition.

**Existing Building Fabric and Airtightness**

The overall building fabric provides limited thermal insulation and airtightness compared to current best practice energy efficient greenhouse construction. This would contribute to relatively high heating energy consumption and heating system capacity.

Ideally the existing fabric would be upgraded to improve thermal performance and air tightness to reduce heating energy consumption however this would have a significant cost and is outside of this electrification scope.

**Electrical Site Distribution Investigation**

Based on the site information provided and site inspection, the exact source of electrical supply to the site could not be confirmed. Further investigation is recommended to confirm if the identified distribution board is the only distribution board on site or if it is being supplied by a main switchboard upstream.

### 4.2.7 Electrification Summary

Total site electrification implementation is recommended in 2027 based on the age and condition of existing systems while limiting the number of sites electrified per year as part of the broader roadmap. Capital cost is estimated to be in the order of $517,000 in 2025 or $550,000 in 2027 after adjusting for inflation. Electrification of this site is estimated to result in net emission savings of 26,345 kg Co2e/year. Note that the capital cost for this site includes replacement of associated pipework due to their poor condition which should allow the use of lower operating water temperatures and improved efficiency.

## 4.3 Box Hill Town Hall and Hub (Including Migrant Info Centre + Citizens Advice Bureau)

### *4.3.1 Existing gas equipment*

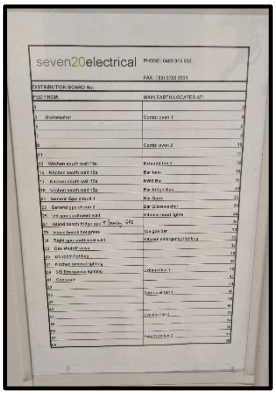
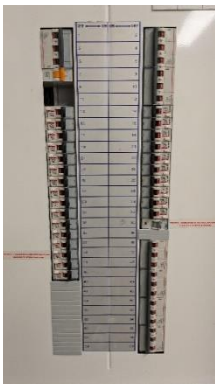
| Equipment Type | Photo | Condition | Indicative End of Life Replacement |
|---|---|---|---|
| Heating Hot Water Condensing Gas Boiler x 2 |  | The Meridian M150 TM condensing boilers, installed in circa March 2021, are designed to recover heat from exhaust gases, delivering an operational efficiency typically exceeding 90%. The boilers are within their expected service life and exhibit no signs of abnormal wear or performance issues. Regular maintenance appears to have been upheld, supporting continued reliable operation. | 2036-41 |
| Gas Cooking - Ground Level Kitchen adjacent to whitehorse room |   | Two 6 burner gas stoves and a single gas griddle/hotplate were identified in the site inspection and appear to date back to 2018 and appear to be in good condition. | 2036-41 |

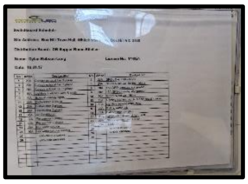
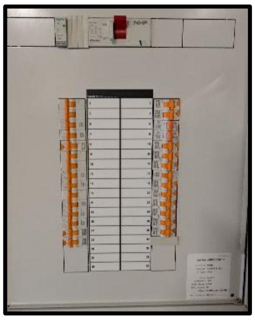
| Equipment Type | Photo | Condition | Indicative End of Life Replacement |
|---|---|---|---|
| Gas Cooking – Level 1 Supper Room Kitchen |  | Three 6 burner gas stoves were identified in the site inspection and appear to date back to 2018 and appear to be in good condition.<br><br>Based on discussions during the site inspection, this kitchen was described as not being used and so removal rather than replacement with electric equipment may be considered. | 2036-41 |

### 4.3.2 Existing electrical MSB

| Equipment Type | Comments |
|---|---|
| Main Switchboard (MSB) | - Could not confirm electrical supply based on site inspection, review of photos, or existing documents. Further investigation is required.<br>- Assume existing 212kW = 384A, 3PH load at the existing MSB and incoming supply.<br>- 2 retail authority meters for the site, one for offices and mechanical, and another for chambers and meeting rooms.<br>- Load increase from 361A, 3PH to 617A, 3PH at existing MSB. |

### 4.3.3 Existing electrical serving electrification equipment

| Equipment Type | Photo | Comments |
|---|---|---|
| Ground Level Kitchen DB |    | - Upgrade to existing electrical switchboards downstream of the existing SMSB to suit the electrification works requires detailed design to confirm associated scope and specific costs.<br>- Main Isolating Switch rated 250A, 3PH. |

| Equipment Type | Photo | Comments |
| --- | --- | --- |
| DB Supper Room Kitchen |   | - Upgrade to existing electrical switchboards downstream of the existing SMSB to suit the electrification works requires detailed design to confirm associated scope and specific costs.<br>- Main Isolating Switch rated 160A, 3PH. |

### 4.3.4 Recommended electrification approach

| Equipment Type | Recommended electrification strategy |
| --- | --- |
| Heating Hot Water Condensing Gas Boiler x 2 | Replace with an electric heating hot water heat pump system. Based on preliminary assessment, the new equipment is likely suitable for installation at roof level. |
| Gas Cooking - Ground Level Kitchen adjacent to whitehorse room | Replace existing stove with induction stove and replace existing griddle with electric equivalent. |
| Gas Cooking – Level 1 Supper Room Kitchen | Confirm utilization prior to electrification. If not utilized, recommend removal of cooking equipment. |
| Site Main Switchboard (SMSB) | Electrification load increase of 256A, 3PH at SMSB from 361A, 3PH to 617A, 3PH will require an incoming supply upgrade. Supply Authority application for increase of supply should be based on 617A, 3PH.<br>New SMSB rating (including 25% future spare capacity) for the electrification works should be based on 800A, 3PH.<br>Supply Authority Customer Contribution required for upgrade of incoming supply.<br>New on-site substation should be required by the Supply Authority.<br>New external SMSB with new CT metering to reconnect to existing MSB and renamed as existing MSB as DB-MSB.<br>New mains cabling, conduits and pits from the new Substation to the new SMSB.<br>New submains cabling, conduits and pits from the new SMSB to the existing MSB. |

### 4.3.5 Other site observations/recommendations

**Heating hot water pipe insulation**

The thermal insulation on heating hot water pipes at roof level has deteriorated. Recommend this be repaired/replaced prior to electrification to maintain system efficiency and prevent heat loss.

**Air Handling Unit – Main Hall**

The air handling unit lacks a bypass feature to allow air recirculation during warm-up mode and is not equipped with controls or dampers to regulate outside air intake based on $CO_2$ levels.

While not required for electrification, upgrading the air handling unit to incorporate these features would allow for reduced operating cost and emissions and thermal comfort in cold winter mornings prior to electrification.

These changes combined with thermal metering could also allow the potential capacity of the heat pump to be rationalised when electrification is implemented.

**Thermal Metering and Heating Water Temperature Reset**

As the existing equipment has extensive remaining life, installation of thermal metering is recommended to allow system loads to be confirmed prior to electrification. The implementation of a heating water temperature reset strategy would also improve the efficiency of the existing condensing gas boilers.

**Heating Hot Water Coils**

If replacement of any air-side system or heating hot water coil is undertaken, it is recommended that coils be specified for low-temperature operation—typically around 50°C rather than the conventional 80°C. This approach aligns with modern heat pump performance and supports improved energy efficiency across the system

### *4.3.6 Further actions/investigation recommended:*

**Lower heating water system temperatures**

- Lower heating hot water system temperatures (i.e. 50°C rather than 80°C) would significantly reduce operating energy consumption and cost of electrified heating systems.
- Testing of the heating hot water systems operation at lower system temperatures (either manually or automatically) is strongly recommended and may demonstrate that while originally designed for 80°C heating water temperatures, parts or all of the system may still have sufficient capacity to achieve air temperature requirements at lower heating water temperatures.
- Subject to the outcome of testing, replacement or modification of the systems to accommodate lower temperatures would be recommended. This could include modification or replacement of existing heat exchangers, fan coil units and air handling units to enable lower heating water temperatures. While replacement or modification of heat exchangers, fan coil units, and air handling units have associated capital cost, this may allow for lower cost heat pumps to be utilised which may provide net capital cost savings in addition to ongoing cost savings due to improved efficiency.

### *4.3.7 Electrification Summary*

Total site electrification implementation is recommended in 2036 based on the age and condition of existing systems. Capital cost is estimated to be in the order of $2,140,000 in 2036 after adjusting for inflation. Electrification of this site is estimated to result in net emission savings of 46,335 kg Co2e/year. Note that this cost does not address other recommendations identified above.

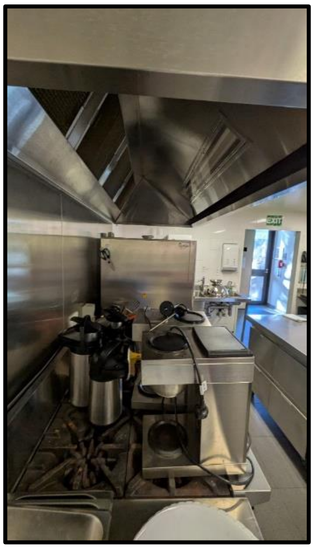
As there are many years until full electrification, a preliminary package of works is recommended which would both reduce operating costs in the short term and to inform the final electrification works. This preliminary package of works is recommended to include

- Rectification of pipework insulation issues
- Upgrade existing air handling units to allow for warmup cycle and demand-controlled ventilation
- Implement heating hot water thermal metering and temperature reset.

## 4.4 Civic Centre, Council Chambers and Nunawading Library

### *4.4.1 Existing gas equipment*

| Equipment Type | Photo | Condition | Indicative End of Life Replacement |
|---|---|---|---|
| Gas-Fired Heating Hot Water Boilers x 2 |     | Manufacturer: Auto-Heet (Automatic Heating Appliances, Melbourne)<br>Model: XR412<br>Year of Manufacture: 07/2002<br>Rated Gas Input: 2,670 MJ/h<br>Rated Heat Output: 525 kW<br>– The boiler is 22 years old and has significantly exceeded the typical service life of commercial hot water boilers (~15-20 years).<br>– The external casing is intact and in reasonable condition with no visible signs of corrosion or physical damage.<br>– The digital controller is functional, with operating temperatures observed around 78–80°C at the time of inspection.<br>– There are no visible leaks or rust stains, and pipework appears connected and labelled (e.g. natural gas line).<br>– Due to boiler age, the internal components such as the burner assembly, heat exchanger, and gas train are likely subject to wear, reducing efficiency and increasing risk of failure.<br>– Manufacturer support and parts availability are expected to be limited. | 2027 |

| | | | |
|---|---|---|---|
| Gas Cooking |  | 4 burner stove top and oven identified in site inspection. Appear to be in reasonable condition. Utilisation unclear. | |

### 4.4.2 Existing electrical MSB

| Equipment Type | Comments |
|---|---|
| Main Switchboard (MSB) | - Could not confirm electrical supply based on site inspection, review of photos, or existing documents. Further investigation is required.<br>- Assume existing 467kW = 795A, 3PH load at the existing MSB and incoming supply.<br>- Load increase from 795A, 3PH to 1,315A, 3PH at existing MSB. |

### 4.4.3 Recommended electrification approach

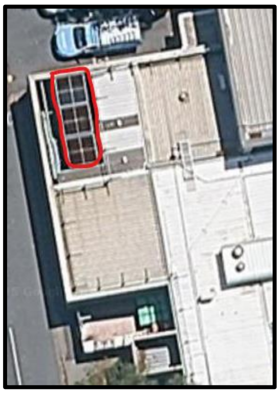
| Equipment Type | Recommended electrification strategy |
|---|---|
| Gas-Fired Heating Hot Water Boilers x 2 | Replace with an electric heating hot water heat pump system. Based on preliminary assessment, the new equipment is likely suitable for installation at roof level. |
| Site Main Switchboard (SMSB) | Electrification load increase of 519A, 3PH at SMSB from 795A, 3PH to 1,315A, 3PH will require an incoming supply upgrade. Supply Authority application for increase of supply should be based on 1,315A, 3PH.<br>New SMSB rating (including 25% future spare capacity) for the electrification works should be based on the incoming breaker set at 1700A, 3PH.<br>Supply Authority Customer Contribution required for upgrade of incoming supply.<br>New on-site substation should be required by the Supply Authority.<br>New external SMSB with new CT metering to reconnect to existing MSB and renamed as existing MSB as DB-MSB.<br>New mains cabling, conduits and pits from the new Substation to the new SMSB.<br>New submains cabling, conduits and pits from the new SMSB to the existing MSB. |

### 4.4.4 Other site observations/recommendations

**Cooling Plant - West**

Air cooled chiller installed in an enclosure without sufficient ventilation. The restricted airflow around the unit may compromise heat rejection performance, leading to reduced system efficiency, increased energy consumption, and potential equipment overheating.

It is recommended that the existing chiller system be either relocated to a position with adequate ventilation or that plantroom be upgraded to improve ventilation. If chiller replacement is undertaken concurrently with boiler replacement, the option to replace both air-cooled chiller and boilers with air-cooled multifunction heat pump should be explored during design which would provide capital cost and operational efficiency benefits.



**Heating Hot Water Coils**

If replacement of any air-side system or heating hot water coil is undertaken, it is recommended that coils be specified for low-temperature operation—typically around 50°C rather than the conventional 80°C. This approach aligns with modern heat pump performance and supports improved energy efficiency across the system.

### 4.4.5 Further actions/investigation recommended:

**Lower heating water system temperatures**

– Lower heating hot water system temperatures (i.e. 50°C rather than 80°C) would significantly reduce operating energy consumption and cost of electrified heating systems.

– Testing of the heating hot water systems operation at lower system temperatures (either manually or automatically) is strongly recommended and may demonstrate that while originally designed for 80°C heating water temperatures, parts or all of the system may still have sufficient capacity to achieve air temperature requirements at lower heating water temperatures.

– Subject to the outcome of testing, replacement or modification of the systems to accommodate lower temperatures would be recommended. This could include modification or replacement of existing heat exchangers, fan coil units and air handling units to enable lower heating water temperatures. While replacement or modification of heat exchangers, fan coil units, and air handling units have associated capital cost, this may allow for a lower cost heat pump to be utilised which may provide net capital cost savings in addition to ongoing cost savings due to improved efficiency

### 4.4.6 Electrification Summary

Total site electrification implementation is recommended in 2027 based on the age and condition of existing systems. Capital cost is estimated to be in the order of $4,810,000 in 2027 after adjusting for inflation. Electrification of this site is estimated to result in net emission savings of 137,890 kg Co2e/year.

## 4.5 Aqualink Box Hill

### 4.5.1 Peer review of previous feasibility study

An electrification feasibility study was undertaken by [redacted] and the report dated 13 December 2024 was provided to WSP for peer review and to inform development of the business case.

As part of the peer review it appeared that the feasibility study did not consider the impact of heating water system types on operational efficiency, electrical demand, and capital cost which are key issues for the feasibility of electrification. Opinion of probable capital cost for full electrification did not appear to consider costs associated with the required electrical infrastructure upgrades or structural works required to accommodate locating new plant on the roof as proposed in the [redacted] feasibility study.

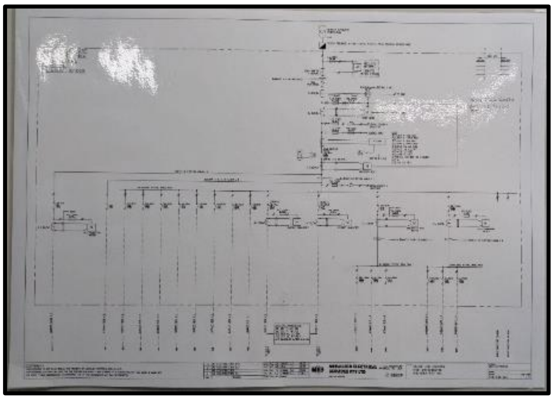
The report did identify significant electrical infrastructure and spatial constraints which are consistent with the findings outlined in this assessment. A copy of the peer review comments is detailed in Appendix B.

### 4.5.2 Existing gas equipment

| Equipment Type | Photo | Condition | Indicative End of Life Replacement |
|---|---|---|---|
| Gas Boilers x 2 |    | Based on a visual observation the existing boilers installed in 2013 appear to be in fair working condition.<br>The boilers are installed in an outdoor plant. The installation of boilers in an outdoor environment reduces their economic life span.<br>The boiler flue is not extended above the wall enclosure. | 15years / 2028<br>2028-2032 |

| | | | |
|---|---|---|---|
| Domestic Hot Water Units |  | Dual Rinnai HD 250e Instantaneous Gas (DHW) installed circa 2013. | 2028-2033 |

### 4.5.3 Existing electrical MSB

| Equipment Type | Photo | Comments |
|---|---|---|
| Main Switchboard (MSB) |   | - Existing 500kVA on-site substation<br>- Assume existing 327kW = 558A, 3PH load at the existing MSB and incoming supply.<br>- Load increase from 558A, 3PH to 1,584A, 3PH at existing MSB. |

### 4.5.5 Recommended electrification approach

| Equipment Type | Recommended Electrification strategy |
|---|---|
| 2x Gas Boilers | Replacement of gas boilers with heat pump system.<br><br>Heat pump systems generally require a larger footprint compared to equivalent gas-fired equipment and must be installed in outdoor locations to ensure optimal performance.<br><br>The available area within the existing external plant zone is not sufficient to accommodate the required footprint of heat pump equipment.<br><br>The facility's adjacent rooftop presents a potential alternative location for installation. However, the steel roof is unlikely to have load-bearing capacity for installation of heat pumps. As an alternative an external plant compound could be created adjacent the plantroom however this would impact existing carpark as illustrated below.<br><br>A detailed study of both options is recommended prior to installation.<br> |
| Domestic Hot Water | Installation of new hot water system including:<br>— air to water heat pump<br>— large volume storage tanks with electric elements.<br><br>The hot water storage tanks can be located in the plant room where the existing tanks are currently located. The heat pumps would be located outside with the mechanical air source heat pumps. |
| Main Switchboard (MSB) | Electrification load increase of 1,026A, 3PH at SMSB from 558A, 3PH to 1,584A, 3PH will require an incoming supply upgrade. Supply Authority application for increase of supply should be based on 1,584A, 3PH.<br><br>New SMSB rating (including 25% future spare capacity) for the electrification works should be based on 2,00A, 3PH.<br><br>Supply Authority Customer Contribution required for upgrade of incoming supply.<br><br>Existing on-site substation upgrade may be required by the Supply Authority.<br><br>New external SMSB with new CT metering to reconnect to existing MSB and renamed as existing MSB as DB-MSB. New mains cabling, conduits and pits from the new Substation to the new SMSB.<br><br>New submains cabling, conduits and pits from the new SMSB to the existing MSB. |

### 4.5.6 Further actions/investigation recommended:

**External Plant Location Feasibility**

Due to the spatial constraints identified, confirming the preferred location for external plant is required. Both the existing roof and the existing carpark could be utilised but both options have capital cost, aesthetic, and operational impacts that would need to be considered. To confirm the preferred location the following is recommended:

- Confirm with relevant stakeholders if both options are acceptable given other operational requirements.
- As part of a preliminary design, engage structural and civil engineers to assess technical feasibility and anticipated extent of works required and undertake costing by a quantity surveyor.
- Finalise the preferred option based on associated costing and other criteria relevant to the facility's operation.

**Lower heating water system temperatures**

- Lower heating hot water system temperatures (i.e. 50°C rather than 80°C) would significantly reduce operating energy consumption and cost of electrified heating systems.
- Testing of the heating hot water systems operation at lower system temperatures (either manually or automatically) is strongly recommended and may demonstrate that while originally designed for 80°C heating water temperatures, parts or all of the system may still have sufficient capacity to achieve air and pool water temperature requirements at lower heating water temperatures.
- Subject to the outcome of testing, replacement or modification of the systems to accommodate lower temperatures would be recommended. This could include modification or replacement of existing heat exchangers, fan coil units and air handling units to enable lower heating water temperatures. While replacement or modification of heat exchangers, fan coil units, and air handling units have associated capital cost, this may allow for a lower cost heat pump to be utilised which may provide net capital cost savings in addition to ongoing cost savings due to improved efficiency.
- The domestic hot water system DHWSP.3, located near the gym, is currently heated via a heat exchanger connected to the mechanical heating hot water system. A study should be undertaken to assess the feasibility of replacing DHWSP.3 with a dedicated heat pump system. Transitioning to a heat pump-based solution may enhance energy efficiency, reduce dependency on central mechanical heating infrastructure, and support site-wide decarbonisation initiatives.

### 4.5.7 Electrification Summary

Total site electrification implementation is recommended in 2031 based on the age of existing systems while limiting the number of sites electrified per year as part of the broader roadmap. Capital cost is estimated to be in the order of $5,770,000 in 2025 or $7,900,000 in 2031 after adjusting for inflation. Electrification of this site is estimated to result in net emission savings of 1,173,455 kg Co2e/year.

# 5 Roadmap Overview

## 5.1 Overall Trajectory

The overall roadmap includes majority of sites being electrified by 2031 which will result in:

- Over 90% reduction in natural gas consumption across council assets
- Net emission saving of approximately 1,440 TCo2e/year compared to 2024/25 baseline.
- Net operating cost savings of approximately $190,000 / year in 2025 dollars, or approximately $230,000 when adjusted for assumed inflation.
- Cumulative capital cost investment in the order of $21 million in 2025 dollars, or $24 million when adjusted for assumed inflation.

By the end of 2040, the proposed roadmap will result in:

- All remaining natural gas use in Council assets being removed.
- Net emission saving of approximately 1,515 TCo2e/year compared to 2024/25 baseline.
- Net operating cost savings of approximately $190,000 / year in 2025 dollars, or approximately $290,000 when adjusted for assumed inflation.
- Cumulative capital cost investment in the order of $28 million in 2025 dollars, or $34 million when adjusted for assumed inflation.

The overall trajectory of net GHG emissions, capital cost, and operating costs is illustrated in the graph below with costs adjusted for assumed inflation.

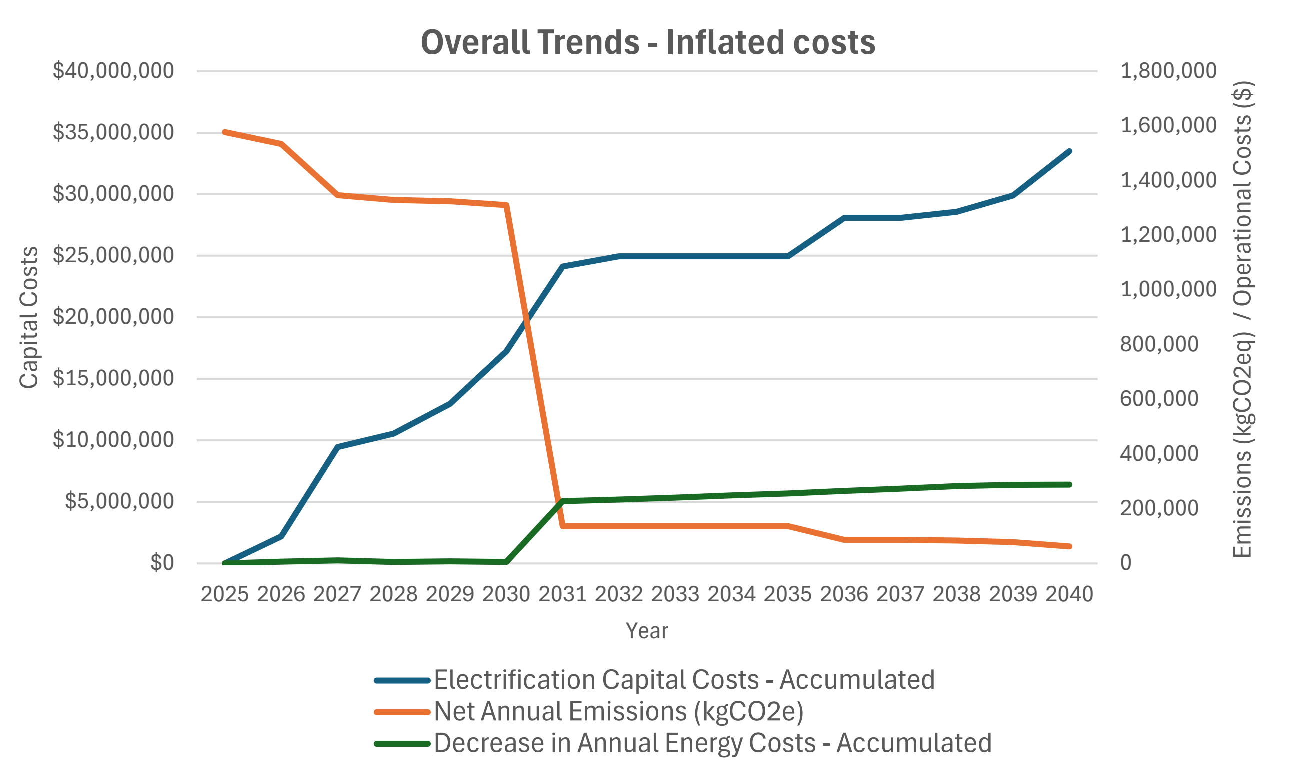



Figure 5.1: Proposed cost and emission trajectory

## 5.2 Capital Cost Breakdown

The different elements of capital costs associated with the proposed roadmap are summarised in the table and graph below and suggests that electrification of heating equipment is the largest element of estimated capital costs followed by electrical infrastructure and domestic hot water equipment costs. Both electrical infrastructure costs and domestic hot water costs will be sensitive to detailed site specific investigation and design so could potentially be reduced.

Electrification of cooking equipment represents the lowest cost of equipment to electrify but contributes to the overall electrical infrastructure costs.

Table 5.1: Breakdown of Capital Costs by Element

| Cost Element | Capital Cost (2025 dollars) | % of Capital Costs |
|---|---|---|
| Heating Equipment | $7,990,000 | 28.6% |
| Domestic Hot Water Equipment | $5,572,000 | 19.9% |
| Cooking Equipment | $296,000 | 1.1% |
| Electrical Infrastructure | $7,575,000 | 27.1% |
| Solar PV | $16,000 | 0.1% |
| Contingency and other Costs | $6,525,000 | 23.3% |
| **Total capital cost** | $27,974,000 | 100% |

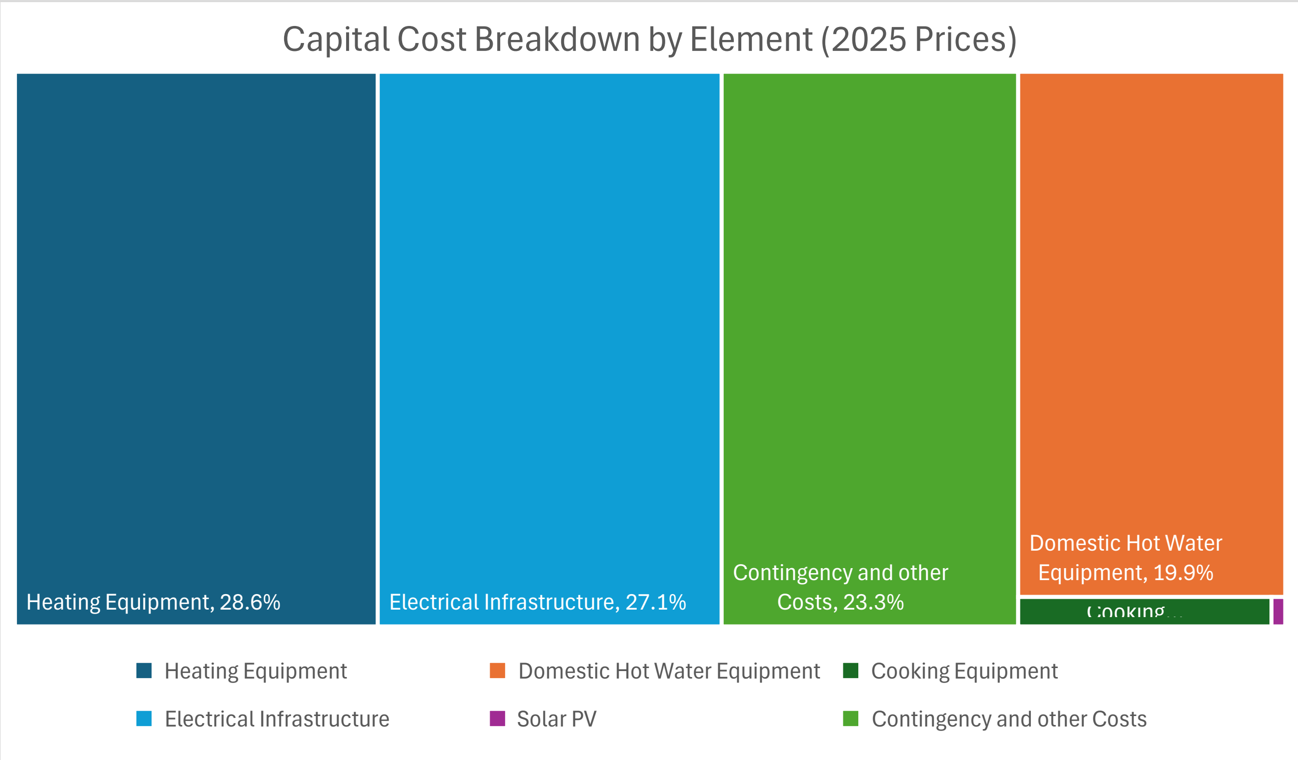



Figure 5.2: Breakdown of Capital Costs by Element (2025 prices)

## 5.3 Breakdown by asset class

Based on the different asset classes in the council's portfolio a breakdown of capital cost and net emission savings associated with the proposed roadmap are summarised in the table and graph below. The major leisure facilities assets consists of Aqualink Box Hill and Sportlink Vermont south and is the asset class that will provide the greatest emission saving through electrification.

Sports pavilions represent the highest share of capital costs which is due to it being the class with greatest number of sites (14) and typically contain high capacity domestic hot water equipment typically used for shower facilities at these sites. Domestic hot water equipment costs have the greatest opportunity to be reduced following site specific load profile analysis and design and so actual capital costs for sports pavilions may go down following detailed investigation.

Table 5.2 Breakdown by asset class

| Asset Class | Number of sites | Net Emission Savings (kgCo2e) | Capital Cost (2025 dollars) |
|---|---|---|---|
| Minor Hall | 3 | 5,787 | $306,000 |
| Maternal Child Health Youth | 7 | 13,454 | $726,000 |
| Sports Pavilion | 14 | 35,980 | $9,449,000 |
| Major Hall | 5 | 70,343 | $3,652,000 |
| Clubroom | 2 | 2,836 | $492,000 |
| Major Leisure Facilities | 2 | 1,179,660 | $6,043,000 |
| Administration Facilities | 1 | 137,890 | $4,540,000 |
| Operational Facilities | 2 | 26,549 | $1,182,000 |
| Parks Reserves | 1 | 8,565 | $1,008,000 |
| Library | 1 | 33,927 | $576,000 |
| **Total** | **38** | **1,514,990** | **$27,974,000** |

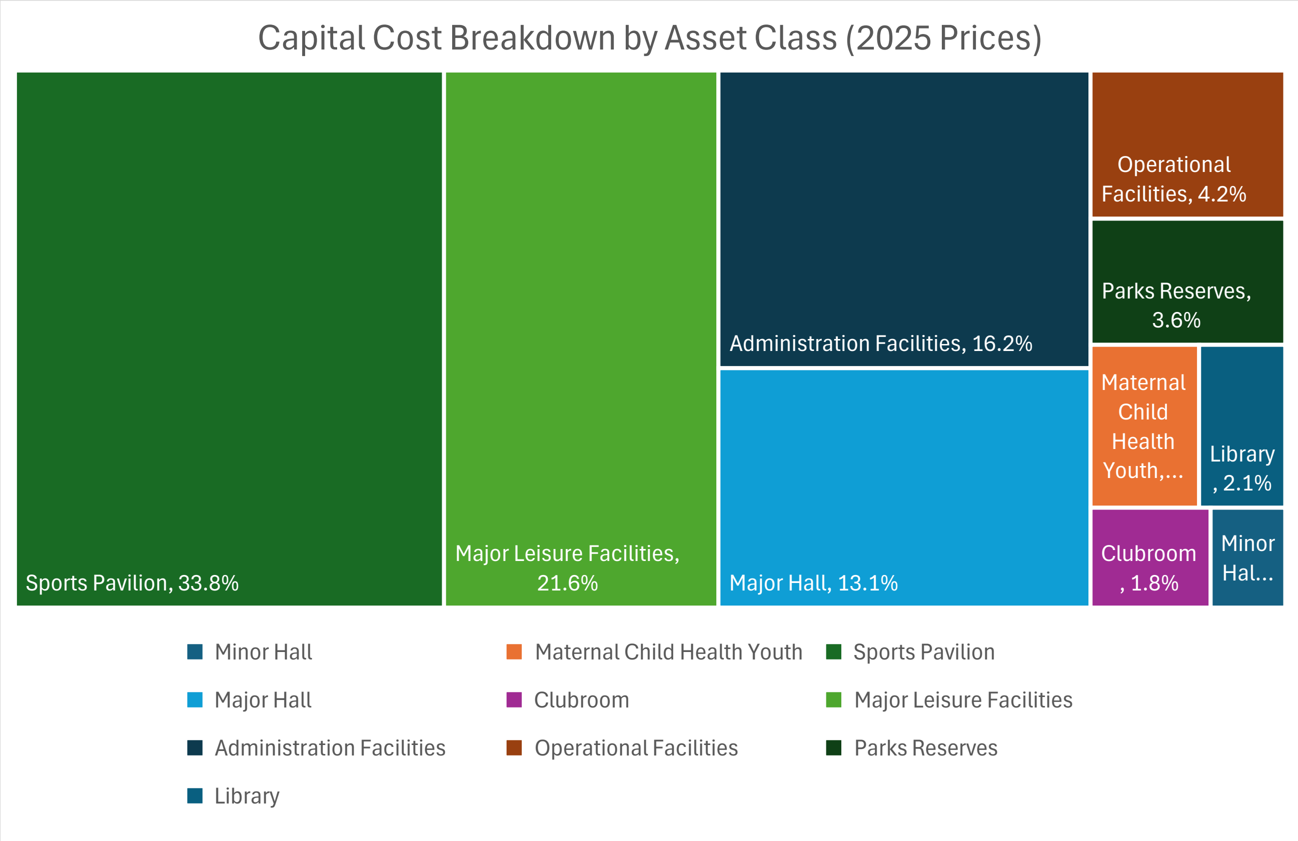



Figure 5.3: Breakdown of capital cost by asset class

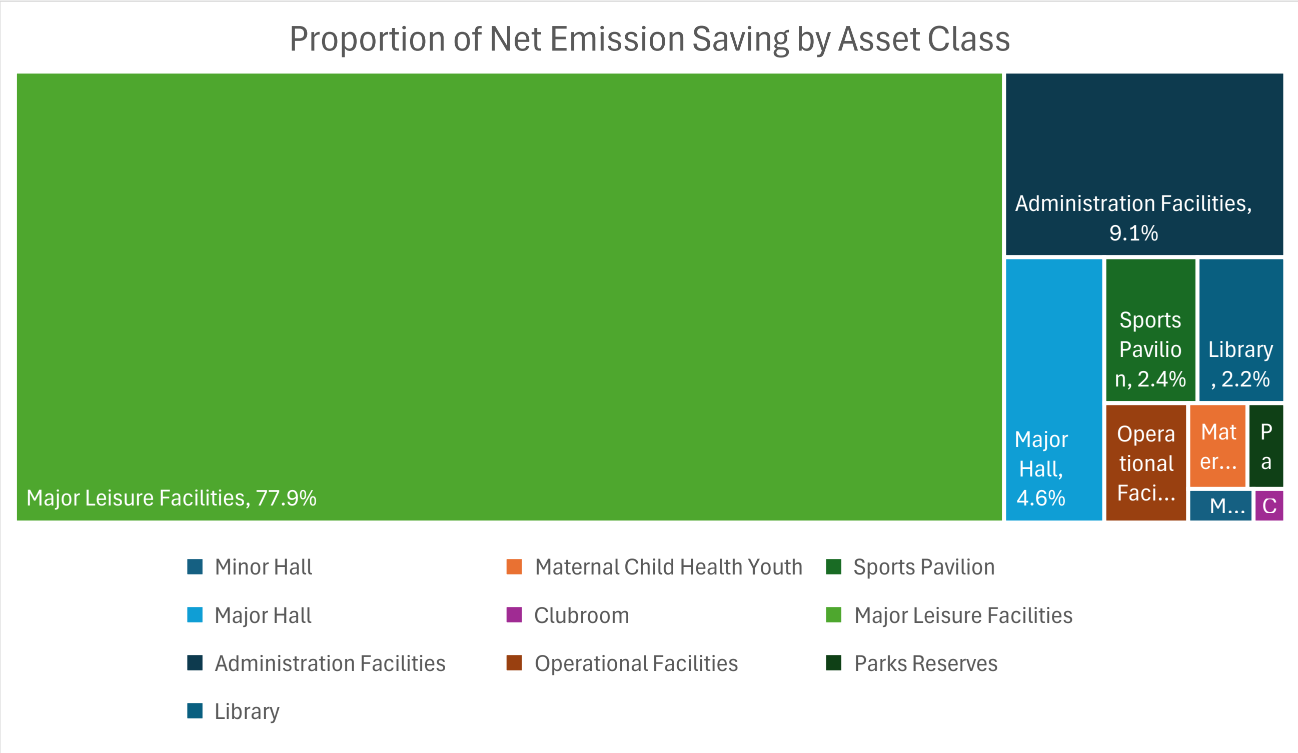



Figure 5.4: Breakdown of natural gas GHG emission savings by asset class

## 5.4 Site by Site Overview

The table below table provides an overview of each sites proposed transition from gas to electric equipment. Additional detail for each site is provided in the supporting roadmap spreadsheet.

Table 5.3: Individual Site Electrification Overview

| Site | Existing Gas Consumption (MJ) | Increase in electricity Consumption (kWh) | Electrification Capital Cost (2025 dollars) | Net Operating Cost Impact (2025 dollars) | Net GHG Annual Emission Savings (Kg Co2e) | Proposed Electrification Year |
|---|---|---|---|---|---|---|
| Blackburn North Neighbourhood House (formerly Koonung Cottage) | 52,888 | 3,781.9 | $60,000 | $1,703 | 2,807 | 2026 |
| Box Hill Library | 662,357 | 53,693.9 | $576,000 | $5,942 | 33,927 | 2026 |
| Burgess Family Centre | 49,325 | 4,617.2 | $63,000 | $75 | 2,556 | 2026 |
| East Burwood South Pavilion and Sports Club Social Rooms | 52,125 | 7,525.0 | $838,000 | -$507 | 2,570 | 2026 |
| Kalang Park Pavilion | 46,364 | 7,506.5 | $550,000 | -$581 | 2,250 | 2026 |
| Parkswide Nursery & Horticultural Centre | 494,188 | 39,579.8 | $517,000 | $800 | 26,345 | 2027 |
| Florence Road Pre-School | 2,449 | 231.3 | $181,000 | $58 | 134 | 2027 |
| Livingstone Pavilion - Multi Purpose Space | 3,431 | 425.9 | $642,000 | $7 | 23 | 2027 |
| Sportlink Vermont South | 111,839 | 23,237.6 | $273,000 | -$2,799 | 6,205 | 2027 |
| Civic Centre, Council Chambers and Nunawading Library | 2,898,972 | 306,453.7 | $4,540,000 | $9,416 | 137,890 | 2027 |
| Nunawading Community Hub | 291,739 | 66,127.5 | $678,000 | -$3,252 | 16,195 | 2027 |
| Scout Hall - 2nd Blackburn | 13,221 | 2,747.0 | $116,000 | -$272 | 734 | 2028 |
| Eley Park Community Centre (Inc Avenue Neighbourhood House) | 35,761 | 3,377.5 | $236,000 | $73 | 1,983 | 2028 |
| Blackburn South Hall | 622 | 250.1 | $37,000 | $5 | 35 | 2028 |
| Box Hill Community Arts Centre | 192,547 | 44,098.6 | $253,000 | -$5,966 | 10,692 | 2028 |
| Bennettswood Neighbourhood House | 59,294 | 4,240.0 | $209,000 | $328 | 2,945 | 2028 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Lucknow Street Children's Services Centre | 28,193 | 5,857.9 | $146,000 | -$651 | 1,565 | 2028 |
| Koonung Park Pavilion | 34,450 | 3,253.6 | $420,000 | $71 | 1,911 | 2029 |
| Surrey Park South West Pavilion - Football / Cricket | 13,950 | 1,317.5 | $319,000 | $86 | 770 | 2029 |
| Whitehorse Reserve Pavilion | 10,344 | 1,758.6 | $1,157,000 | -$107 | 560 | 2029 |
| Aqualink Box Hill Pavilion | 12,801 | -8,982.9 | $229,000 | $2,386 | 708 | 2029 |
| Walker Park Pavilion & Grandstand | 37,529 | 7,797.7 | $1,318,000 | -$884 | 2,069 | 2030 |
| Billabong Reserve Pavilion | 58,004 | 5,478.2 | $1,017,000 | $96 | 3,206 | 2030 |
| Springfield Park Pavilion | 50,410 | 7,277.4 | $1,113,000 | -$493 | 2,586 | 2030 |
| Bennettswood Pavillion | 124,989 | 17,706.8 | $228,000 | -$1,280 | 6,586 | 2030 |
| Aqualink Box Hill | 21,629,727 | 1,719,363.0 | $5,770,000 | $185,886 | 1,173,455 | 2031 |
| Operations Centre | 3,754 | 354.6 | $665,000 | $84 | 203 | 2032 |
| Blackburn Children's Services Centre | 37,287 | 3,521.6 | $160,000 | $178 | 2,068 | 2036 |
| Mitcham Family Centre | 37,048 | 3,499.0 | $84,000 | $57 | 2,057 | 2036 |
| Elgar Park North Pavilion | 90,148 | 15,325.2 | $452,000 | -$1,477 | 5,001 | 2036 |
| Box Hill Town Hall and Hub (Inc Migrant Info Centre + Citizens Advice Bureau) | 834,424 | 98,508.4 | $1,619,000 | $2,598 | 41,226 | 2036 |
| Forest Hill Family Centre | 8,525 | -4,065.1 | $37,000 | $1,172 | 473 | 2038 |
| Elgar Park South Pavilion | 32,998 | 5,609.7 | $302,000 | -$400 | 1,827 | 2038 |
| Morton Park Pavilion | 106,615 | 20,818.0 | $864,000 | -$2,432 | 5,913 | 2039 |
| Box Hill South Family Centre | 82,871 | 7,826.7 | $55,000 | $100 | 4,601 | 2040 |
| Terrara Park Pavilion | 154,471 | 32,095.6 | $1,008,000 | -$3,970 | 8,565 | 2040 |
| The Round (Nunawading Arts Centre) | 4,460 | 1,542.8 | $866,000 | $488 | 248 | 2040 |
| Morack Public Golf Course - Clubhouse | 37,859 | 17,877.8 | $376,000 | -$1,649 | 2,102 | 2040 |

## 5.6 Summary of recommendations

In addition to the overall roadmap a range of recommendations have been made in relation to the gas to electric transition as summarised in the table below. Refer to the related section of this report for further details.

Table ES.1: Summary of Recommendations

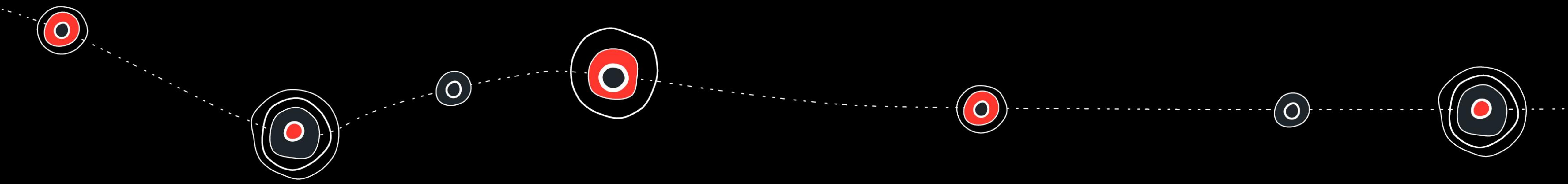
| Section | Recommendations |
|---|---|
| Section 1.2<br><br>Information Provided | — Develop and update an asset register for all engineering services and gas cooking equipment confirming details of equipment, associated condition and anticipated end of life;<br>— Engage maintenance contractors to maintain the register assessing the remaining life of equipment each year;<br>— Require electronic as-built drawings, O&M manuals and equipment schedules for new construction and refurbishments and maintain records in a central location. |
| Section 3.13.2<br><br>Electric Equipment Efficiency | — For split reverse cycle units, select equipment with the highest cold zone energy star rating and as a minimum require a cold zone energy star rating of 2.<br>— For air to water heat pumps use for space heating, investigate strategies for operating the system with the lowest water temperature possible to maximise energy efficiency. Consider upgrading other elements of the heating system to enable low heating water temperatures.<br>— For domestic hot water units, consider additional hot water storage which may both reduce capital cost and ongoing peak electrical demand costs.<br>— For cooking equipment utilise induction units where available. |
| Section 3.2<br><br>Refrigerant emissions | — Select new heat pumps with refrigerants that utilise the lowest global warming potential (GWP) possible and with a maximum GWP of 700;<br>— Where possible utilise packaged air conditioning units or packaged air to water heat pumps located in well-ventilated locations to minimise refrigerant charge and the risk of refrigerant leaks. |
| Section 3.3<br><br>Implementation Approach | — Undertake electrification of all gas equipment at each site as a single package of works to minimise disruption and allow for construction efficiencies.<br>— Use each project as learning opportunity to further refine and improve the approach for subsequent sites.<br>— For smaller sites, consider undertaking procurement of design consultants and contractors in packages with a group of assets to be electrified concurrently to benefit from economies of scale.<br>— For larger sites utilising gas boilers, undertake preliminary performance testing to determine capacity and temperature requirements to inform electrification design.<br>— Engage design consultants and quantity surveyors to develop and optimise design, confirm budgets and to provide tender documentation to allow for contractor implementation. |
| Section 3.4<br><br>Implementation Timing | — Proactively plan for replacement of gas equipment nearing end of life. Undertake electrification at each site at the anticipated end of life of the oldest gas equipment while also avoiding electrification of an excessive number of sites in a single year.<br>— If tenant gas cooking equipment cannot be upgraded concurrently with other gas equipment, allow for additional electrical demand in any electrical infrastructure upgrades and agree strategy with tenant for eventual electrification.<br>— Where possible integrate electrification works into broader refurbishment plans so that they can be undertaken concurrently for improved efficiency.<br>— Require all new construction to be fully electric and embed requirement into design standards.<br>— Communicate approach to ensure all relevant council staff so electrification requirements are considered in maintenance, refurbishment and new construction projects. |

# Appendix A

## Options and Strategy Workshop Slides

# GAS TO ELECTRIC BUSINESS CASE

**WHITEHORSE CITY COUNCIL**
Selwyn Saman | June 2025



We acknowledge Aboriginal and Torres Strait Islander Peoples and their ongoing connection to lands, sea and sky and pay our respects to Elders past and present. All projects are built on a place that has a First Peoples history, story, unique design and language.

As people who have influence over the built environment, we recognise our responsibility to ensure First Peoples culture and connections to Country are strong and continue into the future.

**Artwork by**
Michael Hromek, Budawang
Technical Executive – Indigenous (Architecture), Design and Knowledge

# Agenda

- **Project Context**
  - Background on refrigerant emissions
- **Electrification Options and Strategy**
  - Space Heating
  - Domestic Hot Water
  - Cooking
- **Implementation approach**
- **Aqualink Boxhill Electrification Feasibility - Review Summary**
- **Site inspection plan**

# PROJECT CONTEXT

# Project Context



| | | |
|---|---|---|
| Renewable electricity | Explore options for assets owned or operated by Council are powered by 100% renewable electricity.<br>Refer to Council Meeting 23 October 2023. | ✓ |
| Transition plan from gas to all-electric | Develop a business case to transition Council buildings and assets off gas to electric. | This project |

**Transition plan;**

- **Overall strategy and pathway**
- **General recommendations based on desktop review**
- **Require detailed review and design for each site to confirm final strategy, options, and costs.**

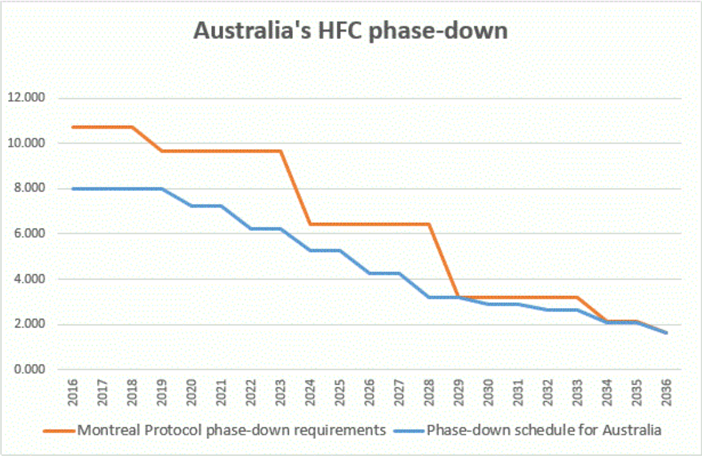
# Refrigerant GHG emissions

**Refrigerant used for heat pumps which are typically used for replacing gas heating and hot water systems.**

**Australian Institute of Refrigeration, Air Conditioning and Heating (AIRAH) research:**

- **5.8%** of all refrigerant stock leaked into atmosphere
- 2.2 million tons of Co2e equivalent emissions (stationary air-conditioning)
- Equivalent to **7% of emissions** from energy consumption of air conditioning and refrigeration systems

**Australia has committed to phasing down use of refrigerants with high global warming potential (GWO) by 2036.**



# Refrigerant GHG emissions

- **Traditional refrigerants have a GWP of ~2000 kg Co2e / kg refrigerant (ie R410a)**
- **Moderate GWP refrigerants are now being provided by most suppliers with GWP ~600 (R32, very mildly flammable)**
- **Low GWP refrigerants are available by have technical challenges;**
  - Propane (R290)– GWP=3, very flammable. Currently used in small amounts for domestic freezers/refrigerators
  - Ammonia (R717) GWP=0 but highly toxic.
  - HFO refrigerants GWP<10 but flammable.
  - Co2 (R744) GWP=1, very high operating pressure

Availability of equipment using low GWP refrigerants is limited and typically much higher cost.

**Even with the highest GWP refrigerant – using heat pumps to replace natural gas results in significant net emission savings.**

| Refrigerant | GWP (AR5/4) | Grams equivalent to 1 Tonne (1000 kg) $CO_2$ |
|---|---|---|
| R134a | 1300 | 769g |
| R404A | 3922 | 255g |
| R407A | 2107 | 475g |
| R407C | 1600 | 625g |
| R407F | 1825 | 548g |
| R410A | 2088 | 479g |
| R417A | 2346 | 426g |
| R422A | 3143 | 318g |
| R422D | 2729 | 367g |
| R434A | 3245 | 308g |
| R448A | 1387 | 712g |
| R449A | 1397 | 716g |
| R452A | 2140 | 467g |
| R507A | 3985 | 251g |
| R32 | 677 | 1477g |
| R1234ze | ≤ 1 | ≥ 1,000,000g |
| R290 | 3 | 333,333g |
| R744 ($CO_2$) | 1 | 1,000,000g |
| R717 ($NH_3$) | 0 | — |

# ELECTRIFICATION OPTIONS AND STRATEGY

# Space Heating

## Existing Gas Heating Systems:

| Ducted Heater | Wall furnaces | Radiant Heaters | Boilers |
|---|---|---|---|
|   |   |  |  |

# Ducted Heaters – Current Use


**Used on following assets:**

1. Bennettswood Neighbourhood House
2. Burgess Family Centre
3. Blackburn North Neighbourhood House (formerly Koonung Cottage)

# Ducted Heaters – Options

Split Ducted Reverse Cycle
- Good efficiency and operating cost.
- Adds cooling function; increased energy costs but improved resilience.
- Cooling can be locked out if not desired.
- Refrigerant GHG need to be considered.

Electric duct heaters (resistance)
- Low equipment cost but high cost for electrical supplies.
- Highest energy consumption and operating cost.

Packaged Reverse Cycle
- Similar to split system but more challenging spatially.
- Refrigerant easier to manage.
- Higher cost for most situations.

Could be considered subject to detail design.

# Wall Furnace – Current use


**Used on following assets:**

1. East Burwood North + South Pavilion – proposed for demo and rebuild.
2. Livingstone Pavilion - Multi Purpose Space
3. Springfield Park Pavilion
4. Bennettswood Pavillion
5. Kalang Park Pavilion

# Wall Furnace – options

<u>Wall Split Reverse Cycle</u>

- Good efficiency and operating cost.
- Adds cooling function; potential increased energy costs but improved comfort and resilience.
- Cooling can be locked out if not desired.
- Refrigerant GHG emissions need to be managed.

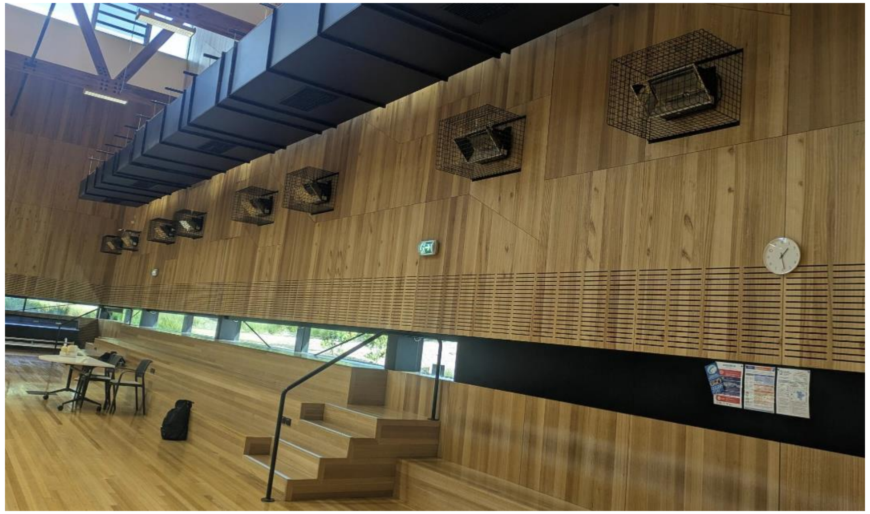
<u>Electric duct heaters or infared heaters</u>

- Much less efficient – considerably higher energy consumption and cost.
- Low equipment cost but high cost for electrical supplies.

<u>Ducted Reverse Cycle</u>

- Higher capital cost than wall split.
- May be insufficient ceiling/roof space
- Slightly less efficient than wall split.

# Radiant Heaters – Current Use



**Used on following assets:**

Parkswide Nursery & Horticultural Centre – inspection proposed

Nunawading Community Hub

**Typically used when air-based heating is inefficient;**

- Tall spaces where heated air rises (such as Nunawading Community Hub)
- External spaces or very high ventilation rates – ie workshops etc
- Large area but only need heating in specific locations

# Radiant Heaters – Electric Options

Electric Infrared Heaters

- Most efficient where gas radiant is best used (tall or outdoor spaces)
- Similar performance to gas heaters.

Reverse Cycle – Ducted or Wall Split

- More efficient if space is suitable for air heating.
- Otherwise not recommended as heating will be wasted.

# Boilers – Current Use

**Used on following assets:**

1. Box Hill Town Hall and Hub – Inspection proposed
2. Civic Centre, Council Chambers and Nunawading Library
3. Aqualink Box Hill – Inspection proposed
4. Box Hill Library
5. Vermont Reserve Pavilion

**Key considerations;**

- Heats water which is then used by ducted units, fan coil units, or other heating systems.
- Temperature of system has big impact on electrification strategy
- Often oversized due to the relatively low cost of boilers.

# Boilers – Electric Options

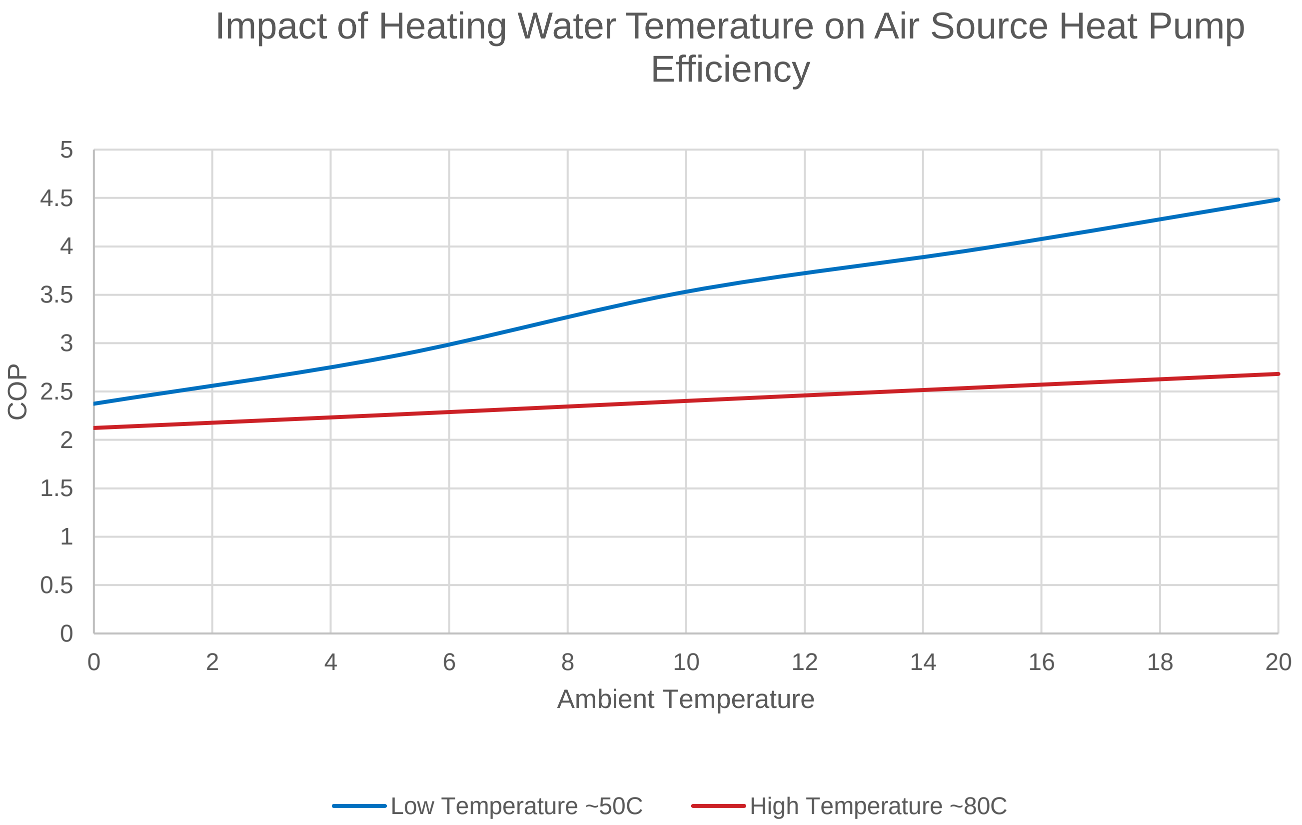

Low temperature heat pump
- Most efficient option
- Often requires upgrade of heating coils etc.
- Bigger + noisier compared to boilers.

High temperature heat pumps
- Less efficient
- Heat pump has higher capital cost.
- Can be higher overall cost even if coils requires upgrade.
- Bigger + noisier compared to boilers.

Electric resistance heater
- Much less efficient – extremely high energy consumption and cost.
- Low equipment cost but high cost for electrical supplies.
- Similar size and noise to gas boilers

# Boilers – Electric Options

High temperature heat pump uses between 25% - 70% more energy for the same heating load. Impact varies based on ambient air temperature.



# Domestic Hot Water (DHW)

## Existing Gas DHW systems:

| Storage | Instantaneous / Continuous Flow |
|---|---|
| Koonung Park Pavilion | Operations Centre |
| Terrara Park Pavilion | Whitehorse Reserve Pavilion |
| East Burwood South Pavilion and Sports Club Social Rooms | Kalang Park Pavilion |
| Elgar Park South Pavilion | Springfield Park Pavilion |
| Box Hill South Family Centre | Livingstone Pavilion - Multi Purpose Space |
| Forest Hill Family Centre | Elgar Park South Pavilion |
| Mitcham Family Centre | Elgar Park North Pavilion |
| Lucknow Street Children's Services Centre | Blackburn Childrens Services Centre |
| Florence Road Pre-School | Aqualink Box Hill Pavilion |
| Surrey Park South West Pavilion - Football / Cricket | Morton Park Pavilion |
| | Eley Park Community Centre (Inc Avenue Neighbourhood House) |
| | Nunawading Community Hub |

## Some sites combine above with solar thermal – does not directly impact electrification strategy

# Domestic Hot – Electric Options




<u>Heat pump</u>
- Most energy efficient option
- More space required
- Louder than existing gas

<u>Electric Storage</u>
- Lowest upfront cost
- Significantly higher energy consumption except if hot water use is very low.
- Consider if space is unavailable or water use is very low.

<u>Point of use / Instantaneous Electric</u>
- Can be efficient when water use is low.
- Electrical supply issues
- Reconfiguration of pipework
- Challenging in existing buildings

# Domestic Hot – Options

Solar Thermal + Electric Storage

- Generally higher cost and similar energy consumption to heat pump.
- Solar hot water has not fallen in price like solar PV
- Available roof space is generally better used for solar PV

# Gas Cooking Equipment

Gas stove tops – 4-8 burners

Deep friers

Ovens

Salamander

Griddle

# Stove Top, Friers, Griddles - Options

<u>Induction</u>

- Heat directly into pan/pot
- fast heat up time / control
- Most efficient
- Requires specific cookware
- Higher install cost

<u>Traditional Electric (Resistive)</u>

- Lowest upfront cost
- Higher energy consumption
- Slow heat-up time and poor control

# Stove Tops – Support for induction

Excerpts from GBCA Practical Guide to Electrification from Professional Chefs:

Stokehouse chef Jason Staudt welcomes the shift saying "the combination of cooking over wood, with the cleanliness and sustainability of induction is absolutely the future".
"As much as I love gas, induction has advanced in so many ways. It's more powerful, the cleaning is easier, and the cooking is more accurate."

JASON STAUDT Chef, Stokehouse, 'No longer cooking with gas: how a shift to induction cooking could affect Victorian homes and restaurants', Good Food Online, May 11, 2021

We use induction cooktops in the kitchens at Rockpool Bar & Grill, Spice Temple and Rosetta," he says. "They're far easier to clean down after use, which is one of the main reasons we chose induction over gas. With induction you're no longer a slave to an incredibly dirty gas stove top with multiple fittings that have to cool down and be dismantled ahead of cleaning. There is far more elbow grease involved when cleaning a gas top."

NEIL PERRY | Chef, 'Gas v induction cooktops' what is your pick? Good Food Online, May 3, 2017

Greater energy efficiency means kitchens save money not only on the cost of fuel, but on airconditioning too. For Wakuda, the higher costs of installation have been offset by the "lower cost of ownership. We have a safer, cooler, more energy efficient kitchen," he says.

TETSUYA WAKUDA | Chef, Tetsuya, 'Electric currents', Restaurant & catering, December 13, 2016

"If I had the choice, all of our restaurants would be induction only, there's no difference in the quality of food you can produce. Unfortunately, many of the buildings our restaurants sit in did not have the foundations for induction cooking because they're so old."

NATHAN TOLEMAN | CEO, Mulberry Group, 'No longer cooking with gas: how a shift to induction cooking could affect Victorian homes & restaurants', Good Food Online, May 11, 2021

"It [induction cooking] is a new thing for me, but the idea is to have an ambient kitchen." says chef, Martin Benn. "Gas stoves makes the kitchen go really hot, but we want to have more of an ambient 24C so the chefs aren't too hot when cooking and the food stays at the right temperature."

MARTIN BENN | Chef, Society, 'Cooking up a dream kitchen: Martin Benn's Society restaurant in Melbourne', The Australian, May 7, 2021

# Other Cooking Equipment

Generally only alternative to other cooking equipment is electric resistive for other cooking equipment types;

# Gas Kiln


**Used on following assets:**

*Box Hill Community Arts Centre*

Options

Direct electric conversion or replacement.

- GE Kilns have previously undertaken repairs – suggested electric conversion may be possible but if previous cracking issues are ongoing full replacement would be recommended.

Heat pump options not feasible due to extremely high temperatures.

# IMPLEMENTATION APPROACH

# Procurement approach

**Generally, undertake with any other proposed refurbishment work if possible, to improve efficiency and reduce disruption.**

**For smaller sites:**

- Undertake all electrification of heating, hot water, and cooking equipment at the same time. Minimise disruption and better efficiency – ie modification of electrical switchboards carried out once rather than multiple times for each stage.
- Consider packaging sites together to improve consistency, quality, and gain economies of scale.
- Engage consultants to prepare documentation for design and construct tender

**For larger sites;**

- Testing and measurement to confirm actual operational required temperatures and capacity recommend as a first stage. In some instances, some initial site works required to enable this.
- Undertake more detailed level of design for procurement to reduce risk.

# SITES INSPECTION

# Site Inspections

- Aqualink Box Hill
- Whitehorse Civic Centre, Council Chambers and Nunawading Library
- Box Hill Town Hall and Hub (Inc Migrant Info Centre + Citizens Advice Bureau)
- Parkswide Nursery & Horticultural Centre
- Sportlink Vermont South.

# Additional sites for consideration

- **Sites with gas boilers which typically are more complex to electrify;**
  - Box Hill Library
- **Sites with high gas consumption;**
  - Box Hill Library
  - Nunawading Community Hub
- **Sites where estimated electrical demand represents a significant increase on existing electrical demand**
  - Whitehorse Reserve Pavilion
  - Aqualink Box Hill Pavilion

# THANK YOU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