Sustainable Apartments Pilot – Feasibility Report

Site: New Acton South

ACT Government

Acknowledgement of Country

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We respect the Aboriginal and Torres Strait Islander people, particularly our Aboriginal and Torres Strait Islander staff, and their continuing culture and contribution they make to the Canberra region and the life of our city.

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Purpose

The Sustainable Apartments Pilot Study sought to understand the opportunities, challenges and costs of the electrification of existing apartment buildings.

Background

On 4 August 2022, the ACT Government announced that the Territory will transition away from fossil fuel gas by 2045. This long-term shift is essential to achieving the ACT's commitment to net zero emissions and will require a coordinated and planned approach to ensure energy remains secure, affordable, and reliable across the Territory.

To guide this transition, the ACT Government released the Integrated Energy Plan on 19 June 2024. This Plan outlines how the ACT will move toward a cleaner energy future, including the electrification of complex buildings such as multi-unit housing developments.

Apartment buildings are a key part of this transition. Many currently rely on gas for heating, hot water, and cooking - systems that contribute to greenhouse gas emissions and rising energy costs. By switching to efficient electric alternatives, apartment buildings can significantly reduce their emissions and often lower energy bills over time - especially as Canberra's electricity grid is powered by 100% renewable energy.

Overview of the Pilot

The Pilot was a joint initiative funded by the ACT Government, Commonwealth Government, and other Australian jurisdictional contributions. The Pilot contracted a technical consultant, GHD, to develop example pathways for electrification and decarbonisation across seven representative apartment complexes in the ACT.

Sites interested in participating in the Pilot applied through an expression of interest process. Submissions were reviewed and evaluated to ensure they were representative of the types of buildings that exist and that they captured a diverse range of electrification challenges faced by buildings.

The Pilot generated a site-specific Feasibility Report (**attached**) for each of the seven sites, which outlines a tailored pathway for the complex to transition off gas, including technical feasibility, estimated costs, and potential benefits.

The outcomes and learnings from this Pilot will be shared with the broader strata community and made available to support similar transitions across Australia - with all sensitive, personal, or commercial-in-confidence information appropriately protected.

Guidance on navigating Unit Title System for building upgrades

In the ACT, apartment buildings are governed under the Unit Titles Act 2001 and the Unit Titles (Management) Act 2011. These laws define how unit plans are created and managed and outline the responsibilities of individual owners and the owners corporation (also known as the body corporate).

There are many variables for owners corporations. The following section provides guidance on how to approach electrification within the ACT's unit title system, with reference to the Unit Titles (Management) Act 2011 (UTMA).

Decision-Making Process for Building Upgrades

Under the UTMA, owners corporations must follow formal decision-making processes when considering upgrades to common property, including electrification.

Decision-Making Process

Ordinary resolutions are used to approve things like the general fund budget and the installation of sustainability infrastructure on the common property.

Special resolutions are needed for upgrades that:

- Significantly alter the appearance or function of common property.
- Involve substantial cost or long-term financial commitment including borrowing or investing money.
- Determine a different method of contribution amounts for unit owners.
- Alter the rules of the owners corporation.

Voting and Meetings

Owners must be given proper notice of meetings where such decisions will be made, and agendas must include detailed information about the proposed upgrades, including cost estimates and rationale. Owners have the right to vote, raise concerns, and request further information before resolutions are passed.

Funding Options for Upgrades

Electrification upgrades are typically funded through levies - contributions paid by all unit owners to a sinking fund. The sinking fund supports both day-to-day operations and long-term capital works.

If funds are insufficient, the owners corporation may:

- Amend their Sinking Fund plan to include contributions for electrification.
- Establish a Special Purpose Fund for owners to contribute to a specific upgrade.
- Take out a loan; subject to approval, owners corporations may borrow funds.

Consultation and Transparency

Owners corporations must:

- Provide notice of their meetings to all owners.
- Provide detailed agendas including information about the proposed upgrades and cost estimates.
- Allow owners to vote and raise concerns.

Legal and Compliance Considerations

Upgrades must comply with:

- Building codes and planning laws.
- Heritage protections, if applicable.
- Insurance requirements.

Executing Contracts

Any contract for building upgrades must be executed:

- With proper authority (via resolution), and
- By designated executive members or with the common seal (if any).

Understanding Your Building Classification

The ACT distinguishes between **Class A** and **Class B** units:

- **Class A** Units: Multi-storey apartments. The owners corporation is responsible for external building maintenance and common property.
- **Class B** Units: Townhouse-style units. Owners are responsible for their own buildings; the owners corporation manages shared land.

You can check your building's classification via your Certificate of Title or through Access Canberra.

For more information:

www.accesscanberra.act.gov.au/building-and-property

www.act.gov.au/housing-planning-and-property/housing/owning-a-unit

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New Acton South

Sustainable Apartments Pilot Electrification Feasibility Report

City and Environment Directorate

20 November 2025

→ **The Power of Commitment**

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[Compliance statement]

The Power of Commitment

Executive summary

The ACT Government has committed to reaching net zero by 2045 powered by 100% renewable energy. The ACT's Integrated Energy Plan (IEP) outlines a long-term strategy to achieve this target, focusing on reducing fossil fuel gas and vehicle emissions. The Sustainable Apartments Pilot (SAP) is undertaking seven feasibility assessments as pilots to identify the challenges and opportunities associated with the removal of fossil fuel gas equipment and providing fully electrified apartment buildings in the ACT.

The New Acton South apartment complex was one of seven selected sites and was included in the pilot based on its large gas equipment load, building size, mixed site use and its location in North Canberra.

This report presents the outcomes of the feasibility assessment for New Acton South apartments. The report documents the process undertaken in the pilot, provides an options analysis on each gas system type identified for replacement as well as solar photovoltaic (PV) and electric vehicle (EV) charging systems, and develops a potential implementation pathway based on the sites' priorities and constraints.

The electrification feasibility assessment provided options to replace all gas using equipment with electrical options. It also included identification of demand reduction measures that could help accommodate these works. Photovoltaic systems were also investigated to ascertain whether they would be cost-effective in offsetting ongoing power costs against the electrification scope. Options for electric vehicle charging were included to enable the Owners Corporation to understand costs related to increasing their existing EV charging infrastructure.

This study informs residents of the potential opportunities, constraints and costs of an electrification project at their site. No detailed design or implementation works have occurred. Should the Owners Corporation want to proceed with electrification works, the feasibility assessment will need to be taken through a detailed design process to finalise the required scope and expected costs.

Existing Building and Equipment

The New Acton South apartments were constructed in 2010 to house 186 apartments and are located in the North Canberra district. The site includes a 4-storey podium level housing apartments and above ground carpark, garden at level 5 with the remaining 14 storeys in the tower above. The site has two existing private EV charging bays. The site is also located within Designated Land with planning controls administered by the National Capital Authority.

The following gas equipment was identified within the building with the notable challenge for electrification being the large capacity of the existing hot water plant.

Type	Purpose	Area Served
Instantaneous water heaters	Hot water	Whole building
Hot water boilers	Space heating	Whole building

Demand & Energy Reduction Initiatives

A wholistic view of the site was first taken to determine if there were any measures that could be provided to reduce the demand for electricity at the site. Reductions in demand can decrease the size of the electric equipment required and subsequently reduce the need for building upgrades, and reduce ongoing energy costs. Meters were installed to log the site hot water usage and to understand peak hot water loads and identify potential direct demand reduction measures. The buildings thermal performance was also looked at for ancillary demand reduction options. A summary is of findings provided below:

1. Existing hot water units are very large relative to the predicted instantaneous peak demand for the whole building, as determined during logging. From this it was concluded that it may be possible to reduce the capacity of the new electric hot water systems therefore lowering peak load requirements.
2. Providing additional sun shading is not expected to be cost effective. This may involve significant modification to the building façade, impacting building aesthetic and likely requiring additional approvals.

New System Options

Analysis of the options for replacement under electrification are provided below as well as the photovoltaic system and electric vehicle charging options.

– **Space Heating** – two options were considered for the heating system: Centralised hydronic air-source heat pumps to replace the existing rooftop hot water boilers; and decentralised ducted splits systems in the apartments.

  The multi-criteria analysis indicates that ***Option 1 – Central hydronic air-source heat pump*** is the highest scoring against the criteria. This was the lowest capital cost option and provide a payback of 17 years, which is not ideal however was preferable to Option 2 which has no payback.
– **Hot water** – three options were considered for the site: Central Electric-Resistive with Storage; Central Air-Source Heat Pumps with Storage; and Centralised Water-Source Heat Pumps with Storage.

  The multi-criteria analysis indicates that ***Option 3 – Water-Source Heat pumps with Storage*** is the highest scoring against the assessment criteria. This provides the shortest return on investment of 3.7 years and therefore will be the recommendation by GHD.
– **Electric Vehicle Charging** – three options were considered for the expansion of the electric vehicle system within the basement: Individual level 1 chargers, full capacity (186 bays); Individual level 2 chargers, full capacity (186 bays); Shared level 2 chargers (7 bays).
– The final selection of the preferred option will be based on OC and residents needs and specialist advice specific to the building.
– **Photovoltaic system options** – Two options were provided for the photovoltaics system size: PV system sized to the maximum roof area (63 kW); PV system sized to maximum available roof area with a solar-sharing solution such as SolShare (63 kW).

  To offset the additional yearly energy consumption from the electrification works ***Option 1 – PV system sized to maximum roof area*** was found to be the optimal solution to offset the common supply.

Based on the current assessment a substation and main switchboard upgrade is required for the electrification works due mainly to the new space heating load. The EV install has the potential to trigger further electrical works; however this can be mitigated by the use of a load management system to limit system demand.

Feasibility Assessment Outcome

Based upon the feasibility assessment the cost to implement electrification at New Acton South, including EV charging infrastructure and a photovoltaic system, has been estimated at **$6,933,000 (incl. GST)**. The proposed costs breakdown is provided in the table below along with a suggested implementation staging approach.

The New Acton South works cannot be provided within the existing electrical infrastructure of the building. The electrical infrastructure upgrade works, in conjunction with the heating plant electrification upgrade, provides a lengthy payback, with a clear peak in infrastructure works costs up to 2029 with a payback by 2041. The addition of the solar and EV slows the pace due to the additional costs but eventually converges 4 years later (c.2045).

Stage	Scope Components	Cost $ incl. GST
0	Pre-works Planning	$33,000
1	Photovoltaic System	$281,000
2	Electrical Infrastructure	$996,000
3	Heating Water Plant	$2,105,000
4	Hot Water Plant	$615,000
5	Demolition of Gas Supply	$76,000
6	Electric Vehicle Chargers	$645,000
Total Trade Cost (incl. GST)		**$4,751,000**
Total Out-Turn Cost (incl. GST)		**$6,933,000**

Notes:

1. Electric vehicle charging costs are based upon ***Option 2 - Individual level 2 EV ready, full capacity***.
2. Total out-turn includes the following allowances: 5% staging, 14% Trade Preliminaries, 2% Design Fees, 20% Contingency. No allowances have been provided for cost escalations.

The staged approach to implementation has been developed to spread the costs over multiple years, reduce the intensity of construction impacts and prioritise works in a practical manner using the following guiding principles:

1. The scope items should be divided up into manageable components.
3. The scope items should be spread across multiple years if possible.
4. Additional efforts to be undertaken to measure and log existing demands and usage to size backbone of infrastructure effectively.
5. Photovoltaic systems are considered in early phases.
6. EV charging is prioritised later to facilitate pre-planning and resulting additional works (if required).

Following the concept assessment of the selected options, it was determined that there were significant impacts to the site that result from the works, most notably the need for electrical infrastructure upgrades. Further assessment would however be required in a pre-planning stage to confirm the overall scope, ensure demand reduction measures are considered in design, and mitigate rework against an uncoordinated ad-hoc approach to implementation. There are also a number of issues and potential risks that that will need to be considered and resolved through the next stage of detailed design to provide more cost certainty. This includes:

– Confirmation of existing hot water usage and power consumption.
– EV charging site specific requirements.

The demand calculations undertaken in the feasibility assessment have been based on available data and calculated estimates. Longer-term logging of the site hot water usage and power consumption during expected peak periods would allow for suitable sizing of the hot water units. This would also confirm that the existing electrical supply capacity is sufficient and that significant infrastructure upgrades are not required.

With regards to implementation of additional EV charging infrastructure, specialist advice may be required to detail any additional safety requirements related to the install of EV chargers.

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1. Introduction

In June 2024, the ACT Government published the Integrated Energy Plan, which provides a long-term pathway for transitioning the ACT to net zero emissions by 2045. With the ACT securing 100% renewable electricity in 2020, a key focus of the plan is replacing fossil-fuel gas appliances with electric alternatives and removing any barriers that are preventing community uptake.

One example where barriers to electrification exist are multi-residential apartments, townhouses and mixed-use buildings. These buildings are complex due to the number of people that manage, own and occupy them. Finding agreement between multiple owners and occupiers, each of which often have conflicting interests, can present challenges.

When developing the Integrated Energy Plan in 2023, the ACT Government undertook consultation with Owners Corporations (OCs) to understand what their key concerns were. As part of these consultations, it was suggested that pilot feasibility studies should be conducted, to help inform decision-making of the owners. This would help determine the best upgrade options for each building type, how technical challenges would be resolved, and how much it would likely cost. The ACT Government has committed to working with industry to help build this knowledge for the community.

It was also recognised that undertaking pilot feasibility studies on representative buildings would provide knowledge and insight that would be more broadly valuable to the ACT Government and other building owners. The Sustainable Apartments Pilot (SAP) program, (funded by the ACT Government, Australian Government and from other Australian jurisdictional government contributions) has provided feasibility studies to seven participating representative apartment complexes located within the ACT. The feasibility studies for each building are presented in individual reports to identify and resolve the challenges that OCs will face through electrification and propose an implementation pathway with costings. Key learnings from all seven feasibility assessments will be summarised in a report provided to the wider community outlining the findings from the Feasibility Studies to aid community in their own site electrification considerations.

The feasibility studies focus on full site electrification, namely the replacement of natural gas equipment with electric alternatives. This includes consideration of any demand reduction or energy efficiency initiatives that could remove barriers or negate any of the adverse impacts that electrification may have. From this context, measures such as photovoltaic systems are included in this assessment. Furthermore, in support of the ACT's transition towards zero emissions vehicles, it is prudent for these electrification studies to holistically consider how electric vehicle charging facilities can be incorporated into these complexes, so therefore these are also included in the assessments.

1.1 Purpose of this report

The purpose of this report is to identify and analyse options to replace gas assets with electric options at New Acton South as well as identify potential implications and challenges associated with these options. The report also includes assessment of the potential to use solar power to offset ongoing electrification costs, and to consider the inclusion of Electric Vehicle (EV) charging facilities.

The report includes a summary of the site, OC priorities and site gas infrastructure to be replaced – including capacity and condition of the existing systems – and then provides a replacement options assessment, including:

– Demand analysis including proposed demand reduction measures
– Options analysis and recommendations for the gas asset replacement
– Concept design and scope development, including sketch of the proposed options
– Cost estimates, including capital and lifecycle costs.

1.2 Scope and limitations

The SAP program produced feasibility studies to support seven sites only. The selection process prioritised common apartment features and constraints to provide results with the widest applicability to non-pilot sites due to the limited reach.

This report has been prepared by GHD for City and Environment Directorate and may only be used and relied on by City and Environment Directorate for the purpose agreed between GHD and City and Environment Directorate as set out in section 1.1 of this report.

GHD otherwise disclaims responsibility to any person other than City and Environment Directorate arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer to Section 4.3). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared the preliminary cost estimate set out in section 8 of this report ("Cost Estimate") using information reasonably available to the GHD employee(s) who prepared this report; and based on assumptions and judgments made by GHD and its sub-contractors.

The Cost Estimate has been prepared for the purpose of informing options at this site and must not be used for any other purpose.

The Cost Estimate is a preliminary estimate only. Actual prices, costs and other variables may be different to those used to prepare the Cost Estimate and may change. Unless as otherwise specified in this report, no detailed quotation has been obtained for actions identified in this report. GHD does not represent, warrant or guarantee that the works can or will be undertaken at a cost which is the same or less than the Cost Estimate.

Where estimates of potential costs are provided with an indicated level of confidence, notwithstanding the conservatism of the level of confidence selected as the planning level, there remains a chance that the cost will be greater than the planning estimate, and any funding would not be adequate. The confidence level considered to be most appropriate for planning purposes will vary depending on the conservatism of the user and the nature of the project. The user should therefore select appropriate confidence levels to suit their particular risk profile.

GHD has prepared this report on the basis of information provided by City and Environment Directorate and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

1.3 Glossary and Definitions

Term	Definition
Abbreviations	
ACTF&R	ACT Fire and Rescue
ACT	Australian Capital Territory
BA	Building Application
BCA	Building Code of Australia (includes Volume 1 and 2)
BESS	Battery Energy Storage Systems
CO_2	Carbon dioxide
DA	Development Application
EOI	Expression of Interest
EV	Electric Vehicle

Term	Definition
GWP	Global Warming Potential
HAP	Hourly Analysis Program
HFC	Hydrofluorocarbons
HVAC	Heating, Ventilation and Air-Conditioning
ICE	Internal Combustion Engine
MDL	Meter Data Logger
MSB	Main Switchboard
NCC	National Construction Code, made up of 3 volumes: Vol 1 & 2 of the BCA and Vol 3 being the Plumbing Code
OC	Owner Corporation
p.a.	Per annum (per year)
PAC	Packaged Air Conditioning
P.O.E.	Point of Entry – electrical supply to the site
PV	Photovoltaic
SAP	Sustainable Apartments Pilot
STC	Small-scale Technology Certificate
XLPE	Cross-linked Polyethylene
Definitions	
CAPEX	Capital cost
GHD	Program consultant providing technical input
OPEX	Operational cost
Pilot Program	A government-funded initiative providing tailored advice for the electrification of seven apartment complexes
Program Team	Members of the City and Environment Directorate team managing the Pilot Program
Units of measure	
A	Amps, Ampere
VA, kVA, MVA	Volt ampere, kilo volt ampere, megavolt ampere
mm^2	Millimetre squared
V	Volts
W, kW, MW	Watts, kilowatts, megawatt
$kgCO_2$-e	Kilograms of carbon dioxide equivalent (standardised measure for comparing impact of different greenhouse gases)

2. Site Selection Process

2.1 Overview of site selection process

The ACT Government Program Team and GHD developed an Expression of Interest (EOI) questionnaire that Owner's Corporations submitted as part of the application to register their interest in joining the pilot program. As the program was limited to only seven sites the EOI was used to identify factors, challenges or constraints that would need to be considered when electrifying gas assets, providing EV charging infrastructure and solar PV to apartment buildings. The selection process prioritised aspects of each site that were broadly representative of the challenges faced by the strata community. Choosing sites with unique or atypical issues—such as a problem specific to a single apartment complex—could have diminished the broader applicability and effectiveness of the Pilot's learnings. The questions were broadly represented by the following categories:

– Building description including location, heights and number of apartments
– Contains commercial premises such as retail, offices or services
– Types of installed gas equipment
– Description of the electrical services
– Other known constraints to electrification (e.g. Heritage, ACT planning limitations, known building limitations).

The EOI also required applicants to identify the types of documentation available on their building such as billing data (Gas and electricity) and drawings (architectural, structural, building services). These were to be provided for use during the assessment.

2.2 Reasons for Selection

Following the site selection process New Acton South was identified as a candidate for the pilot. The site was selected based on the following characteristics:

– Diverse range of gas consuming equipment (i.e. hot water, space heating)
– Mixed use (residential and commercial)
– Represented a large-size apartment complex, in terms of building height, number of dwellings, etc.
– National Capital Authority planning constraints including building heights
– Geographical location was considered, with New Acton South representing the North Canberra (central) region.

3. Current State

3.1 Building Description

3.1.1 The Site

The site, located at 19 Marcus Clarke St City was constructed in 2010. The complex contains one building on a fairly flat block with pedestrian access to 3 sides, blocked by a public carpark to the south. Vehicle entry is from the from east to the basement/above ground carpark. The 4-storey podium level supports the rooftop garden and 18-storey residential building. The building houses 186 apartments, consisting of a combination of 1, 2, 3 and 4-bedroom apartments with balconies, bespoke penthouse suites, 2-level walk-up style courtyard apartments, two main lift cores, theatre and a shared gym. Apartments face all cardinal directions, some with aspects to two sides.

Parking is provided within the 318-bay carpark with no visitor parking available.

The building has two commercial tenancies on ground floor which provide the following:

- Office
- Café (Močan & Green Grout)

Table 3.1 Site Summary

Name of Premise	New Acton South
Number of Buildings	1 building
Building Height	High rise, 18 storeys
Building Floor Area	Medium
Number of Residential Dwellings	186
Mixed-Use	Yes
Type of Commercial Spaces	Food & Beverage; Office
Type of Common Areas and Facilities	Gymnasium; Outdoor Common Areas; theatre
Carparking Facilities	Yes (Above Ground; Underground)
Part of Embedded Network	No
EV Charging Facilities	Yes
Solar Installation	No
Gas Assets	Heating; Hot Water;
Territory Plan Zone	Designated (National Capital Authority)
Districts	North Canberra

Figure 3.1 Site plan

Tower from Peppers courtyard

Podium levels from Kendall Lane

Figure 3.2 Sample photographs of external areas

3.2 Utilities

3.2.1 Electricity supply

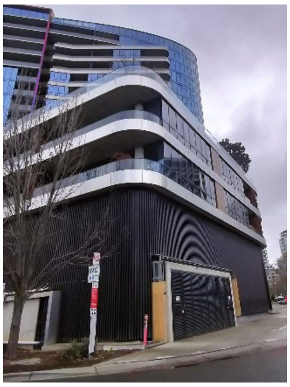
The site is supplied by a 1,000 kVA chamber substation S9455 located on the ground floor Figure 3.1. It houses two 500 kVA transformers. The site also houses an existing chamber substation S9185 near the café that was located on the site prior to construction. It does not serve the building complex.

The two site Main Switchboards (MSB) are located under the substation in the basement and are rated to 1,250 A. The MSBs is provided with a metered and unmetered sections. The metered sections supply the house services while the unmetered sections connect to the meter panels and commercial tenant meters. Each apartment and retail tenancy are provided with a dedicated meter.

The MSBs contains the following:

- 3x Tenant riser power supply to meters
- Safety services section serving the lifts and fire panel
- House distribution boards

Residential meter panels are located on each floor at each lift core.



Substation

Main Switchboard (partial)

L17 meter panel in lift core

Figure 3.3 Sample photographs of electrical systems

3.2.2 Fossil fuel gas supply

Gas enters the site on the eastern side to the gas meter room located next to the carpark entry. Additional meters are located within the building, available to apartments 1405, 1601, 1602, 1603 and 1607.

The site is billed for two common supplies, one labelled as "gym".

3.3 Building Services

The site is provided with the follow services.

- Hot water: two central systems serving half the building each. Ground floor equipment serving floors up to level 9, the roof equipment serving down to level 10.
- Heating and cooling: Water-cooled packaged air conditioning units per apartment. These units are reverse-cycle and ducted type, connecting to a central condenser water that contains adiabatic coolers for heat rejection (in cooling) and gas condensing boilers for heat source (in heating).
- Cooking: electric cooktops
- Gas fireplaces, barbecues or cooktops may have been installed in some of the upper floor bespoke apartments, however, requires confirmation.
- No photovoltaic system.
- 2x electric vehicle chargers are provided in the resident parking bay for personal use.

3.4 Energy Usage & Tariffs

3.4.1 Energy Usage

The current state of energy usage at New Acton South is summarised in this section. It is important to establish as a baseline for which the proposed electrification works (including PV and EV charging) can be assessed against when determining operating costs, return on investment, and emission reductions.

Metering data available to GHD was limited during the pilot study. Assumptions were necessary to bridge gaps in information to develop the energy use profiles shown. The following outlines the basis of the energy assessment and the assumptions made. Although precise accuracy is not likely, these assumptions are considered sufficient to serve the purposes of this feasibility study.

Figure 3.4 conveys the monthly electricity and gas consumption, and Figure 3.5 shows an average daily profile of average power draw per hour. Note that both electricity and gas consumption is expressed in kWh to provide direct comparison.

The gas consumption profiles shown in Figure 3.4 and Figure 3.5 are based on:

– Annual gas metering data supplied from EvoEnergy (Apr-24 to Mar-25).
– Logging of the cold-water make-up meter to the ground floor hot water system, carried out from 27 June to 1 August 2025. The roof level hot water system is assumed to have a similar daily profile.
– Gas consumption is shown for hot water and heating systems only.

The electricity consumption profiles shown in Figure 3.4 and Figure 3.5 are based on:

– 12 months of sample electricity invoices provided by residents (for 1 apartment plus common areas).
– 12 months of sample electricity invoices for the other 6 apartment buildings part of the Pilot. This data was used to generate the overall trend of kWh per apartment based on number of bedrooms, and then New Acton South specific sample invoices were used to scale this trend to suit the site.
– Typical electrical load profiles from the Energies journal article, *Constructing Australian Residential Electricity Load Profile for Supporting Future Network Studies*.[1]
– The office and café electricity usage are not included in these profiles.

The following observations and findings can be drawn from the energy consumption data shown in Figure 3.4 and Figure 3.5:

– Gas consumption from hot water and heating system accounts for approximately 45% of the building's total energy consumption.
– Seasonal profiles of electricity and gas consumption differ between summer and winter. For electricity, this would be due to the use of electric package units for cooling over the summer. For gas hot water, this would be attributed to residents using more hot water for comfort during showering, hand washing, etc. and additional gas for space heating during winter.
– Daily profiles show both gas and electricity usage typically have two peaks, one during the morning when occupants are getting ready for work/school and another at nighttime when residents are at home.

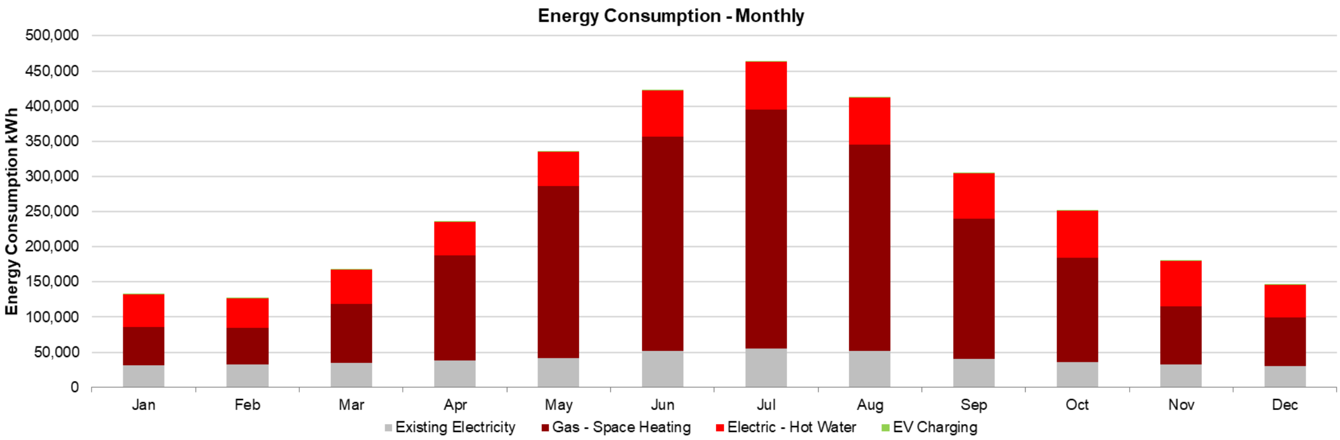


Figure 3.4 Monthly energy consumption

[1] Mumtahina, U. et al (2024). Constructing Australian Residential Electricity Load Profile for Supporting Future Network. *Energies* 17(12) **https://www.mdpi.com/1996-1073/17/12/2908**

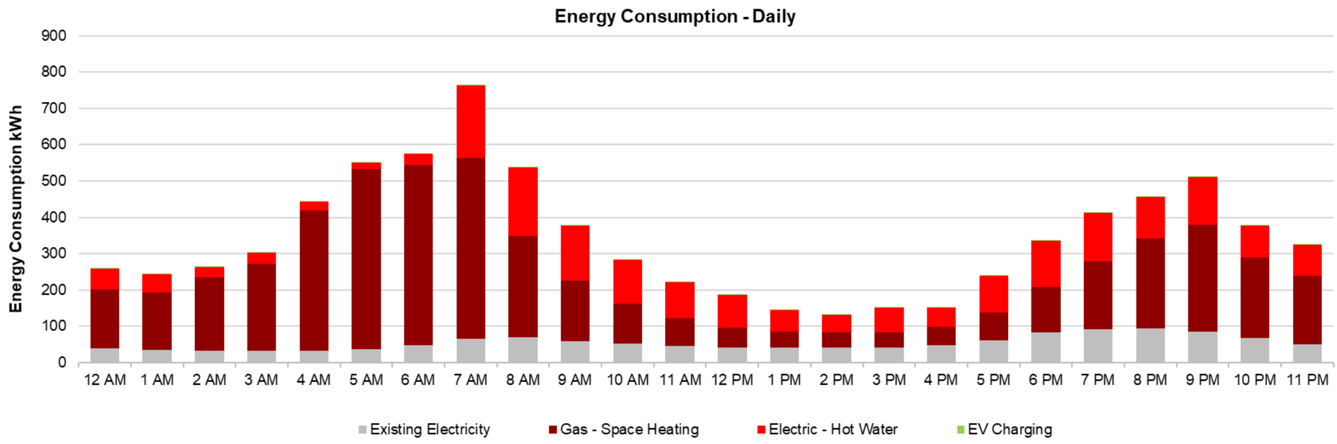


Figure 3.5 Daily energy consumption

3.4.2 Tariffs

Based on a review of the electricity and gas invoices provided, the following billing rates were noted. These will form the basis of the energy costs calculated in this study.

Table 3.2 Business Electricity Tariffs

Retailer	Network Charges				Retail charges			
	Access ($/day)	Business rate ($/kWh)	Evening rate ($/kWh)	Off-Peak rate ($/kWh)	Service fee ($/day)	Peak rate ($/kWh)	Shoulder rate ($/kWh)	Off-Peak rate ($/kWh)
Smartest Energy	0.689280	0.074660	0.042340	0.024220	1.49000	0.154537	0.154537	0.113474

Table 3.3 Business Gas Tariffs

Retailer	Plan	Supply rate ($/day)	Usage rate 1 ($/MJ)	Usage rate 2 ($/MJ)	Usage rate 3 ($/MJ)
Origin	Business Select	1.24113	0.0358600	0.0333300	0.0327800
Origin	Origin Business Basic	1.55144	0.0448800	0.0416900	0.0410300

Table 3.4 Residential Electricity Tariffs

Retailer	Plan	Supply rate ($/day)	Usage rate ($/kWh)
ActewAGL	Direct Saver Gas plan	0.63840	0.04200

Table 3.5 Residential Gas Tariffs

Retailer	Plan	Supply rate ($/day)	Usage rate ($/kWh)
ActewAGL	Direct Saver Electricity Plan	0.245814	0.980000

3.5 Identified Gas Equipment

To summarise, the gas equipment identified that requires replacement with electric alternatives are as follows:

– Heating system: two hot water condensing boilers located externally on rooftop, that provide a heat source to the condenser water system to allow the reverse-cycle packaged AC units in each apartment to provide heating.

– Hot water system: Two central hot water systems, each consisting of banks of gas instantaneous hot water units with storage tanks.

- Residential gas supply: Provided to apartments 1405, 1601, 1602, 1603, 1607 assumed to operate gas fireplaces and gas connections on their balconies for a BBQ.

Table 3.6 Gas Equipment to be replaced

Type	Purpose	Area Served	Qty	Make	Model	Output	Year
Instantaneous water heaters	Hot water	Lvl 1-9	12	Rinnai	REU-VCM2837WC-AK	48.8kW	2011
Instantaneous water heaters	Hot water	Lvl 10-17	6	Rinnai	REU-VCM2837WC-AK	48.8kW	2011
Hot water condensing boiler	Heating	Whole Building	1	Rendamax	*Unable to be confirmed*	1MW	2018
Hot water condensing boiler	Heating	Whole Building	1	Rendamax	R606	500kW	2018
Fireplace	Heating	Apt. 1405, 1601, 1602, 1603, 1607	5	-	-	-	-
Balcony BBQ	Cooking	Apt. 1405, 1601, 1602, 1603, 1607	5	-	-	-	-


Hot water (ground)


Hot water (roof)


Evaporative cooler


Boiler

Figure 3.6 Sample photographs of gas systems

High-level commentary on the condition, lifecycle obsolescence, fitness-for-purpose and compliance of these gas systems are provided below, to inform whether systems are due for upgrading or have any existing issues:

- Hot water units are mostly original at approximately 14 years old. This is beyond the typical economic life expectancy of these types of units (i.e. 10 years) and are likely approaching a need for replacement. It is noted that some of the units appear to have been replaced over the years, indicating that further unit failures should be expected in the future. Hot water units appear to be in a reasonable condition.
- The hot water heating boilers are both (500 kW and 1 MW) located externally on the rooftop and provide a heat source to the condenser water system to allow the reverse-cycle packaged AC units in each apartment to provide heating. They are both approximately 7 years old. The typical economic life expectancy of these types of units is 10-15 years. As such, these units are expected to be in their mid-late lifecycle. The hot water boilers are in good condition and are protected from weather in an enclosure.
- The drawings show the apartments 1405, 1601, 1602, 1603, 1607 to be supplied with gas connections to the apartments, supposedly for gas fireplaces and gas connection to their balconies, assumed to be for BBQs. The gas connection on the balcony of apartment 1603 was noted but a fireplace was not noticed. Further investigations would be required to determine whether there are any additional gas appliances inside these apartments.
- The Heating, Ventilation and Air Conditioning (HVAC) infrastructure (i.e. water-cooled Packaged Air Conditioners (PAC), condenser water pipework, rooftop heat rejection plant) is significant throughout the building and appropriate for the application. Furthermore, although there were reported instances of

frequent Packaged Air Conditioning (PAC) unit failures early in the building life, these issues appear to have mostly reduced over the years with no reportable ongoing reliability issues. Therefore, it was not considered practical to move towards an alternative concept for these electrification works, and the options explored have looked to integrate with this system.

Figure 3.7 Gas equipment locations

3.6 Electrification Constraints

The following challenges and constraints to electrification have been identified with New Acton South:

– Heating system is relatively large-capacity (1500 kW) and similarly, hot water system is relatively large-capacity (875 kW). Electric replacement options for such capacities may introduce issues with electrical supply, require larger outdoor plant areas, increase structural loadings on roof, etc.
– Limited available external space for equipment. There is a limited slab areas on roof and no ground level external space. Options may need to consider the use of space within the carpark.
– Planning constraints are applicable, notably the building is at RL617 Canberra height limit (which may limit placement of plant and PV panels on rooftops). Additionally, the building is subject to planning requirements of the National Capital Authority (NCA) as it is located within Designated Areas.

3.7 Electrification Opportunities

The following opportunities were identified that may enable or simplify the electrification works at New Acton South:

– Potential to optimise heating and hot water systems capacity to limit unnecessary oversizing and the associated consequences. For the heating, this is proposed based on feedback from residents that active heating and cooling is often not required due to high-performing façade. For the hot water systems, this is proposed based on actual hot water demand logging of the cold-water make-up being carried out as part of this pilot to measure actual demands.

- Opportunities to use HVAC condenser water as a heat source for domestic hot water units may be used. Additionally, there is an option of using thermal storage to save on heating plant space.
- Reconfiguration of rooftop plant may be able to house most of the upgraded equipment.
- The EC members indicated that there are several unused parking spaces in basement that could be utilised as plant areas.
- The EC members indicated that use of AC systems could be provided per apartment as an option for residents to decentralise. However, NCA requirements may limit the opportunities to achieve this.

4. Requirements & Priorities

4.1 Owners Corporation Consultation

GHD held a meeting with the New Acton South Owner's Corporation and Program Team on 16 June 2025. During this meeting GHD provided the key observations from the site inspection, which was carried out on 15 May 2025, in terms of identifying the gas systems that required electrifying, the potential challenges and opportunities to electrifying, the requirements and priorities framework, and presented the options that GHD consider to be worth assessing. This was a productive discussion with the owners where they provided valuable feedback on existing issues, requirements/priorities and options they would like considered. GHD documented minutes from these discussions which are included in Appendix A.

Specific requirements raised are noted below:

- EV charging restrictions are in place by EC for any new connections due to concerns around electrical maximum demand.
  - Building survey indicated 75% of residents are unwilling to share EV charging bays. Furthermore, there is no available space for shared parking to be converted to EV charging.
- One apartment currently has separate dedicated roof mounted equipment. Electrification solutions should consider re-integrating this apartment back into the central systems.
- Solar solutions should be investigated to achieve equitable outcomes to benefit tenants. The ACT government has multiple energy related schemes that have not overlapped yet that could be investigated.

4.2 Requirements

The requirements that will be used as a framework for this feasibility assessment are listed in Table 4.1. These are divided into Essential and Desirable requirements. Essential requirements must be satisfied, whereas Desirable requirements are more preferential and have flexibility to be traded off against each other to optimise the option selected.

Desirable requirements are provided with a relative importance percentage weighting (i.e. higher percentage = high priority/importance). These requirements and their relative importance are based on assumptions made by GHD on behalf of the ACT Government Program Team and the Owner's Corporations, and were presented during the Owner's Corporation meeting and recorded in the minutes.

It was acknowledged that it is unlikely that there will ever be complete agreement on priorities and relative importance across a large group of owners and residents. The intent of the below requirements and weightings is therefore to provide a reasonable framework to assess options against.

Table 4.1 Requirements

Essential Requirements	
– Achieve full electrification of all gas equipment. – Provide Electric Vehicle charging facilities – Comply with Territory Planning requirements and Noise Limits – Avoid significant disruptions to occupants during works – Work within constraints of the building	
Desirable Requirements	
Low Cost	**45%**
– Low capital costs	20%
– Low operating costs (energy, maintenance)	20%
– Low replacement costs	5%
High Performance & Robustness	**20%**

Essential Requirements	
– High climate adaptability	5%
– High usage adaptability	5%
– Resilient	5%
– Simple systems	5%
Low Environmental Impacts	**25%**
– Low aesthetic impact	5%
– Low acoustic impact	10%
– Environmentally sustainable solutions	10%
Other	**10%**
– Address existing deficiencies (e.g. age, condition, etc.)	5%
– Minimise disruptions to occupants	5%

4.3 Assumptions

Other assumptions that underpin the technical options analysis and feasibility studies are outlined below:

- Space heating basis of assessment:
  - Design conditions: Options selected to achieve design full load performance at -3°C ambient conditions, based on AIRAH DA09 for Canberra Airport.
  - Extreme operation conditions: The ambient temperature range in which the heating plant must remain operational (albeit derated) is between -10°C and 45°C.
  - Indoor design temperatures: 21°C.
  - No requirement to provide specific resilience or redundancy measures for the heating systems, although where central systems are proposed there will be a requirement for multiple items of equipment to minimise any single points of failure.
  - No requirement to "futureproof" provisions for the heating system or electrical infrastructure (i.e. no requirement to provide spare capacity for future expansions).
  - The existing natural ventilation provisions are proposed to be retained. It is not proposed to introduce mechanical outdoor air ventilation.
- Hot water basis of assessment:
  - Design conditions: Options selected to achieve design full load performance at -3°C ambient conditions, based on AIRAH DA09 for Canberra Airport.
  - Extreme operation conditions: The ambient temperature range in which the hot water plant must remain operational (albeit derated) is between -10°C and 45°C.
  - Water temperatures: capable of heating water to store at temperatures no less than 60°C as per AS/NZS 3500.4. Assumed cold water make-up temperature is 8°C.
  - No requirement to provide specific resilience or redundancy measures for the hot water systems, although where central systems are proposed there will be a requirement for multiple items of equipment to minimise any single points of failure.
  - No requirement to "futureproof" provisions requirements for the hot water plant or electrical infrastructure (i.e. no requirement to provide spare capacity for future expansions).
  - The hot water system to be compliant with AS/NZS 3500.4.
- Planning basis of assessment:
  - District: North Canberra
  - Territory Plan: Designated Area within the City Centre
  - Building Type: Mixed Use

    - Heritage: Yes
    - Contaminated Site: No
    - Planning advice was provided to GHD by sub-contractor PLANIT Strategic.
- Acoustics basis of assessment:
    - Impacted noise zone/s and limits:
        - Zone F (site): Same as the noise standard for the adjoining noise zone with the loudest noise standard for the time period (Daytime – 60 dBA, Night time – 50 dBA)
        - Zone B (adjacent): Daytime – 60 dBA, Night time – 50 dBA
    - Indoor noise limits per AS 2107, as follows:
        - Apartment in inner city: Living areas – 35-45 dBA, Sleeping areas – 35-40 dBA
- Structural basis of assessment:
    - Complete existing structural drawings were not available from the OC.
    - It is reasonably assumed that the roof structure can support a live load of 0.25 kPa in accordance with AS1170.1.
- Electrical Infrastructure basis of assessment:
    - Single-line drawings were provided by the Evoenergy for site electrical supply, and the OC for Main Switchboards.
    - Maximum demand calculations, performed per Appendix C of AS/NZS 3000, form the basis of the assessment in the existing site's electrical capacity.
- Building Compliance basis of assessment:
    - All new works are assumed to constitute as new works that require a Building Approval. All new works will be required to comply with Building Act 2004, which includes reference to the National Construction Code (NCC) and referenced Australian Standards. The assessment is based on NCC 2022 (current edition).
    - Existing systems being connected to are not required to be modified to comply with the NCC.
    - Building Compliance advice was provided to GHD by sub-contractor CBS Surveyors.
- Capital cost (CAPEX) assessment is based on advice provided to GHD by sub-contractor Wilde and Woollard. Assumptions and qualifications pertaining to the cost estimates are included in Section 8.1.
- Operating cost (OPEX) assessments are based on the following assumptions:
    - Tariffs for electricity and gas usage and supply chargers are approximate average of the sample residential bills provided to GHD. These are as follows:
        - Electricity usage: $0.335 / kWh
        - Gas usage: $0.152 / kWh
        - Gas supply: $0.692 / day per connection.
        - Note: Electricity supply charges are not expected to change between existing and proposed options, so therefore have not been included in the assessment.
        - Gas usage includes an escalation factor, based on the Evoenergy forecasted gas retail bill increases up to 2045. Escalation factor is based on Figure 21 in **Evoenergy-Overview of our five-year gas plan-June 2025_Public_v2.pdf**
    - Energy consumption and operating costs (energy/maintenance) are assessed for the site in total. In practice, these costs will be apportioned to residents or the OC via either direct billing from the energy retailer or OC levies, however for consistency it is assumed the site costs are assessed on the whole. The exception to this is the EV charging costs, which is excluded as these are anticipated to be billed directly to the resident with installed EV charger.
    - Small-Technology Certificates (STCs), which are applied to photovoltaic systems below 100 kW, assume 1.38 STCs per kW of system rating, with a price of $40 (July 2025) and a deeming period of 5 years.

  - Cumulative cash flow estimates are expressed in present value (year 2025), based on inflation of 2.5% and interest rate of borrowing of 3%.
  - Maintenance costs are based on estimate of hours for items of equipment, with an assumed labour rate of $120/hr.
  - Replacement costs are based on capital costs divided by the typical economic life expectancy from sources such as CIBSE Guide M and AIRAH DA19.
  - Gas disconnection costs incorporate an account disconnection fee of $200 (per account holder), and a meter abolishment fee of $1200 (per gas meter).
- Emissions factors used in the emissions calculations are based on the following:
  - Electricity usage: 0 kgCO_2-e / kWh (based on ACT zero emissions electricity).
  - Gas usage: 0.23 kgCO_2-e / kWh, including Scope 1 and 3 emissions factors (source: **National Greenhouse Accounts Factors: 2024 - DCCEEW**).
  - Refrigerant leakage rate: 4% of unit charge per annum (source: **https://airah.org.au/Common/Uploaded%20files/Archive/Resources/Best_Practice_Guideline/Best_Practice_Tewi_June2012.pdf**).

5. Demand & Energy Reduction Initiatives

Prior to developing the electrification replacement options, it is prudent to consider potential opportunities to reduce peak demand on existing infrastructure and improve energy efficiency. In addition to providing operating cost savings, these reductions may help to reduce the required capacity of the services or reduce the loads imposed on other infrastructure, thereby simplifying the extent of the electrification works.

There are two types of demand reduction opportunities being considered:

– Measures that directly reduce demand for the gas systems being replaced with electric (which for New Acton South is primarily the hot water and space heating systems), and
– Measures that reduce demand on other ancillary systems that are not necessarily in the scope of this feasibility assessment, but where a reduction in demand could offset the increases caused by the electrification works (e.g. façade treatments such as window films or sun-shading to reduce power usage for the electric heating and cooling within each apartments may offset other increases in demand).

The first type of demand reduction is considered in the scope of the upgrade options that this pilot is assessing feasibility of. The latter are assessed at a high-level in this section to provide information for the OC on the cost effectiveness and return on investment that could be expected if undertaking these works.

5.1 Direct Demand Reduction

5.1.1 Heating

Feedback from building residents during the site visits suggested the façade's thermal performance was strong and they often did not feel it necessary to operate heating during cooler ambient conditions. Although this small sample of the population may not be enough to draw any conclusions for the remainder of the building, it did identify the potential value in re-evaluating the heating loads to determine whether the existing heating capacity is adequate or potentially excessive.

GHD undertook a simplified thermal energy model of the building using **Carrier Hourly Analysis Program (HAP) v6.1** software to determine the heating and cooling loads and compare to the existing plant. These loads are summarised in the table below. Note that GHD were unable to carry out any meaningful real-world logging of heating energy, as this is variable based on ambient conditions plus there is currently no thermal metering provision to do so.

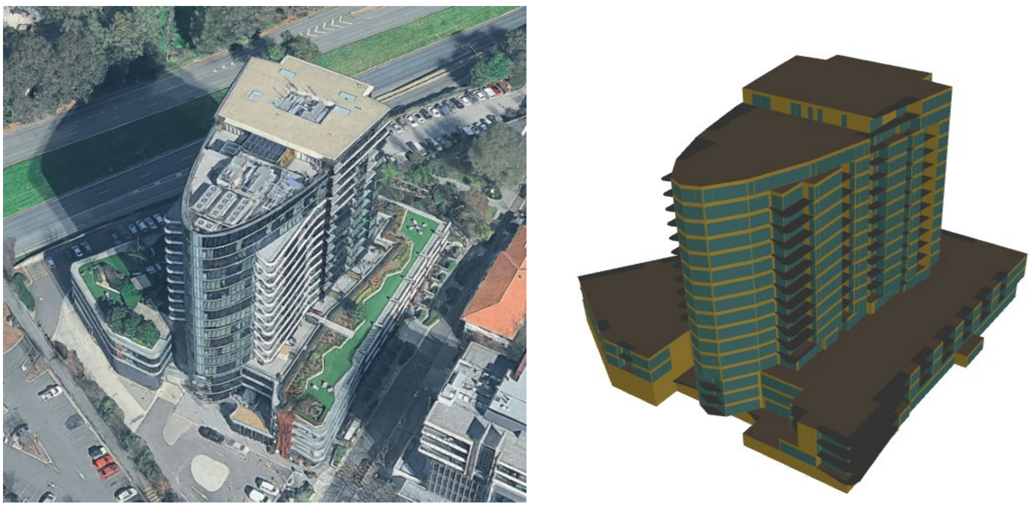


Figure 5.1 Actual building vs simplified energy model

Table 5.1 shows the modelled heating demand to be almost half of the existing heating plant capacity. Although the model is not expected to be precisely accurate to the real-world building, the large difference warrants further investigations. We would recommend that prior to any further electrification works, the building undertakes more detailed logging of flow rates and temperatures in the heating system to determine accurate loads, which may inform any upgrade decisions. For context, if heat pumps were installed to match the existing capacity, there is insufficient spare plant room space the accommodate.

Table 5.1 Heating system – Demand Assessment

	Peak Demand kW
Heating	
Existing Plant Capacity	~2,060
Modelled heating demand	807

Note:

1. Existing capacity is based on 1,500 kW of heat source from boiler plant x 1.375 of additional heat added by packaged air conditioners compressors.

Thermal energy storage is another concept that may be worth considering to reduce heating demands. Basically, the concept operates on the principle of storing heating energy in a large thermal storage tank, so that when peak heating demand occurs the heating plant does not need to be sized to meet this peak and is assisted by the energy storage.

For New Acton South, the impact of thermal storage is shown in Figure 5.2. In this case, instead of the heat source plant providing the required 807 kW, it need only be sized to provide 730 kW and the remaining load is provided by the thermal storage. However worth noting is the size of thermal storage tank to achieve this level of demand reduction shown is relatively large (i.e. 15,000L) and itself would introduce challenges with attempting to implement (i.e. space requirements, structural loadings, capital cost, controls complexity, etc.). Therefore, GHD will not proceed with considering thermal energy storage as a demand reduction strategy.

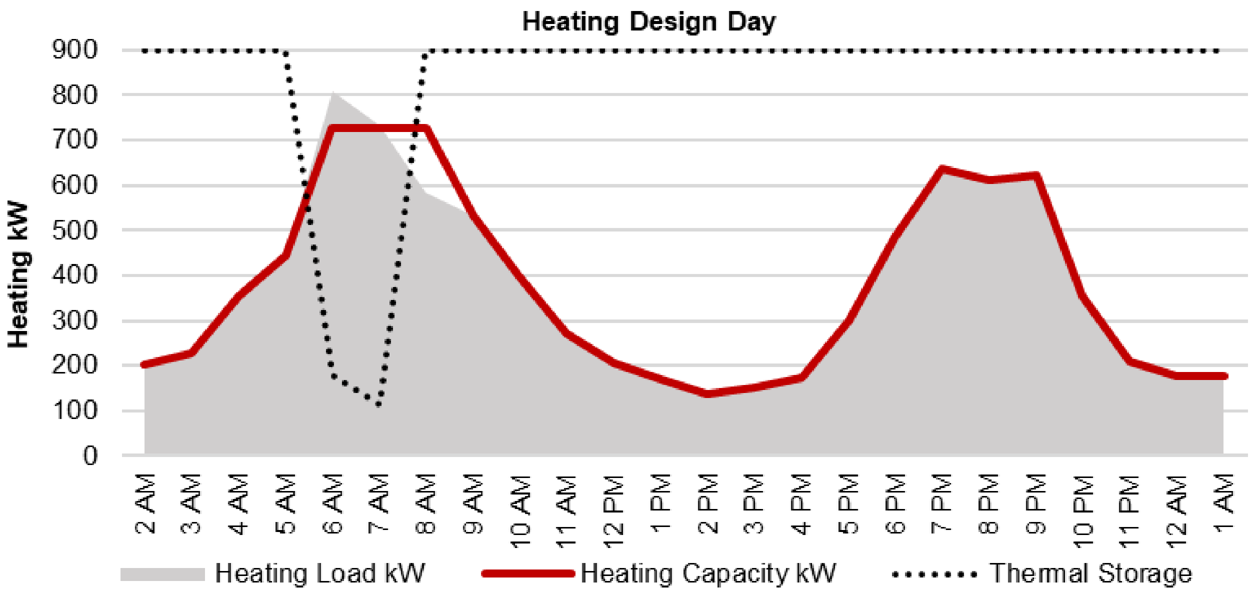


Figure 5.2 Thermal Storage impact

5.1.2 Hot Water

As noted in Section 5.1, demand reduction opportunities were identified with the hot water system. These included the use of hot water storage to help satisfy peak demands and thereby reduce the dependence on high-capacity capacity heaters. It also included logging of actual hot water demand to consider reducing the plant sizing according to actual loads. Table 5.2 assesses both opportunities for both hot water systems.

Table 5.2 Hot Water Demand – Modelled vs Existing

	Ground floor system			Roof system			Combined		
	Max L/day	Peak L/hr	Heater kW	Max L/day	Peak L/hr	Heater kW	Max L/day	Peak L/hr	Heater kW
Hot water									
Capacity – Existing Plant	235,340	12,110	586	118,870	7,260	293	-	-	-
Demand – Existing (logged)	19,000	3,000	181	-	-	-	-	-	-
Demand – Proposed for sizing									
– No Hot Water Storage	22,800	3,600	239	14,600	2,400	159	37,400	6,000	398
– With Hot Water Storage	22,800	3,600	**96kW w/ 3060L**	14,600	2,400	**72kW w/ 1530L**	37,400	6,000	**168kW w/ 4490L**

Note:

1. Calculated hot water demand is determined assuming cold water make-up is 8°C and hot water storage temperature is 60°C. The hot water demand flow rate is determined based on 65 L/person per day (based on actual logging figures) for 347 people served by Levels 1-9 system and 222 people served by Levels 10-17.

The results show the actual hot water demand (measured for Levels 1-9 only) to be lower than the peak capacity of the existing gas hot water system. Additionally, the use of hot water storage provides a further significant reduction in peak capacity. Overall, the hot water system to Level's 1-9 could potentially be reduced to **96 kW with 3,060 L of storage**, whilst Levels 10-17 system could similarly be reduced to **72 kW with 1,530 L of storage**, and combined the system could be sized for **168 kW with 4,490L** of storage**.** This sizing will be the basis of the options proposed in the upcoming options analysis.

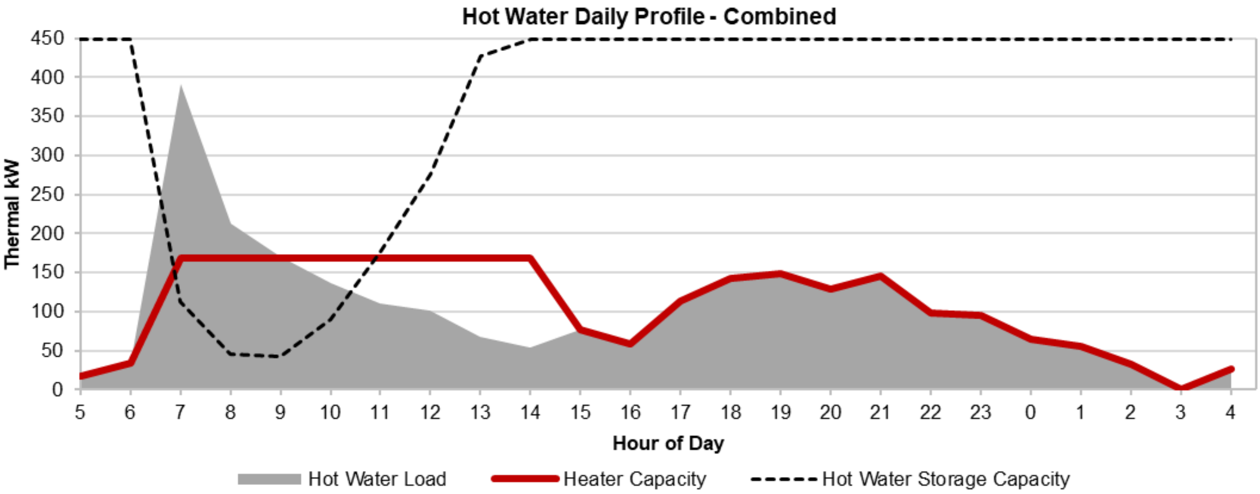


Figure 5.3 Impact of Hot Water Storage – Combined

Note the above savings on plant sizing are not envisaged to provide any reduction in overall energy consumption. This is because the heaters only provide heat in response to the demands placed on them, and the use of hot water storage does not reduce the energy required it only shifts and levels out when the energy is consumed.

5.2 Ancillary Demand Reduction

Ancillary demand reduction measures are identified with the HVAC systems. These are typically large consumers of energy and electrical power in buildings and therefore measures that reduce the heating and cooling loads are considered worth assessing. With the types of systems typically being room split system air conditioners with no introduced outdoor air ventilation, the primary cause of heating and cooling loads on the air conditioning systems are the heat gains and losses from the building façade. Therefore, the façade is assessed below as demand and energy reduction measures.

5.2.1 Building façade improvements

Heating and cooling demands for New Acton South have been estimated using a simplified thermal energy model produced using **Carrier Hourly Analysis Program (HAP) v6.1** software.

Options have been put forward based on existing façade and condition. New Acton apartments are relatively new, and constructed under a recent version of the National Construction Code (NCC) with similar building fabric efficiency requirements to current. These buildings are understood to have reasonable thermal performance, with double glazed and tinted windows, and insulation to external walls and roofs. Providing any further improvement to these is expected to deliver diminishing returns, and as such, these have not been considered as demand reduction measures. The only demand reduction opportunity identified for New Acton South to be worth assessing was to provide sunshades to windows, where not already present.

The results from the base case were then cross checked against the energy usage analysis from Section 3.4.1. Each demand reduction measure was simulated, with the results provided in Table 5.3 to provide comparison to the base-case.

Table 5.3 Demand reduction opportunities

Demand Reduction Opportunities	CAPEX $	Peak Demand				Annual Energy		Simple Payback yrs
		Heating kW	%	Cooling kW	%	kWh p.a.	Saving $	
0. Base Case	0	253	-	298	-	299,100	-	-
1. Sunshades	$357,600	251	0%	278	7%	278,100	$5,000	80

Note:

1. Peak demand is provided for heating and cooling. Annual energy consumption and costs is based on heating and cooling.
2. CAPEX is based on the m^2 areas for windows, ceilings, walls as calculated from the 3D geometry in HAP. Unit prices are based on $630/$m^2$ for sunshades.

Based on the results of the demand reduction assessment, the following conclusions can be made:

– Providing additional sun shading is not expected to be cost effective or practical. This has a high capital cost which the energy savings this provides are not enough to recover. This would also involve significant modification to the building facade which may impact building aesthetic and require additional approvals, which may not be desirable.

For the purposes of this feasibility study, none of the above façade demand reduction measures will be considered any further.

5.2.2 Energy Storage

In addition to thermal energy storage considered previously for the heating system, battery energy storage could be considered to help in reducing the peak loads to offset the increased electrical loads caused by electrification.

Battery Energy Storage Systems (BESS), where batteries are charged during favourable periods – i.e. off-peak times, or when renewable energy generation exceeds building consumption – and then discharged during peak demand times to assist in meeting the loads in lieu of drawing more grid power. BESS may help to avoid the need to upgrade the electrical infrastructure, however would incur significant CAPEX and maintenance costs and require space to install. In the context of these electrification studies, these will only be considered if there is a need for electrical infrastructure that a BESS can avoid in an otherwise more cost-effective manner.

Furthermore, applying multiple means of energy storage can have a “diminishing returns” effect. The hot water storage reduces the peak electrical demand associated with the hot water system, which may negate much of the benefit that BESS would provide. From GHDs viewpoint, considering storage as part of the necessary electrification upgrade works is more cost-effective approach than providing standalone systems.

6. Replacement Options

This section identifies and analyses electrification replacement options that GHD proposed to the OC for New Acton South. It includes a brief overview of the technologies available, followed by an analysis of those which GHD nominated as options. Where multiple options exist, this section provides key performance metrics and order-of-magnitude CAPEX, OPEX and simple paybacks, and then proceeds with a multi-criteria analysis to score each option against the project requirements identified earlier. The outcomes of the multi-criteria analysis will generally form the basis of the recommendations.

When developing options to consider, GHD aimed to develop options that represent different intents to other options, as follows:

1. Option 1 aims to represent the baseline minimal works necessary to achieve electrification. It prioritises low capital cost and minimising disruptions to the apartment during installation.
2. Option 2 targets high energy efficiency performance and resolving existing deficiencies.
3. Option 3, where present, provides alternative configurations including options specifically requested by the Owners Corporation.

This section is split into subsections for each type of gas systems that needs electrifying.

As noted previously, the focus of this assessment is full site electrification, namely the replacement of natural gas equipment with electric alternatives. Provision of photovoltaic systems are considered from the context of reducing energy consumption to offset the electrification impacts, and electric vehicle charging facilities are considered to holistically integrate other elements of the ACT Government's zero emissions strategy that could similarly have significant impacts on the building's electrical infrastructure. These additional works are covered below in support of the electrification feasibility study, and are not intended to be read as standalone feasibility assessments for those components. Should the OC be interested in considering these further, additional more-focused feasibility assessments may be required.

6.1 Space Heating

6.1.1 Technology Review

Apartments in Canberra are commonly served by electric reverse cycle split system air conditioners, which can provide heating and cooling to the space, and are not dependent on gas. Reverse cycle split system air conditioning is based on heat pump technology.

Heat pumps work by transferring heat between two locations to provide heating and/or cooling. In a typical residential split system air conditioner, heat pumps extract heat from the outside air and move it inside to provide heating to a space. In cooling, this process is reversed, by transferring heat to the outside. Residential split systems consist of an outdoor unit serving a single indoor unit (in standard split systems), or multiple indoor units (in a multi-head system). Refrigerant circulates between these units, absorbing heat from one side and expelling it to the other.

In some instances, apartment buildings contain alternative types of heating and cooling systems which would otherwise be more typical of commercial buildings. New Acton South is one such building.

These systems typically also use heat pump of some form, for which there are numerous types and configurations. Some of these key types and terminologies are outlined below.

– **Air-source vs Water source** – The source describes where the system extracts heat from. Typically heat pumps are either air-source (i.e. extract heat from the ambient air) or water-source (i.e. extract heat from a water supply). Air is typically the most common heat source because outdoor air is readily available. Water-source heat pumps, on the other hand, require a supply of sufficiently warm water (e.g. heat rejected to the water from a cooling or industrial process, or in-ground piping loops that extract heat from the relatively stable ground temperature).

– **Hydronic vs air-based** - This describes where the heat pump releases heat to. Typically heat pumps are either air-based (i.e. directly heating the indoor air) or hydronic systems (i.e. heating to a water circuit, which circulates to other heat emitters throughout the building such as wall radiators, in-floor piping loops, or air conditioning units which heat or cool air using the water circuit).

– **Package vs split systems** – This describes whether the whole heat pump system is packaged within a single unit, or the heat pump is split into two units with the heat rejecting parts and heat extracting parts physically separated but connected via refrigerant pipework.

– **Cooling/heating-only, reverse-cycle, heat recovery** – This describes the general function and purpose of the heat pumps. Cooling or heating-only units are the simplest, with the system always transferring heat in the same direction, either into the space, when heating only, or out of the space when cooling only. Reverse-cycle units contain components that are able to reverse refrigerant flow and therefore switch the roles of the heat rejection and extraction components to allow the heat pumps to provide either heating or cooling (although not simultaneously). Heat recovery units can also provide both heating and cooling, but are capable of doing so simultaneously. These contain two refrigerant circuits, and are able to reject heat from the cooling circuit into the heating circuit.

For New Acton South, the existing system uses water-source packaged reverse-cycle heat pumps. These integrate with a central water loop, which acts as the source. Packaged units located in each apartment extract or reject heat from the central water loop to heat or cool each space. A boiler is used to provide heat into the central water loop when required and an evaporative fluid cooler is used to remove heat, to make up from the heat added or removed by the packaged heat pump units.

The water-source packaged unit system at New Acton South contains substantial infrastructure, and is relatively new. Therefore, it is desirable to preserve this system, and investigate options that can integrate with it. Replacement options will therefore focus on hydronic heating options, that are able to replace the boiler to provide warm water to the central water loop.

Figure 6.1 Types of heat pumps (photos from Trane, Temperzone, Daikin) (L-R – hydronic air-source heat pump, hydronic water-source heat pump, air-based air-source package units, air-based air-source split system)

6.1.2 Options to be Considered

From the technology options outlined, the following are proposed for the heating system replacement options for New Acton South:

1. **Central air-source heat pumps** – This option directly replaces the rooftop gas boilers with hydronic air source-heat pumps. It provides moderate energy efficiency, has relatively high capital costs, requires a large footprint for outdoor plant space and its performance is dependent on ambient conditions.

   This option will use the free space that is available within the existing rooftop plant enclosure. However, it is anticipated that at least one of the existing evaporative fluid coolers will require removal in order to accommodate the necessary heat pumps to provide the required heating capacity. To make up for this loss of heat rejection capacity, the heat pumps will operate in reverse-cycle cooling when required to provide cooling into the condenser water loop. This will result in a loss of energy efficiency as compared to the fluid coolers. The central hydronic heat pumps will use R454B refrigerant, which is the low-Global Warming Potential (GWP) refrigerant option used for similar hydronic air-source heat pumps used in the HVAC industry. Products using natural refrigerants are limited in this application, with both R744 (CO_2) and R290 (propane) having heat pumps available but are either not operating at optimal water temperatures or available products are limited in capacity and the quantities required in this instance would not be practical in GHD's view (approximately 20 units).

2. **Ducted split system per unit:** This option proposes to provide single split systems for each apartment to replace the existing water-cooled packaged systems in the living room. This option is proposed in case the residents wish to consider decentralising from the central system. It is envisaged this option will provide outdoor units on balconies and new ducted units to replace the existing ducted packaged unit within the ceiling of each apartment. It will have impacts on the aesthetic of the building with possible implications on NCA approvals. These units will use R32 refrigerant, which is the low-Global Warming Potential refrigerant typically used in modern split system air conditioners.

Figure 6.2 Heating system – Air source heat pump, thermal storage tank, split system

Planning

No exemptions for external works exist from the NCA, so therefore Works Approval will be required.

Electrical works

The increase in electrical demand will require an upgrade to at least one substation transformer and the associated main switchboard. The main switchroom housing the main switchboard has spare space to stage the switchboard works. The transformer upgrade works will require a shutdown and the works undertaken by Evoenergy. This power shutdown should be able to be limited with either an alternative temporary power source or the power transferred temporarily to the other transformer if loads are reduced within the building for a period of time.

6.1.3 Multi-Criteria Analysis

This section provides detailed assessment of the options proposed. This includes making preliminary equipment selections for each option to estimate key outputs such as maximum electrical demand, plant area requirements, energy consumption, emissions, and costings (i.e. capital, energy, maintenance and 20-year lifecycle costs).

Table 6.1 provides a summary of these key outputs for each option. This forms the basis of a multi-criteria analysis provided in Table 6.2 which assesses each option relative to the weighted project requirements to determine the most suitable option.

Table 6.1 Heating system options - Summary of Options Analysis

Category	Item	Units	Options		
			Existing	1. Central Air-source heat pumps	2. Ducted split system per unit
Energy	Electricity	kWh p.a.	-	467,000	378,900
	Gas	kWh p.a.	2,023,900	-	-
Emissions	Electricity	kg_{CO2-e} p.a.	-	-	-
	Gas	kg_{CO2-e} p.a.	470,900	-	-
	Refrigerant	kg_{CO2-e} p.a.	-	6,052	12,347
Max. Demand	Electrical	kW	-	345.5	290.5
	Gas	kW	1,395	-	-
Sound	Sound Power Level	dBA	-	99	110

Category	Item	Units	Options		
			Existing	1. Central Air-source heat pumps	2. Ducted split system per unit
Space	Footprint	m^2	24.7	135.8	393.5
	Height	m	1.5	2.5	0.6
Weight	Mass	kg	3,200	14,900	12,400
Costs	CAPEX	$	-	1,914,000	3,806,500
	OPEX	$ p.a.	333,000	222,400	377,700
	Simple Payback	yrs	-	17.3	No Payback

Table 6.2 Heating system options - Multi-Criteria Analysis

Sub-Category	Importance Weighting	Option	
		1	2
Essential Requirements			
– Achieve full electrification of all gas equipment.		Y	
– Provide Electric Vehicle charging facilities		N/A	
– Comply with Territory Planning requirements and noise limits		Y	
– Avoid significant disruptions to occupants during works		Y	
– Work within constraints of building		Y	
Desirable Requirements			
Low Cost	**45%**		
Low capital costs	20%	3	5
Low operating costs (energy, maintenance)	20%	3	1
Low replacement costs	5%	4	3
High Performance & Robustness	**20%**		
High climate adaptability	5%	4	3
High usage adaptability	5%	3	4
Resilient	5%	3	3
Simple systems	5%	3	3
Low Environmental Impacts	**25%**		
Low aesthetic impact	5%	4	2
Low acoustic impact	10%	3	2
Environmentally sustainable solutions	10%	3	3
Other	**10%**		
Address existing deficiencies (e.g. age, condition, etc.)	5%	3	3
Minimise disruptions to occupants	5%	3	2
Score		**63**	**57**
Ranking		***1***	***2***

The multi-criteria analysis indicates that ***Option 1 – Central air-source heat pump*** is the highest scoring against the criteria. This provides a payback of 17 years, which is not ideal however Option 2 does not payback. Based on this, GHD recommend the heating electrification upgrade be based on Central rooftop air-source heat pumps.

6.2 Hot Water

6.2.1 Technology Overview

Hot water systems exist in a variety of configurations and water heating technologies. The two most applicable system types to this electrification feasibility assessment are described in this section.

Firstly, the most important component of any hot water system is the water heater. This heats the incoming cold water from 5-15°C to around 45-65°C before delivering this to the building occupants to consume. How the water heater achieves this differs between the following options:

- **Electric-resistive heaters** – Water is heated by running an electrical current through a resistor element to generate heat. All of the input electrical energy is converted to heat, therefore making them 100% efficient. They are relatively inexpensive to buy, are compact, and reliable. However they have a very high electrical demand, so in addition to the high operating costs these may also trigger upgrade works on the electrical infrastructure to accommodate.
- **Heat pumps** – Heat pumps extract heat from a low-temperature source – e.g. ambient air – and transfer this heat via refrigeration to where it is required, which in this case is the hot water. Heat pumps technically do not “generate” heat but rather transfer it. They are often defined by the type of heat source, with the most relevant type being ‘air-source’ (i.e. where heat is drawn from the ambient air). Heat pumps are substantially more energy efficient than electric-resistive (approx. 3-5 times), however their use requires careful consideration of the following:
    - Performance is dependent on climatic conditions. As the heat is being extract from the cold ambient air, the heating capacity and efficiency reduce as ambient conditions get colder, and defrost cycles are needed periodically to de-ice the units, which interrupt the heating output. Selection of air-source heat pumps to compensate for these factors can increase costs.
    - Physical dimensions are larger.
    - Unit weights are heavier.
    - Installation locations need to be accessible to ambient air. This presents potential noise concerns to neighbouring apartments and may also be problematic with respect to external aesthetics (i.e. planning requirements, etc).
    - Refrigerant volumes may present environmental or safety hazards if loss of refrigerant to atmosphere occurs. Heat pumps can be expected to leak a portion of their refrigerant and depending on the type of refrigerant and its Global Warming Potential (GWP), this will contribute to greenhouse gases emissions.
    - Higher capital costs.

The below Figure 6.3 shows example images of each type of water heater.

Figure 6.3 ***Types of water heaters (photos from supplier Rheem) electric-resistive (left), heat pump (right)***

The water heaters can be configured for use in either instantaneous systems or storage systems. Instantaneous systems generate the hot water as it is demanded and therefore typically require large heater capacities so they can meet peak demands. However in theory these will not “run out” of hot water, provided there is sufficient heater capacity. Storage systems, on the other hand, pre-heat the hot water and store above 60°C until such time as it is required, meaning the system can deliver the peak demands with a smaller heater capacity. They do require storage tanks of water which have large mass and can impose challenges on building structures and their capability to support these loads. As noted in the demand reduction section, hot water storage has advantages for electrification projects when demand reduction is considered important to minimise impacts on electrical infrastructure.

Instantaneous electric hot water systems are available, which use electric-resistive heaters (as heat pumps are typically not responsive enough). These systems are low cost, small footprint, low noise, etc. However as outlined in Table 5.2, the required heater capacity is substantially higher, and combined with the high power draw of these types of heaters relative to heat pumps, the resulting electrical demands are significant. These types of instantaneous electric systems may be suitable on small hot water systems where electrical impact is less pronounced, however for large-scale central systems these types of systems in many instances will trigger the need for electrical infrastructure upgrade. As such, for the central hot water systems, GHD will focus on hot water options that incorporate storage.

6.2.2 Options to be Considered

From the technology options outlined, the following are proposed for the hot water system replacement options for New Acton South:

1. **Central Electric-Resistive with Storage –** This option proposes electric-resistive elements to heat and store water to a minimum of 60°C ready for use by the residents. This option aims to represent the lowest capital cost and provide the least disruption to the apartment when implemented, however will have higher energy consumption, electrical demand and operating costs.

   This option proposes to retain the existing hot water system configurations, with one central system on ground floor serving Levels 1-9 and the other central rooftop system serving the Levels 10-17. The types of equipment to be used will be a combination of electric storage tanks sized to the required heating capacity, and then additional storage tanks as necessary to make up the remainder of the required storage capacity. This new hot water plant will connect into and reuse the existing hot water pipework to serve the building. No works to the hot water system are envisaged beyond the central plant locations.
2. **Central Heat Pumps with Storage** – This option contains air-source heat pumps combined with storage tanks, that like Option 1 stores hot water at 60°C ready for building use. This option is more energy efficient than Option 2, but has a higher capital cost, will require a larger outdoor plant space and will generate more noise.

   Unlike Option 1, this option is proposed to combine the two systems into the one. This consolidation of the hot water plants is required due to the lack of plant space in the carparks or at ground level to installed new air-source heat pumps. The one central system will be installed at roof level with new pipe droppers to connect to the ground floor system.
3. **Central Water-Source Heat Pumps with Storage** – This option contains water-source heat pumps combined with storage tanks. This option is the highest energy efficiency and connects to the proposed heating water system to use the heating water generated as a water-source for the hot water heat pumps. New heat source pipework will be reticulated from the rooftop heating water system to the rooftop hot water plant and to ground floor hot water plant. Existing storage tank locations will be retained. New pipework risers will be reticulated through the core risers in the building.

Hot water heat pumps are available with several options for refrigerants. Typically, R134A has been the most common, although recently natural refrigerants such as R744 (carbon dioxide) and R290 (propane) have become available and other low Global Warming Potential (GWP) options exist such as R1234yf. For the air-source heat pump options, the refrigeration systems are required to provide sufficient lift to extract heat from cold ambient air in Canberra (-5°C) up to hot water storage temperatures exceeding 60°C to prevent growth of legionella. This large operating range for most heat pumps is a challenge and results in heat pumps using R134A and R290 being supplemented by an electric-resistive booster element when ambient conditions are too cold (below 7°C). However, heat pumps using R744 (CO_2) are transcritical systems and operate at high-pressures to provide high-temperature hot water without the use of the booster elements, allowing for higher efficiency at the cold ambient design conditions. Additionally, the use of a natural refrigerant makes this an attractive option in the event of refrigerant leakage. Therefore, if air-source heat pumps are being considered, the CO_2 will be the refrigerant considered. For water-source heat pumps, these are extracting heat from a condenser water system and do not need to require electric booster elements, and therefore will be based on low-GWP R1234yf option heat pumps.

Planning

Initial assessment indicates that the hot water system works will require a Development Application, as there are no exemptions within the designated area. The National Capital plan height limit of RL617 will also need to be adhered to.

Figure 6.4 Hot water system – Options 1, 2 and 3

6.2.3 Multi-Criteria Analysis

This section provides detailed assessment of the options proposed. This includes making preliminary equipment selections for each option to estimate key outputs such as maximum electrical demand, plant area requirements, energy consumption, emissions, CAPEX and OPEX.

Table 6.3 provides a summary of these key outputs for each option. This then forms the basis of a multi-criteria analysis provided in Table 6.4, which assesses each option relative to the weighted project requirements to determine the most suitable option.

Table 6.3 Hot water system – Performance assessment

Category	Item	Units	Options			
			Existing	1. Electric Resistive	2. Air-Source Heat Pumps	3. Water-source Heat Pumps
Energy	Electricity	kWh p.a.	-	615,700	144,700	151,000
	Gas	kWh p.a.	751,200	-	-	-
Emissions	Electricity	kg_{CO2-e} p.a.	-	-	-	-
	Gas	kg_{CO2-e} p.a.	174,800	-	-	-
	Refrigerant	kg_{CO2-e} p.a.	-	-	2	3
Max. Demand	Electrical	kW	-	168.0	53.9	22.2
	Gas	kW	488	-	-	-
Sound	Sound Power	dBA	69		85	86
Space	Footprint	m^2	3.2	4.9	32.8	24.0
	Height	m	0.6	1.6	2.2	1.8
Weight	Mass	kg	300	2,200	7,900	6,900
Costs	CAPEX	$	-	139,700	871,500	559,000
	OPEX	$ p.a.	218,500	213,300	78,200	68,700
	Simple Payback	yrs	-	26.9	6.2	3.7

Note:

1. Cost estimates are based on preliminary estimate of scope.

2. Emission factors are based on NGA Factors (2024) for NSW/ACT and include a notional emission factor for the ACT of 0 kgCO_2-e/kWh due to ACT's energy market arrangements with renewable generators of electricity. Emissions from refrigerant is based on the assumption of 4% leakage.

Table 6.4 Hot water system options - Multi-Criteria Analysis

Sub-Category	Importance Weighting	Option		
		1	2	3
Essential Requirements				
– Achieving full electrification of all gas equipment.		Y	Y	Y
– Comply with Territory Planning requirements and Noise Limits		Y	Y	Y
– Avoid significant disruptions to occupants during works		Y	Y	Y
– Works within Constraints of Building		Y	Y	Y
Desirable Requirements				
Low Cost	**45%**			
– Low capital costs	20%	1	3	5
– Low operating costs (energy, maintenance)	20%	1	3	1
– Low replacement costs	5%	5	4	3
High Performance & Robustness	**20%**			
– High climate adaptability	5%	4	3	3
– High usage adaptability	5%	3	3	4
– Resilient	5%	3	3	3
– Simple systems	5%	4	3	3
Low Environmental Impacts	**25%**			
– Low aesthetic impact	5%	3	2	4
– Low acoustic impact	10%	4	2	3
– Environmentally sustainable solutions	10%	3	3	4
Other	**10%**			
– Address existing deficiencies (e.g. age, condition, etc.)	5%	3	3	3
– Minimise disruptions to occupants	5%	3	3	2
Score		**50**	**58**	**63**
Ranking		***3***	***2***	***1***

The multi-criteria analysis indicates that ***Option 3 – water-source heat pumps with storage*** is the highest scoring against the criteria. This provides the shortest return on investment and therefore will be the recommendation by GHD.

6.3 Electric Vehicle Charging

As Electric Vehicles (EVs) become more common on our roads, there will be an ongoing demand for EV charging facilities within apartment buildings. When considering the implementation of EV charging solutions, there are a range of technical and practical issues that need to be considered by the OC before deciding the optimal solution. This includes deciding the number of chargers that will be installed, the capacity of these chargers, and whether chargers can be shared amongst users. All these choices will impact the cost of implementation.

Central to decision making is the choice of charger as this has implications on the capacity of the electricity system to supply the current needed.

6.3.1 Technology Review

Charger types

Three types of chargers are used to facilitate different rates of Electric Vehicle charging which are broadly categorised as:

- Level 1 (slow)
- Level 2 (fast)
- Level 3 (rapid)

A summary of these different categories is provided in the table below.

Table 6.5 Types of EV chargers

Level	Power	Locations	Range	Speed
Level 1 (slow)	10-25 A single-phase	Typically standalone domestic homes	Adds 10-20 km of range per hour plugged in	Top up daily use, will not fully recharge a typical pure electric vehicle overnight
Level 2 (fast)	7 kW, 32 A single-phase	Locations where vehicles will be parked for a while: homes, apartment complexes, workplaces, shopping centres, hotels, etc.	Adds up to 40 km of range per hour plugged in	Top up average daily vehicle use in an hour, or deliver a full recharge overnight
Level 3 (rapid)	25–350 kW 40–500 A three-phase	Commercial premises and road-side locations	Minimum 150 km per hour plugged in	Up to fully recharged in 10 to 15 minutes

Note:

1. It is worth noting that different models of electric vehicles charge at different rates due to their internal equipment and batteries of different capacities. Due to this, some users may see charging times that are different to their neighbours.

Level 1 Chargers: Charging is suitable for residential parking locations such as within the parking garage due to long charge times. This limits the shareability of the chargers as vehicles must be parked for a long time. The advantage of this system is the lower initial cost and that more basic infrastructure is needed, assuming electrical supply is not an issue. However, in an apartment scenario, it is likely that the existing electrical supply may not have sufficient spare capacity, limiting the number of chargers that can be connected. If implemented together with a load management system, which limits the charging current to the chargers based on a predefined limit to avoid impacting electrical supply to the building, a further increased number of users will be able to be connected without building upgrades. This can however mean that users receive a decrease in the level of service as charging is controlled (particularly at peak times) or provided only at predetermined times. Level 1 chargers are typically connected to a static management system which have a fixed hard upper electrical limit and offer limited other smart capabilities. These systems can also require a yearly subscription charge per parking space or a rate per kWh, for significant on-going costs. The basic 4G or Wi-Fi signal access typically provided for their cost effectiveness can be affected by a basement’s structure, potentially cutting-off charging access when the signal is lost. The lower electrical load can also allow for the EV distribution boards and cabling to be rated to a lower electrical capacity, making for a cheaper install, though with less flexibility than level 2, and the electrical system may have limited expansion opportunities and upgrades may be required to facilitate the expansion.

Level 2 Chargers: These chargers provide a faster charge time compared to Level 1 chargers, and can draw more electrical power. This means simultaneous users will have a greater impact on the site electrical supply. These chargers can be provided for individual residential parking spaces as above or they can be effective in a shared system up to a limit. They can also be located inside or outside. When paired with a load management system the smarter level 2 chargers allow for a more dynamic use of the available electrical supply. Each apartment complex will have an electrical limitation based on the site infrastructure and their Evoenergy Connection Agreement. The load management system will monitor this limit against the usage of the building, allowing the available capacity to be used for EV chargers and avoiding drawing power at peak times (e.g. when everyone gets home after work, refer Figure 6.5). The system would be proposed with hardwired communications to each bay limiting data faults and allowing full management flexibility for maximum access to available supply, allowing the system to also prioritise between vehicles, where empty batteries can take priority over fuller ones. This method can allow for more vehicles to be charged simultaneously without the need for electrical infrastructure upgrades.

Alternatively, where chargers are used by multiple users in a shared system, it is advantageous to have the full capacity of the charger available to allow for turn-over as quickly as possible to provide opportunity for the greatest number of users. In this case, it is possible that a fewer number of shared chargers can have a greater impact on the electrical infrastructure than a higher number of load-managed individual chargers, and as such a smaller number of users may benefit from the chargers. Indicatively, the daily availability of the shared charger is expected to be around 30%, as accessible charge time is reduced while vehicles are moved and setup in the bay, peak times are prioritised by most users for convenience, and nighttime charging is limited as people are less willing to move their vehicles around. This will limit the total number of vehicles able to have access to the onsite chargers, at which point a load managed expanded system would need to be considered.

Level 3 Chargers: These larger capacity chargers allow for a much higher current to deliver a much faster rate of charge. They are typically also located at 'on-the-go' type locations such as short-term parking, at petrol stations or highway rest stops. Due to the complexity of the chargers themselves, they also have a higher capital cost. Without a significant revenue stream, they are unlikely to provide a suitable payback. These chargers have a large electrical load and would be a significant contributor to the site electrical load, particularly if multiple chargers were installed. Based on these reasons, Level 3 chargers have not been considered further for New Acton South.

Charging infrastructure providers

There are a number of infrastructure providers available that can manage a system on behalf of the OC. Infrastructure providers can also provide support in completing a project from inception to installation including ancillary items such as line marking, bollards and signage.

The providers' design package can nominate management systems with a number of options available such as payment and vehicle management which would need some form of connectivity to a communications system between chargers or externally. The costs can vary depending on system complexity, interconnectivity and physical locations and will need to be considered against the OCs' requirements.

Electrical infrastructure

For new buildings designed post-2022, compliance with the NCC clause J9D4 requires backbone infrastructure to be provided to enable the installation of EV chargers to 100% of parking spaces. However, in the case of retrofits for buildings that were built before this time, the electrical infrastructure may be limited in providing this required number of EV chargers in terms of EV distribution boards, cabling, and cable pathways.

Any alteration to the site electrical system will also require written notification to Evoenergy which may include supporting documentation such as drawings and maximum demand calculations for the new electrical load. Though not yet formally written, Evoenergy has advised that they are able to accept a load management system as a method to reduce the demand assessment for the site which can reduce the likelihood of needing a significant building electrical upgrade.

EV infrastructure is commonly considered through the following four categories:

– **Not ready**: Electrical infrastructure upgrades are required to facilitate the electrical demand for a one-to-one EV strategy where each resident has access to their own charger.
– **EV capable**: based on Building Code compliance, electrical capacity is available within the building. The required electrical infrastructure, EV distribution boards, metering and load management system are all in place. No additional EV infrastructure is installed and the final charger installation is by the resident with cabling back to the EV distribution boards, which will be of varying lengths for each parking bay.
– **EV ready**: In addition to the infrastructure provided above for EV capable systems, a connection point is provided within the vicinity of each carpark, allowing a provision of one per apartment. Metering and load management is provided by the OC. Final charger installation by the resident only requires cabling back to the parking bay connection point.
– **EV installed**: EV chargers are installed, metered and load managed to all parking bays. Resident is not required to provide additional infrastructure.

In lieu of providing chargers to all apartments, a shared system may be suitable from an initial cost perspective for existing buildings. This may be part of staged strategy on the way to getting full parking coverage. Shared chargers would be located in parking bays accessible to all tenants with electrical consumption paid by each user. The charging assets would be wholly OC owned.

Building impacts

It is understood that a car fire involving an EV vehicle behaves differently from an Internal Combustion Engine (ICE) vehicle, and although the risk of catching fire is less, the consequences are potentially more significant. The requirement for new buildings to facilitate EV chargers came into effect under the current version of the Building Code, NCC 2022, generally pertaining to electrical infrastructure with no additional specific fire protection measures outlined.

The Australian Building Codes Board, who publish the NCC, and ACT Fire and Rescue have provided the following documents as guidance for EV charging facilities within buildings:

– ABCB Advisory notice, Electric vehicles in buildings
– ACT Fire and Rescue, Fire safety guideline FSG-22 Electric Vehicles and EV Charging Equipment in the Built Environment

If a Fire Engineering Report is recommended by the building's insurer, Building Certifier or a specialist EV charging installer, that report will outline compliance issues with installing the chargers within the existing building and identify any required upgrades.

Planning

Initial assessment indicates that no Development Application is required for the EV system install, however, a Building Approval under the Building Act 2004 will be required as the works will affect the passive fire rating of the building.

The replacement of surface level parking spaces for private EV charging will trigger a Development Application if public carparks are removed from public use for private or public EV charging purposes.

6.3.2 Site specific considerations

The site has no visitor parking spaces so implementation of any shared systems would be by acquiring owners parking spaces (if agreed with owners) or require reconfiguration of non-parking OC areas to new parking spaces (though initial assessment does not indicate this is possible).

An EV charging survey undertaken by the OC indicates that 26% of respondents would be willing to rent their parking space for a shared EV solution. The installation would need to be considered longer term as owners buy and sell apartments and the parking entitlement changes. New owners may not wish to give up their parking spots and existing owners may change their mind over time. The OC has indicated that sentiment generally indicates a positive want for private chargers by owners.

The site is provided with 2 existing private chargers.

6.3.3 Options to be Considered

Based on the above technology review, the following options are proposed for New Acton South EV charging. Total site electrical load calculations, including apartments and electrification equipment are based on AS/NZS 3000 C2 calculation requirements. All options consider 186 users for the energy calculations.

1. **Individual level 1 chargers, full capacity** – Approximately 318 parking spaces are available to 186 apartments. The option will provide capacity for 186 Level 1, 2 kW chargers, with the remainder of parking spaces not provided with chargers. Units with 2 or more parking space allocations will be provided with capacity to connect 1 charger. The OC managed system will be based on an EV Ready infrastructure.
   - The total 280 kW additional load is outside the available capacity of the building and would require a dynamic load managed system to avoid significant substation upgrades and associated electrical works. The load management system will reapportion the loads throughout the day when capacity is

available and avoid charging during peak times. This option will have limited access to the full electrical capacity available on site as hard upper electrical limits and block-out periods are set.

- Eight new EV distribution boards will be required, spaced around the basement, supplied by the OC. Each parking space will be provided with a managed power point provided by the OC. Load management system (including 3rd party billing) is nominated to be supplied by the OC.
- Residents can plug their own Level 1 charging cable into the managed power point.
- A cheaper load management system is offset by the need for either a yearly subscription fee per connected charging bay (assessed in this option) or $ rate per kWh as an ongoing cost for either the OC or the user.
- Wi-fi access will be provisioned through the basement.

2. **Individual level 2 chargers, full capacity** – Approximately 318 parking spaces are available to 186 apartments. The option will provide capacity for 186 level 2, 7 kW chargers, with the remainder of parking spaces not provided with chargers. Units with 2 or more parking space allocations will be provided with capacity to connect 1 charger. The OC managed system will be based off an 'EV ready' infrastructure scenario. This option will have maximum flexibility for residents to access capacity with the dynamic load management system.
   - The total 978 kW additional load is outside the available capacity of the building and would require a dynamic load managed system to avoid significant substation upgrades and associated electrical works.
   - Eight new EV distribution boards will be required, spaced around the basement supplied by the OC. Each parking space will be provided with an isolation point provided by the OC. Load management system (including 3rd party billing) supplied by the OC.
   - Chargers will be installed by the residents back to their local isolation point. Costs for residents will be higher as chargers are more expensive than Level 1 charging cables.
   - Data outlets and cabling will be provisioned to each charging bay, provided by the OC.

– **Shared level 2 chargers** – Shared chargers will be provided based on 30% utilisation allowing usage by 64 EVs. No electrical supply upgrades are proposed for the site. 7 new charges are nominated to the carpark with owners cooperation required to acquire the bays. This option limits the number of users, however the backbone system can be designed with enough capacity to be expanded for chargers, a load management system and potentially modified to be part of one of the full system options in the future. No changers would be expected for the shared chargers as they would become private on the expanded system. In this option:
   - Main switchboard upgrade has been provisioned as part of the hot water/heating upgrade works and allows for additional spare connection points for the EV distribution boards so is not an additional cost for the EV charging solution.
   - One EV distribution board is proposed however this may require expansion to additional if available parking spaces are not close to each other. EV distribution board supplied by the OC. In this option the full charging capacity is available with no load management system proposed.
   - Chargers will be installed and owned by the OC.
   - Data outlets and cabling will be provisioned to each charging bay, provided by the OC.

6.3.4 Options Analysis

The following provides an analysis of the three options proposed.

Table 6.6 EV charging options - Summary of Options Analysis

Item	Units	Options			
		Existing	1. Individual Level 1	2. Individual Level 2	3. Shared Level 2
Max. Power	kW	14	Up to 2.3	Up to 7	Up to 22
CAPEX	$	-	359,100	586,000	79,000

Item	Units	Options			
		Existing	1. Individual Level 1	2. Individual Level 2	3. Shared Level 2
OPEX	$ p.a.	3,150	34,075	1,000	11,225

Note:

1. Electric vehicle charging energy consumption assumes 186, 186 and 64 users respectively per option that use on average 2,000 kWh per year, based on figures from: **How much electricity does charging an electric vehicle consume compared to typical household usage? - Electric Vehicle Council**
2. Power is based on 2 kw per Level 1 charger and 7 kW for Level 2 chargers (for non-load managed systems), and based on 0.38 kW per vehicle as a daily peak demand, as per Mumtahina, U. et al (2024). Constructing Australian Residential Electricity Load Profile for Supporting Future Network. *Energies* 17(12) **https://www.mdpi.com/1996-1073/17/12/2908**
3. For Options 1 and 2 these costs do not include the costs of individual chargers which is borne by the resident
4. The existing site is provided with 3 shared 7 kW chargers.
5. Refer to Section 4.3 for additional assumptions that form the basis of these calculations.
6. OPEX includes subscription costs under Options 1 & 3 and replacement costs for the existing and option 3. Replacement costs are not included in Options 1 & 2 as chargers are resident property.

The resident costs per option are estimated below:

Table 6.7 Estimated residential EV costs

		1. Individual Level 1	2. Individual Level 2	3. Shared Level 2
CAPEX (charger)	$	1,500-2500	2,500-4000	0
OPEX (subscription and energy)	$ p.a.	845	670	670

Note:

1. CAPEX costs include charger, power connection to local isolator, data connection to local outlet and cable containment.
2. Subscription costs are estimated at $175 per year per bay if passed on by the OC.
3. Electric vehicle charging consumption is per note 1. of Table 6.6. Electricity tariffs rates are per section 4.3.

Daily load profiles and the impact of EV charging are shown for the proposed options in Figure 6.5. The electrical load assumes the worst-case maximum demand day calculated for the site combined with EV charging. This demonstrates that Options 1 and 2 can accommodate charging for all residents whilst avoiding charging during peak times (6pm-9pm). During days of lower electrical demand, the load management system can make available the additional charging capacity over the peak period. In contrast, Option 3 can only accommodate a relatively low number of chargers before potentially exceeding the site electrical capacity causing an outage or requiring MSB and substation upgrades. However, with the substation upgrade works triggered by the heating upgrade this may allow substantially more chargers than currently allocated under the existing site capacity.

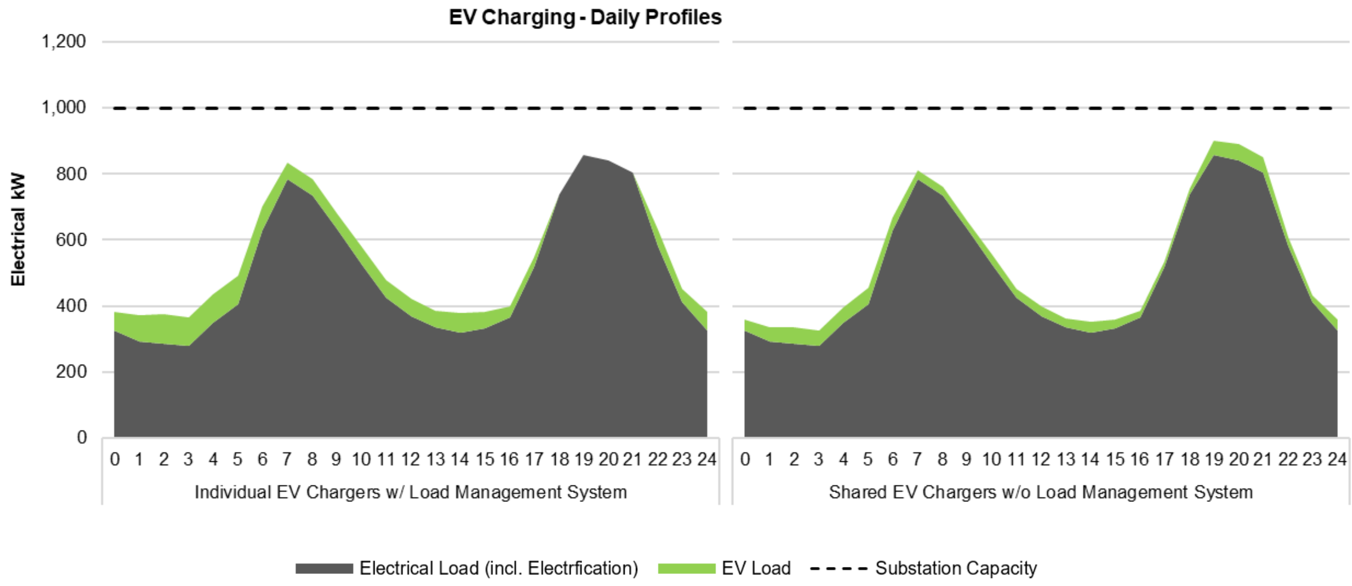


Figure 6.5 ***Daily Load Profiles – (left) Individual Level 1 or 2 chargers, full capacity (186 EVs), (right) Shared chargers, limited capacity (64 EVs)***

The selection of the above options is dependent on the appetite for upgrades by the OC at any particular point in time. This will be influenced by the number of current users, those currently considering EV and expected future uptake and the OCs ability to negotiate renting parking spaces from owners. There is the ability to consider a staged approach to lessen initial costs and start the journey of EV charging capability. For example, the shared system will be suitable for a period of time and could be expanded in stages to achieve full coverage of parking spaces over time. These options will need to be considered together with any building upgrade works. Notwithstanding the above, for the purposes of this feasibility assessment it is assumed that an EV-Ready solution based on ***Option 2 - Individual level 2 chargers, full capacity*** will be provided, with each apartment having opportunity to purchase and install their own individual Level 2 EV charger. This option provides the greatest equity, flexibility, reliability, maximum access to available power supply and reduced ongoing operational costs.

6.4 Photovoltaic Panels

6.4.1 Technology Review

Photovoltaic system

Photovoltaic (PV) systems are composed of two main components: the photovoltaic solar panels and the inverter.

The silicon based solar panels convert sunlight energy into direct-current (DC). The amount of current generated depends on the amount of available sunlight which is affected by clouds, shadows and the orientation and tilt that the panel is installed. The seasonal intensity and daylight hours also have an impact on the generating capacity of the system. The panels can still be effective in limited light as any reflected light can also be converted (though they are most effective with direct light). A photovoltaic system is typically made up of multiple panels of between 300-500 W each. The total number of installed panels will give you the system size usually in kilowatts.

Inverters take the DC electricity produced by the panels and transforms it into a usable alternating current (AC). The electricity can then be connected to the electricity grid. In the ACT this will be used directly within the building first with the excess exported to the grid (net metering).

The installation of a PV system requires approval from Evoenergy as the electricity utility. The size of the system will impact the application fee, approvals process and additional technical installation requirements. There are also limits on the amount of energy able to be exported to the grid. Based on a combination of the Evoenergy requirements the assessments will use a maximum 200 kW system size for the PV where possible.

SolShare

One of the hurdles for multi-tenanted buildings is the ability to access solar power with a common property roof. An Australian developed system called SolShare allows a 20 kW PV system to be shared with up to 15 units, allocating 1-5 kW to each. This system connects the power directly into each tenant's retail metered power supply, behind the meter, allowing the power to get used on site before any excess is delivered to the grid. For sites with more than 15 units, multiple SolShare units can be installed with their own dedicated PV panels and inverters, less efficient than a single large system as additional inverters are required.

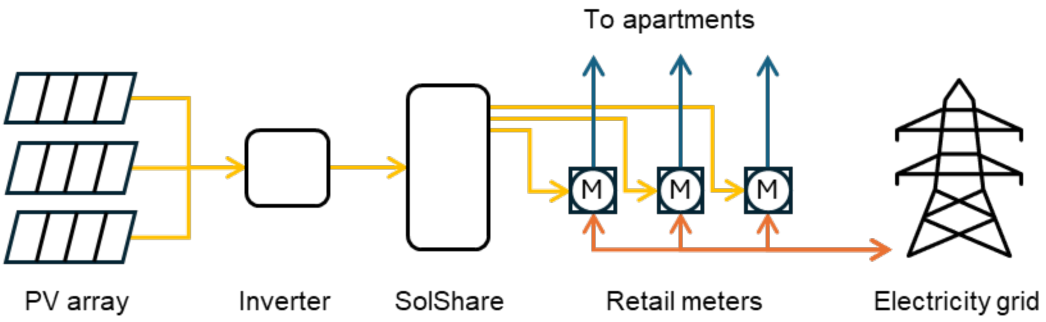


Figure 6.6 SolShare schematic

The system provides an algorithm-controlled approach to delivering power by monitoring the power supply used by each tenant. The unit initially sends power to offset power as it is actively used, each apartment using power at different rates through the day. Then over the course of a month the algorithm adjusts the power delivery to provide an equitable delivery across all apartments on that system. If the power profile for a tenant means there is limited power usage during the day (e.g. away from home during the day), the solar offset will be diverted through their meter to the grid under their solar feed-in tariff. The default algorithm is an equal allocation across tenants but can be configured to alternate configurations such as a unit entitlement % e.g. by bedroom number or floor area.

The SolShare system doesn't require modifications to a standard retail metering arrangement found in many apartments and also doesn't require all tenants to take part. A modification to the metering panel will be required for a set of main switches to allow the solar supply to be isolated for each apartment. There additional SolShare equipment will be required to facilitate the shared energy use and is recommended to be close to the metering equipment. The PV and SolShare system would be owned as an OC asset.

Batteries

Batteries can be used to support the PV system in times of high-power generation. Excess power that is not consumed within the building can be stored in batteries to be used at other times such as during periods of high electricity demand (load lopping). They can also be charged during off-peak periods where electricity is cheaper then supplied at other times. The batteries can also provide power during a power outage. To do anything meaningful the battery system size, amount of excess generation for charging, and the size of the load needs to be balanced.. This is unlikely to be viable in a large site such as an apartment where there is limited roof area compared to power usage, the power would be utilised within the complex before there is sufficient excess energy to be stored. The grid supply in Canberra is also stable so would have limited use. Special protections would also need to be put in place to ensure power is not exported to the grid at these times.

Most household and business batteries are lithium-ion batteries. Lithium-ion batteries have high performance, long lifetimes and low maintenance needs. They have almost entirely replaced older, lead-acid batteries in the market. Other emerging technologies such as solid state, iron, sodium-ion and flow batteries are currently under development.

As with EVs there are fire risks associated with batteries located within a building. The NCC requires battery systems of 12 V and 200 kWh to be installed within a 2-hr fire rated room, however at a residential level there is little to no likelihood that a system will get this large. The system can also be placed outside to remove this impact from the scope.

The site-specific energy breakdowns provided in the following section will outline how viable a battery system is for this site to offset the electrification scope based on utilising free solar energy. The battery system will not be considered for site peak demand optimisation or grid charging.

Small-scale technology certificates

As part of an Australian Government initiative to improve the uptake of renewable systems, Small-scale Technology Certificates (STCs) can be created to help offset the costs of renewable energy systems such as PV. These are applicable to PV systems of no more than 100 kW. Larger systems and multiple systems totalling more than 100 kW for a site are not eligible. Certificates will only be generated for systems that meet this and other strict requirements including using accredited designers and installers. STCs are generally earned and then traded by a registered agent for a cash offset on the system installation. The value of the certificates are variable, set by a market value but is typically around $37-$40 per certificate. With the program coming to an end in 2030, the deeming period for the generation of the STCs has dropped from a peak of 15 years to 6 years in 2025, reducing by 1 year up to 2030, meaning the total value of the incentive will drop yearly towards zero.

6.4.2 Options to be Considered

Based on the above and the preceding technology review, the following options are proposed for New Acton South PV systems:

1. **PV system sized to maximise shortest payback period:** The PV system is sized to less than 100 kW to minimise the payback period while STCs are able to be generated. Due to the limited roof space available the system size is limited to 63 kW over 404 m^2. The layout of the panels will need to allow for the existing roof mounted services and access to each, indicatively providing a 70% efficiency factor applied to the yellow highlighted roof area in Figure 6.7. The system will be connected into the common services supply.
2. **PV system sized to maximum PV system sized to maximise shortest payback period with a management system such as Solshare**: The PV system will be sized to 63 kW per the above, to the yellow area in Figure 6.7. The 186 apartments split into 13 SolShare units with 4.8 kW each from the 63 kW array. The solar energy will offset resident power in this scenario. There is sufficient space on the SolShare units to also connect the common and commercial power.

Figure 6.7 Roof area for PV systems

6.4.3 Site specific considerations

The available roof area is very limited for this site as well as being covered by NCA planning restrictions that may limit the extent and tilt angle of panels. There are a limited number of vent pipes, exhausts, etc. on the roof however all install points will need to be coordinated with the pedestal pavers installed as part of the waterproofing system. The system capacity calculations allow for a spacing efficiency factor to allow for clear space used for walkways, locating panels around roof mounted services and shading.

Figure 6.8 Roof obstructions

An energy assessment of the maximum available PV system is provided below against the future electrified loads for the building. PV panel ratings are based on 440 W panels. The graph shows the energy users above the line and the solar generation in yellow below the line. Adding the two sides gives the resulting dotted line indicating the PV system modelled is sized to provide minimal offset against the building load. This also indicates that there is no excess energy generated during the year to be stored in batteries. As such, batteries will no longer be considered as part of the presented options as there is very limited opportunity for their operation.

The hot water and heating systems system connected to the common power supply will consume 135,800 kWh and 378,900 kWh in a year respectively. The proposed Option 1 PV system will be able to generate 90,300 kWh in a year, significantly less than the electrification works indicating a full offset for the electrification works is not possible within the roof constraints of the building, refer below.

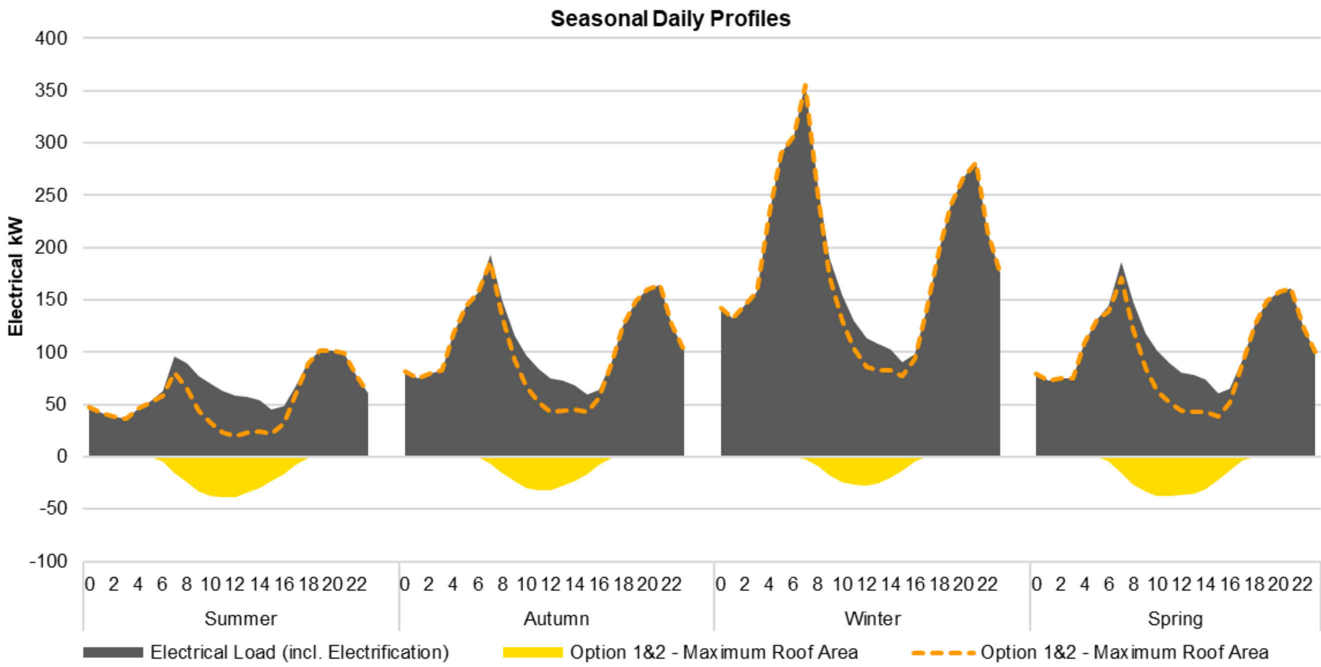


Figure 6.9 Post-electrification daily loads by season

Planning

Initial assessment indicates that the PV system works will require a Development Application as there are no exemptions under the NCA within the designated zone.

6.4.4 Options Analysis & Recommendation

Table 6.8 Photovoltaic system options - Summary of Options Analysis

Item	Units	Options		
		Existing	1. Shortest Payback	2. Shortest Payback with SolShare
Power Generation	kW	-	63	63
Energy Savings	kWh p.a.	-	90,300	90,300
Roof Area	m^2	-	380	380
Mass	kg	-	3,260	3,260
CAPEX	$	-	237,600	497,600
OPEX Savings	$ p.a.	-	21,900	14,100
Simple Payback	Yrs	-	10.8	35.3

Notes

1. Values are based on panel 20° tilt and 5° orientation from PVWatts – NREL https://pvwatts.nrel.gov/pvwatts.php
2. Refer to Section 4.3 for additional assumptions that form the basis of these calculations.

Both systems generate the same amount of energy, however to provide an equitable distribution of power to residents through the SolShare system the paybacks periods are long when the additional equipment costs are considered with the limited roof space.

To offset the new electrified site demand ***Option 1 – Shortest Payback*** is recommended.

6.5 Billing Arrangement

6.5.1 Overview of Options

Gas usage for hot water is currently metered and billed by a Meter Data Logger (MDL) system. The existing Meter Data Logger (MDL) system utilises a network of water meters to monitor hot water usage at each apartment. A calculation is completed by the energy retailer based on the amount of water metered to bill the amount of gas used to heat the measured amount of water. The resident is able to pick their own energy retailer (e.g. ActewAGL, Energy Australia, Origin, etc.) for their gas bill but the metering system is owned by Jemena.

The hot water system is provided with a dedicated gas and cold-water meter as a check against the amounts billed to the residents but is not directly billed to anyone. The two meters also contribute to the conversion factor shown on the gas bill.

Currently this system is not able to be converted to monitor an electric hot water system. At present there is no electricity distributor-owned equivalent system. Any changes to the billing management through the MDL will require ending the contract with Jemena, which at this point does not have a fee associated. Each tenant will be required to cancel their gas account and Jemena organised to remove the MDL system once all accounts are cancelled. If the MDL is not removed, the retailer may continue to log hot water usage and continue to issue bills accordingly. It is anticipated the hot water meters may not require removal, however this is at the discretion of Jemena. An alternative billing system is then required to be put in place for the hot water billing. As electric hot water demand and technology evolves, it is expected a suitable alternative to allow for electricity billing of hot water usage will be developed, however this is yet to be confirmed as it is reportedly still in development by service providers. As such a bulk, or bulk-plus-private metering system will be required per the below two options.

The following options may be considered for metering and billing of hot water with the installation of a new electric domestic hot water system:

1. **Strata fees** – In this option, the electrified hot water system will become unmetered to tenants with the total cost borne by the OC and charged to the tenants via a levy. This could have the effect of tenants using more hot water than if they were accountable to their own usage through a bill.

   The system does, however, have the benefit of only requiring either one new meter per hot water system or being connected into the common services electricity supply, which will reduce the complexity and installation cost of the system. The existing MDL meters can be disconnected.

   It is noted that the OC does charge residents strata fees currently and would be a similar approach moving forward.

2. **New embedded network** – An alternative system available is the embedded network. With this system, the complex is provided with a new parent electrical meter on the incoming electrical supply and a single owner pays for the electricity at a cheaper bulk rate. Each tenant is then billed privately by the owner based on their individually metered consumption. The system would be required to be managed by the OC or by a third party as the embedded network operator, not Evoenergy or the energy retailer. Solar connected into the system can offset consumption for all tenants.

   It would be proposed that the system is set up to mimic that of the existing MDL with local hot water meters and a bulk electricity meter on the supply to the hot water. This system would not allow the tenants to connect to their retailer of choice, creating simplicity across the system but losing consumer protections afforded by a regulated system.

   The conversion process would require terminating all the gas connection contracts and removing the existing meters, to be replaced with new parent and child meters managed by the OC/third party.

At this stage, GHD propose ***Option 1 – Strata fees*** as the method for billing residential and commercial tenants for the electricity consumption to generate hot water. This is proposed at least for the short-term, until an alternate approach that permits residents to be billed directly can be developed through the service provider. The site currently already uses levies for some services and would be an extension of that service.

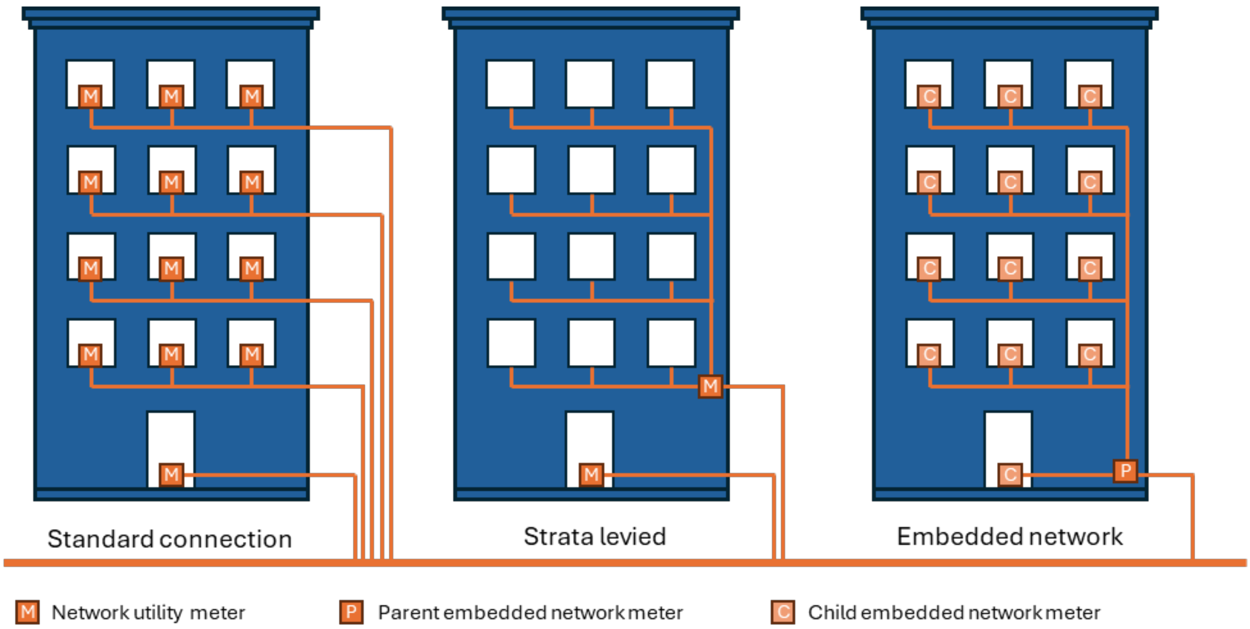


Figure 6.10 Billing types

7. Concept Development

The recommended electrification options for New Acton South from the previous options assessment will be developed further in this section, to a level of detail that enables the following:

– Impacts assessment and identification of associated works.
– Assessment of risks.
– Development of an Implementation Strategy.
– Estimation of energy use and greenhouse gas emissions.

It is important to emphasise that concepts developed throughout this section are not designs that are ready for implementation by the Owner's Corporation. These are scopes developed based on the feasibility studies conducted by GHD as outlined in this report. When ready for implementation, the Owner's Corporation will need to engage a suitably qualified engineer or design practitioner to further develop these concepts into detailed designs ready for implementation.

7.1 Concept Development

In summary, the feasibility assessment has adopted the following works for New Acton South:

– Heating System – Central hydronic water-source heat pump, injecting heat into the condenser water system.
– Hot Water System – Water-source heat pumps with storage, connecting to the heating water system as a heat source.
– Photovoltaic System – Maximise to available roof space.

Table 7.1 further develops these works, in terms of outlining the associated scope and providing additional commentary on sizing assumptions, nominal product selections and additional considerations.

Note, electric vehicle charging facilities were assessed however no option has been recommended, as these are dependent on the number of EV users and appetite of the OC and the residents to undertake the upgrade works. Table 7.1 does not further develop the scope for EV charging facilities. However, Option 2 – Individual level 2 EV ready has been considered in further analysis to allow for indicative costs and planning.

Table 7.1 Proposed Scope of Works

#	Scope	Proposed Scope
1	Space Heating	**Description:** Replacement of the existing rooftop heating water plant with new air-source heat pumps and circulating pumps. New heating water system provides a heat source into the condenser water system for the apartment packaged air conditioning units and also the hot water heat pumps (refer to item 2). Existing condenser water system and associated packaged units are to be retained, except for one of the evaporative coolers which will be removed to accommodate the new air-source heat pumps. Refer to Figure 7.1. **Preliminary Scope:** 1. Demolish and removal from site of existing heating water plant, including: • Two gas condensing-type boilers, circulating pumps, and associated frames, pipework, connections, controls, electrical, etc. 2. New heating water plant, including: • 3x hydronic air-source heat pumps with in-built circulating pumps. • Buffer tank • Expansion tank and make-up water • Water treatment dosing pot • Plate heat exchanger • Pipework, insulation, valves and fittings. 3. Automatic controls: • Connection to existing BMS, including sensors, controllers, programming, etc. 4. Electrical:

#	Scope	Proposed Scope
		• New switchboard for heating plant. Located adjacent new plant on rooftop, with new sub-mains cable back to basement Main Switchboard. 5. Building works: • Lifting and craning for rooftop equipment • Support frames for pipework, units • Plant fixings and making good roof membrane. **Considerations:** – Heat pumps sizing is based on the following: • 1,010 kW heating capacity (based on 807kW of heat source for the heating system and 150kW of heating source for hot water plant +5% safety margin). – Sizing is based on the heat load calculations performed for the building using Carrier HAP v6.1, as noted previously. This is based on actual geometry and information for building construction gathered during the site visit and from as-installed documentation provided. – Nominal equipment selections are based on the following products: a. Heat pumps: 3x Trane CXAF 165 HE. b. Buffer tank: 1x Aquazone AVBT-2000-C0 – Billing: no change to existing billing structure for electricity. Gas account will be cancelled.
2	Hot Water	**Description:** Existing two hot water systems (Levels 1-9 system and Levels 10-17 system) to be replaced with water-source heat pumps with hot water storage. Existing plant locations to be reused (rooftop and ground floor). **Preliminary Scope:** 1. Demolish and removal from site of existing hot water plant, including: • Ground floor: 12x gas hot water units, incl. frames, pipework, connections, controls, electrical, etc. Existing storage tanks to be retained. • Rooftop: 6x gas hot water units, incl. frames, pipework, connections, controls, electrical, etc. Existing storage tanks to be retained. 2. New hot water plant, including: • Water-source heat pumps • Additional storage tanks • Pump circulators. • Pipework, insulation, valves and fittings. 3. Controls: • Hot water plant central control system, including sensors, controllers, 4. Electrical: • New switchboard per hot water plant. Located adjacent new plant, with new sub-mains cable back to basement Main Switchboard. 5. Building works: • Lifting and craning for rooftop equipment • Support frames for pipework, units • Plant fixings **Considerations:** – Hot water plant sizing is based on the following: • Levels 1-9: 96kW heaters with 3,060L storage (to deliver peak 3,600 L/hr). • Levels 10-17: 72kW of heaters with 1,530L storage (to deliver peak 2,400 L/hr). – Sizing is based on the cold-water make-up logging undertaken for the Levels 1-9 system. An average daily load profile was calculated from 3 weeks of demand logging, which was then scaled to meet the peak daily consumption observed +20% safety margin, and then the profile was further modified to incorporate a 1-hour long high-demand peak at a rate matching the peak hourly demand observed +20% safety margin. The profiles were then scaled for the Levels 10-17 system based on number of each type of apartment. Heater capacity was sized to match the average daily load and the storage is sized to meet the short peak demand periods with a maximum 5-6 hour recovery period. – Nominal equipment selections are based on the following products:

#	Scope	Proposed Scope
		a. Levels 1-9 system: 3x Rheem W2W YF-Series heat pumps, 5x Rheem 410L storage tanks. b. Levels 10-17 system: 2x Rheem W2W YF-Series heat pumps, 3x Rheem 410L storage tanks. – Staging works will be required to utilise the existing plant area. As existing systems are oversized it may be possible to remove some gas units in a staged manner to facilitate the new equipment installation. The east plantroom is provided with more free space than the wester building. – Billing: As per Section 6.5.1, billing residential and commercial tenants for the electricity consumption to generate hot water is proposed to be via strata levies.
3	Photovoltaic System	**Description:** New PV systems installed across upper level of rooftop, as follows: **Preliminary Scope:** – Supply, installation, commissioning and testing of new PV system, including. • New inverters, PV panels and frames for roof incline • Electrical: New submains from roof to MSB in basement **Considerations:** – Total sizing of system is for maximum 63 kW. This is serving only the common areas, with no proposed connections to residents. – Frames to be installed to existing roof structure.

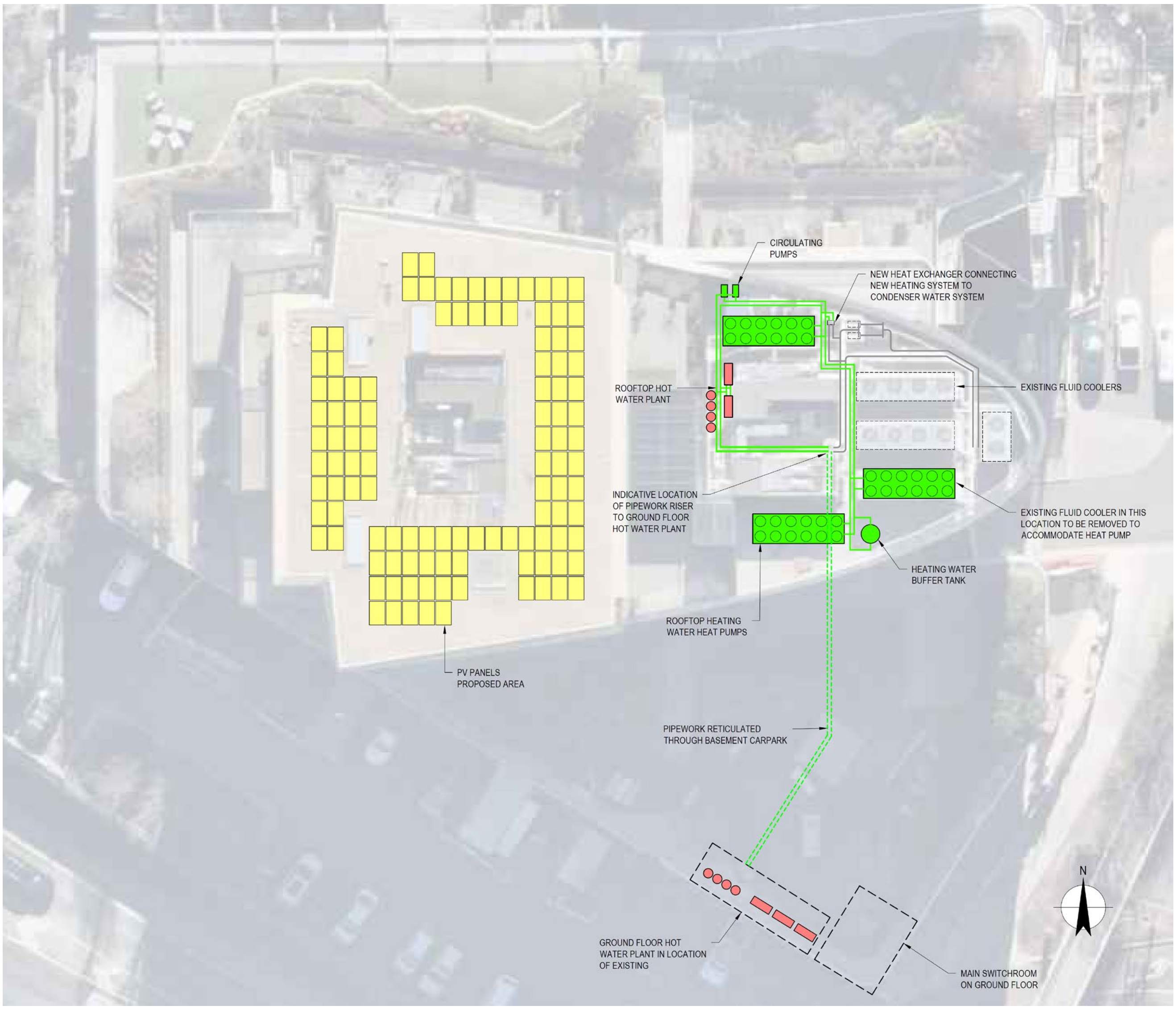


Figure 7.1 Sketch of Proposed Electrification Works

7.2 Impacts Assessment

An impacts assessment was undertaken for the developed concepts to determine what consequences or additional works are necessary to facilitate the electrification works, in addition to the PV systems and EV charging facilities. The potential impacts assessed include the following:

- Electrical, including assessing the impact of the increases in electrical demand caused by the electrification works and identifying the potential need for electrical infrastructure upgrades (incl. substations and main switchboards).
- Structural, including assessing the impact of the increased equipment weights imposed on the roof structure and identifying whether there is a need for structural reinforcements or new structure to accommodate this.
- Acoustics, including assessing the noise impact caused from the proposed new electrification works from a compliance with regulatory noise limits and acceptable indoor sound levels, and identifying whether any noise treatment measures are necessary.
- Planning and Environmental approvals, including assessing the proposed works against the Planning Act 2023, to identify any requirements, limitations and fees with the nominated electrification works.
- Regulatory and Authority approvals, including assessing the proposed works against the Building Act 2004, to identify any requirements, compliance issues, and fees with the nominated electrification works.

Table 7.2 summarises this assessment and identifies associated works that should be allowed for with these electrification projects. These assessments are based on the concept development provided in Section 7.1 and the assumptions outlined in Section 4.3.

Table 7.2 Impacts Assessment

Category	Impact	Assessment
Electrical	**High**	– The existing electrical maximum demand for the site was calculated in accordance with AS/NZS 3000, with an estimated peak demand of 525 kW. The proposed new electrification works is estimated to increase this to approximately 1019 kW (+494 kW). – The capacity of the existing electrical infrastructure was assessed to limited by the 2X500 kVA substation. – **Based on this, the power supply to the site is not expected to accommodate the increase due to electrification works as such a new MSB and substation upgrade will be required.**
Structure	**Low**	– Structural drawings are required to confirm the existing upper roof slab has acceptable live loading capacity to cater for the PV system. At this feasibility stage it is considered likely that the roof structure with no structural modifications has capacity exceeding the proposed PV system loading. – Structural drawings are required to confirm the existing lower roof slab has acceptable live loading capacity to cater for the proposed heat pump and hot water plant. It is considered likely that the roof structure has capacity exceeding the proposed heat pump and hot water plant unit loading of ~3.4kPa. – However, the proposed 2000 L storage tank in its current arrangement appears to overload the assumed load limit of the existing roof slab structure. It is reasonable to assume that with the introduction of load bearing spreader elements, that the concentrated load imposed can be reduced below the assumed live load limit typically of structures used to support plant, machinery (5kPa/4.5kN).
Acoustics	**Medium**	– The proposed heating water plant is predicting noise levels at the nearest surrounding rooftop balcony of approximately 63 dBA and result in non-compliance at these receivers. The predicted noise level at internal receivers is predicted to be approximately 43 to 53 dBA based on partially open and closed windows respectively and therefore exceed AS2107 internal noise criteria. The noise level at the Western Boundary is predicted to be approximately 50 dBA and potentially exceed the night-time criteria. There are limited options available to mitigate this noise level on the balcony in a reasonable and feasible manner and therefore discussions with the owners should be discussed if these works were to progress.
Planning and Environ-	**Medium**	– The New Acton South site is within Designated Area where the National Capital Authority has planning jurisdiction. There are no exemptions for external works within the

Category	Impact	Assessment
mental Approvals		Designated Area, so a Works Approval will be required. A works approval application will be assessed against the requirements of the National Capital Plan. – New Action South is within the West Basin Precinct. Chapter 4.7 of the National Capital Plan sets out the key objectives and detailed conditions of planning, design and development but they are generally not applicable to the works contemplated in this project. – Section 2.4 of the National Capital Plan states that *'In Canberra Central no building or structure which protrudes substantially above the tree canopy must exceed a height of RL617'.* This control could limit the height of permissible rooftop structures, although it expected that no mechanical equipment will exceed this height. – Works approval application fees are $5,335 + 0.20% of the amount in excess of $1,000,000 but exceeding $10,000,000.
Regulatory and Authority Approvals	**High**	– Under the Building Act 2004, proposed works will require a Building Approval, as the proposed works may affect the structural integrity or passive fire rating of the building. – The proposed new works are expected to be considered compliant with the NCC and the referenced Australian Standards. Only new works are deemed necessary to comply, existing systems being connected are not expected to require upgrading to comply with current standards. – Building Approval fees are estimated in this range of $6,000-8,000. – Demolition of redundant gas supply pipework also has potential compliance impacts. Demolition of a service affects the original compliance of the building and therefore the new demolition works are expected to comply. This is especially relevant with pipework penetrations in fire barriers, which are treated to mitigate the spread of fire. Unused services penetrations in fire barriers are not considered in the NCC as a compliant manner to maintain the integrity of a fire barrier. Furthermore, redundant services left in situ create potential safety risks in future if personnel unknowingly connect under the expectation this is fit for reuse. Decommissioning therefore must be undertaken to ensure there is no mistake that the service can be reactivated. This may come in a variety of methods and may not necessarily require full removal such as to inaccessible areas. However, as a minimum, it would be expected that: • Redundant penetrations in fire barriers are to have the pipework removed, and the opening sealed to not compromise the Fire Resistance Level of the fire barrier. • Exposed and easily accessible pipework is to be removed (i.e. through carparks, on rooftops, etc) • Pipework concealed in inaccessible risers or plasterboard ceiling spaces may consider non-removal decommissioning and make-safe methods (e.g. cap-off ends). These will require discussion and approval with a Building Certifier. – As noted previously, should EV charging provisions be considered, site specific advice may be required, with potential upgrades necessary to achieve compliance..

From the impacts assessment in Table 7.2, the following additional scope of works have been identified to facilitate the proposed electrification works:

1. Electrical Infrastructure Upgrade: This includes replacement of the substation transformer supplying the common services to 750 kVA. A new MSB for that supply is proposed within the switchroom for a new MSB or extension to the existing MSB. The increased supply will cater to the increased EV capacity, hot water and heating loads as well as supplying the existing connected services.
2. Decommissioning of Gas Supply Pipework: This includes:
   - Isolation, decommission and demolition of gas supply meters, regulators and pipework in exposed and easily access areas. For New Acton South, this includes inside the gas meter room, throughout the carpark, exposed on rooftops.
   - Removal of all redundant gas pipework in services penetrations in fire barriers, and fill opening to maintain passive fire integrity of fire barrier, including at apartments.
   - Decommissioning and make-safe pipework concealed within inaccessible areas, including capping the ends and providing signage on capped ends.

7.3 Risk Assessment

The proposed electrification works for New Acton South contain risks that have the potential to undermine the successful delivery of these works. Table 7.3 identifies and summarises these risks along with potential mitigation measures that can be applied to the implementation strategy to maximise the chance of success.

Table 7.3 Risk assessment

Risks	Mitigation Measures	Risk Rating
Heating & Hot Water		
Sizing of heating and hot water plant risks: The approach recommended and adopted in this feasibility study is to undertake logging of the actual demands of existing systems to inform the design and selection of new electrification systems, to reduce oversizing systems and the resulting higher costs and challenges to solve. However this introduces the risk that logged demands are not representative of the worst-case scenario, resulting in systems decisions being made based on data that is not appropriate, resulting in under-sized equipment that is not fit for purpose.	– Log demand over a longer time period, including higher peak periods (e.g. winter season, non-holiday periods where building occupancy may be less, etc). – Apply safety margins over the monitored data.	**Low**
Industry resistance to proposed approach: The design of hot water systems is conventionally provided by suppliers (e.g. Rheem, Rinnai, etc). These suppliers rely on tested and proven rules-of-thumb which are typically very conservative, as they understandably do not want to risk under-sizing a system and receiving complaints. However the proposed electrification approach requires an engineering approach to analyse and incorporate actual loads in efforts to reduce demand. This approach may not be fully understood or embraced by the engaged designers or suppliers. Furthermore, designers or contractors often have preferred suppliers they deal with, who may only offer certain products that are not applicable or compatible with the proposed approach. Therefore there is a risk the recommended approach may not be offered as a solution from the engaged designers.	– Engineering approach is recommended, where engineering design consultant is engaged to oversee the proposed logging and detailed design using this data. – OC to provide clear brief to the design engineers to outline requirements of the demand reduction approach. – Detailed design of measures to undergo an engineering process, whereby engineers use the logged data to using logged data. – Ensure designers/suppliers are considering the full building impact including structural and electrical capacity.	**Low**
Interruptions to tenants during works: The recommended upgrades propose to provide new heating and hot water plant that connects into and reuses the existing systems. This will require some downtime as the heating and hot water plant is changed over from old to new. If not carefully planned, there is risk of unacceptably long outages of services to building occupants. Furthermore, the works undertaken can generate noise that could be disruptive to residents in nearby apartments.	– New plant to be installed in the free rooftop space within the existing plantrooms whilst the existing plant remains operational. Once the new plant is installed and operational, the changeover works can be carried out over a shorter period (estimated half day outage). Then as the new plant operates, the existing plant can be demolished.	**Medium**
Billing of residents: Currently there are limited options to bill residents for central electrical hot water in a similar manner to the current gas hot water arrangement. The options available are practically limited to strata levies in the short-term. These are expected to require getting consensus with residents, which may present challenges which could stall the progress of electrification works.	– Levies is the likely option in the short-term, although this could transition to another approach in the future.	**Medium**
Cold climate performance of heat pumps: The recommended hot water solution extracts heat from the ambient air to heat the water. These systems decrease in performance as ambient conditions become colder. If these factors are not suitably allowed for, the performance of the hot water plant may be affected.	– Selection of air-source heat pumps to compensate for the reduction in performance.	**Low**
EV Charging		

Risks	Mitigation Measures	Risk Rating
Significant upgrade works for fire and structure: If site specific advice identifies significant upgrade works to the fire protection services or building structure, these could be expensive and may impact the uptake of electric vehicle charging facilities in the building.	– Engage Building Certifier and insurer early to whether site-specific safety advice is necessary and to enable planning.	**High**
Associated Works		
Electrical capacity: The existing maximum demand calculation indicates the electrical loads will not be sufficient for the capacity of the site against the substation serving the heating plant. There is cost and disruption risk to the residents as the impact of an electrical upgrade works will require power outages and input from Evoenergy for the substation works.	– Log actual electrical demand over a longer time period prior to any works proceeding, including higher peak periods (e.g. winter season, non-holiday periods where building occupancy may be less, etc).	**High**
Demolition of existing gas supply: There is a risk to achieving building compliance if redundant gas supply services are left in-situ after the building as transitioned off gas. There are also safety risks in future and impact passive fire protection measures for the building.	– Engage a Building Certifier prior to any works being carried out to seek advice for extent of demolition works on gas supplies is necessary to achieve compliance, to assist with project planning and considerations.	**Low**

7.4 Implementation Strategy

This section provides considerations and a high-level strategy of how the proposed concepts could be implemented in a manner that can be accommodated by the owners whilst mitigating the risks and disruptions to owners and tenants. During detailed design these should be discussed with the chosen designer(s) to ensure the design outcomes required by the OC are met.

7.4.1 Sequencing of Works

When developing a plan for the sequencing of works, GHD were guided by the following principles:

– The scope items are proposed to be to be divided up into manageable components that can be implemented in isolation of each other over time. It is assumed the Owner's Corporation may not have access to funds to implement all works at once, and therefore consideration for how the works could be implemented in stages is important to help alleviate the risks of large upfront costs being a potential constraint to electrification.

– The scope items should be spread across multiple years if possible, to again minimise the risk of high costs over short time periods that cannot be accommodated.

– Prior to works proceeding, it is recommended that additional efforts are undertaken to measure and log existing demands and usage. This logging is an important part of the recommended demand reduction strategy, in order to gather data that could feed into detailed design to help avoid any unnecessary costly oversizing in addition to identifying shortfall in existing systems capacity. This logging is proposed for hot water demand and electricity at the main switchboard, carried out over a longer duration and preferably over 12 months to capture any seasonal trends, or a minimum summer and winter to observe likely periods of system extremes.

– Photovoltaic systems are considered in early phases to realise the best value from offsetting energy costs early.

– Electric vehicle charging systems are prioritised later as additional investigations are required to identify site-specific works required prior to EV charger install.

Based on the above principles, the following works sequencing is proposed:

Table 7.4 Sequencing of works

Stage	Scope Description
Stage 0	**Pre-works preparation** – Prior to any works proceeding, additional monitoring for hot water and electricity supplies is recommended to gather real-life demand data to inform design decisions for the upcoming works. Additional planning and specialist advice should be considered during this period to gather the full extent of the scope required for all systems. This will limit future impacts as each system is added. Structural documentation on site is limited. Sourcing documentation combined with the advice of a structural engineer will enable assessment of existing structural performance against proposed works and the need for any structural enhancements.
Stage 1	**Photovoltaic Systems** – This work is proposed early to allow for the full immediate energy impacts to the site. It is understood the OC were already considering installing a system in the near future. This would allow for the benefit of energy offsets to be realised immediately, prior to the electrification works. These works have limited dependence on other scope except to allow for space planning of the hot water system. – Development Application: the height of the installed PV system may require a DA application. This would be confirmed through the design process. – Building Approval: as the system may impact the building structural loading a BA application is likely to be required, which may have been confirmed through the Stage 0 works.
Stage 2	**Electrical Infrastructure works** – These works are proposed to provide the backbone electrical upgrade in readiness for the electrification works that will follow. Providing the necessary electrical capacity ahead of each electrification project helps to avoid piecemeal MSB works and potentially can be completed in a manner to reduce the risk of multiple interruptions to the power supply. The extent of the works should be supported by the Stage 0 energy monitoring and wholistic design review of the remaining stages to understand system limits.
Stage 3	**Heating water upgrades** – The heating upgrade works are required to be completed before the stage 4 hot water works as the new hot water system is dependant on the new heating water system for operation. These works will likely require staging to enable some heat pumps to be installed in the spare plant space whilst the existing boilers remain operational, and then once these are installed and operational the boilers are removed to enable the installation to be completed.
Stage 4	**Hot Water Upgrades** – the works are not proposed to be split into 2 portions of work but installed at the same time following the stage 3 works. The existing hot water system will continue to operate until the cut over with the new works. The order of the works is not critical, provided it occurs after the Stage 2 and 3 works have occurred.
Stage 5	**Demolition of Gas Supply** – Once all the gas systems are converted to electric, the final stage is the decommissioning of the gas supply works. Works at minimum will include disconnection and capping off of pipes at the gas meter, penetrations at fire barriers are rectified, and potentially the remainder of pipework is removed. This can be completed incrementally after each gas system is converted to electric, however cannot be wholly completed until all of Stages 3 and 4 are completed (i.e. all gas equipment has been replaced). Furthermore, the gas supplies to Level 16 penthouse apartments are serving items such as BBQ and fireplaces and are not considered essential to providing heating, hot water, cooking to the apartments. These can be removed at any time and do not have a strong influence over the sequencing of works.
Stage 6	**Electric Vehicle Charging –** Additional passive and active fire protection measures (if required) would be undertaken after Stage 0 and before Stage 6 (i.e. concurrently with other works, or alternatively separately after the other works). Stage 6 does not include the installation of EV chargers. These would be undertaken by the residents at their leisure or immediately if the shared option is selected. Scope includes whichever option is adopted. The proposed pathway assumes Option 2 (individual level 2 EV ready with Load Management System).

A high-level program for the implementation is provided in Table 7.5 which follows the scope per Table 7.4. This is nominal and as noted previously, the works can be implemented at any stage in a manner that can be accommodated financially or practically by the Owner’s Corporation and residents.

Table 7.5 Implementation program

	Year																			
	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Pre-works Planning		■																		
Photovoltaic System			■																	
Electrical Infrastructure			■																	
Heating Water Plant				■																
Hot Water Plant					■															
Demolition of Gas Supply					■															
Electric Vehicle Chargers						■														

7.4.2 Minimising disruption during works

As the works progress on site disruptions will occur to many systems including electricity, water and gas. The works can also limit accessibility around the site. Some high-level considerations to limit this include:

- Installing equipment adjacent to existing. The existing system is left in operation for as long as possible until a changeover can be scheduled to make the final pipe and cable connections.
- Changeover periods are scheduled for low use times, e.g. hot water during a weekday daytime.
- The electrical design and other specialist advice is to consider the works as a whole (all scopes), rather than the immediate works that will follow. This will minimise potentially needing to undertake multiple upgrades and experiencing the costs and disruptions that arise due to this such as multiple shutdowns for each new scope

7.5 Energy-use Assessment

The estimated energy consumption and greenhouse gas emissions for the scopes of work that will have an impact on energy are outlined in this section. Table 7.6 compares the current state of energy usage to the proposed, with an indication of the estimated percentage savings.

Figure 7.2 provides a monhtly energy breakdown of the key components the scope items, and Figure 7.3 shows the impact to energy consumption and emissions over the course of the implementation timeframe.

Table 7.6 Concept energy and emissions summary

Upgrade Scopes	Energy (kWh p.a.)		Emissions (kg_{CO2-e} p.a.)	
	Existing	Proposed	Existing	Proposed
– Heating Water Plant	2,023,800	467,000	470,900	6,052
– Hot Water Plant	751,200	150,900	174,800	3
Total - Electrification Only	**2,775,000**	**617,900**	**645,700**	**6,055**
– Photovoltaic System	-	-90,300	-	-
Total - Electrification + PV	**2,775,000**	**527,600**	**645,700**	**6,055**

Note:

1. Existing energy usage is based on Section 3.4.1. Existing energy use includes gas and electricity, expressed in kWh p.a. The proposed energy use uses energy consumption estimates nominated in the options assessment.
2. Refer to Section 4.3 for additional assumptions that form the basis of these calculations.
3. Energy savings and emissions reduction associated with EV charging is not included as vehicle energy costs are not currently borne by the building. For reference, a typical petrol passenger vehicle's tailpipe emissions are 2,285 kg CO_2-e annually

Based on these results, the following observations are noted:

– The proposed electrification works provides a 60% reduction in total energy consumption, of which majority is achieved with the proposed heating water upgrade, although the hot water system is not insignificant energy consumer. If PV is implemented with the electrification works, the energy consumption reduces further to 64%.

– Greenhouse gas emissions, as expected, reduce significantly by 99%. The remaining emissions are attributed to refrigerant leakage from primarily the hydronic heat pumps.

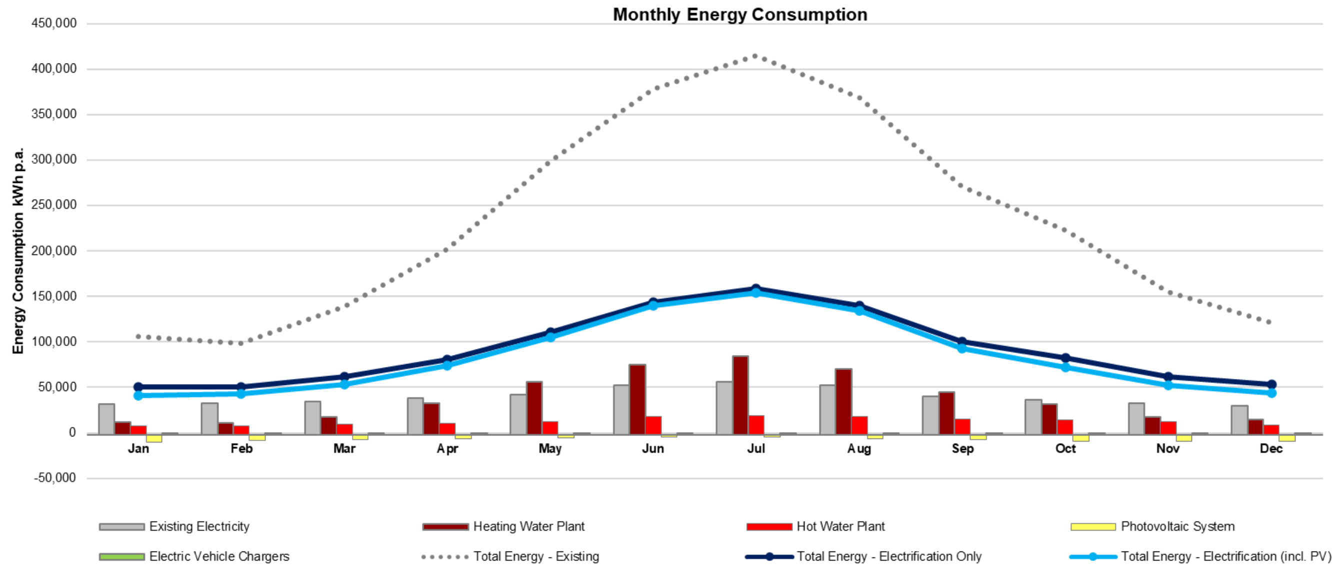


Figure 7.2 Monthly Energy consumption

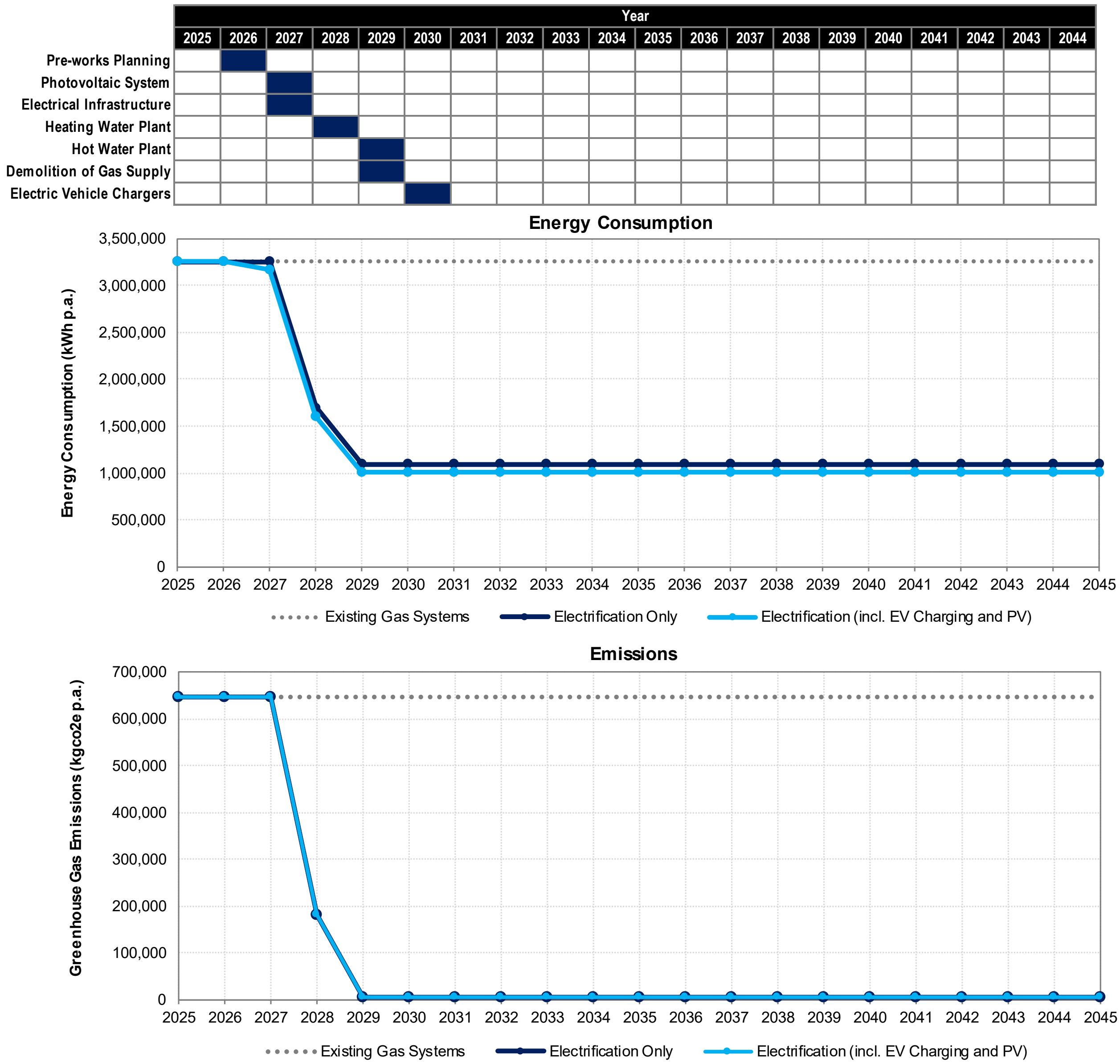


Figure 7.3 *Energy Consumption & Emissions over Time*

8. Cost Analysis

Cost estimates have been developed for the recommended options with cumulative cash flows included to aid in program planning. Works include supply, install, commissioning and demolition as noted with energy impacts included in in the cumulative cash flows.

8.1 Capital Costs

Capital costs for the concept design were provided by quantity surveyor Wilde and Woollard. These were developed with a bill of quantities per concept item, scope descriptions, site plans and following discussions with GHD. They represent the complete scope selected for the concept design from design, supply, installation, testing and commissioning, certification to defects liability. The estimate targets a +/- accuracy of 30% and provide an element of cost conservatism. The breakdown of the costs is provided in Appendix C.

Table 8.1 Out-Turn Cost Summary – New Acton South Apartments

Stage	Scope Components	Cost $ incl. GST
0	Pre-works Planning	$33,000
1	Photovoltaic System	$281,000
2	Electrical Infrastructure	$996,000
3	Heating Water Plant	$2,105,000
4	Hot Water Plant	$615,000
5	Demolition of Gas Supply	$76,000
6	Electric Vehicle Chargers	$645,000
Total Trade Cost (incl. GST)		**$4,751,000**
Total Out-Turn Cost (incl. GST)		**$6,933,000**

Note:

1. Cost estimates for pre-works planning includes specialist advice for EV charging development and approvals, engaging contractor/s for logging of hot water and electricity supplies.
2. Total out-turn includes the following allowances: 5% staging, 14% Trade Preliminaries, 2% Design Fees, 20% Contingency. No allowance has been provided for cost escalations.
3. Cost estimates assumes the works will be carried out one at a time in a sequenced manner under separate works packages, rather than all at once under a Head Contractor delivery.

In addition to the above the following fees may be required:

– Development Application (incl Public Notification) $1,000-6,000 + $2,000 public notification (depending on cost of scope). This could be submitted in one go for a higher single fee, or if designs are completed gradually then multiple submissions are possible at the lower fee.

– Building Approval $6,000-8,000

8.2 Cumulative Cash Flows

The following cumulative cash flow graphs have been provided based on the following two scopes:

– Electrification scope only: hot water and cooking equipment are electrified; gas system is decommissioned. Works do not include the PV system or EV chargers

– Full scope: includes all works per above with the inclusion of PV system option 1 and EV charging option 2.

The costs factor in capital costs, operating costs (energy and maintenance) and replacement costs to determine the return-on-investment for the proposed concepts.

The electrification life cycle costs shown below provide a clear peak in infrastructure works costs up to 2029 with a payback by 2041. The addition of the solar and EV slows the pace due to the additional costs but eventually providing a payback by 2045. The limited amount roof area restrictions the contribution available from PV.

The OC should consider the additional cost savings for residents (not included in this cash flow analysis) to charge EVs at home compared to using public EV chargers or purchasing petrol/diesel fuel, and projected increases in fossil fuel costs over time. These cost savings (for example around $2,000 fuel savings per EV per year based on the average driving habits of Canberrans) are significant and flow directly to residents, as well as potentially increasing the overall asset value of the complex.

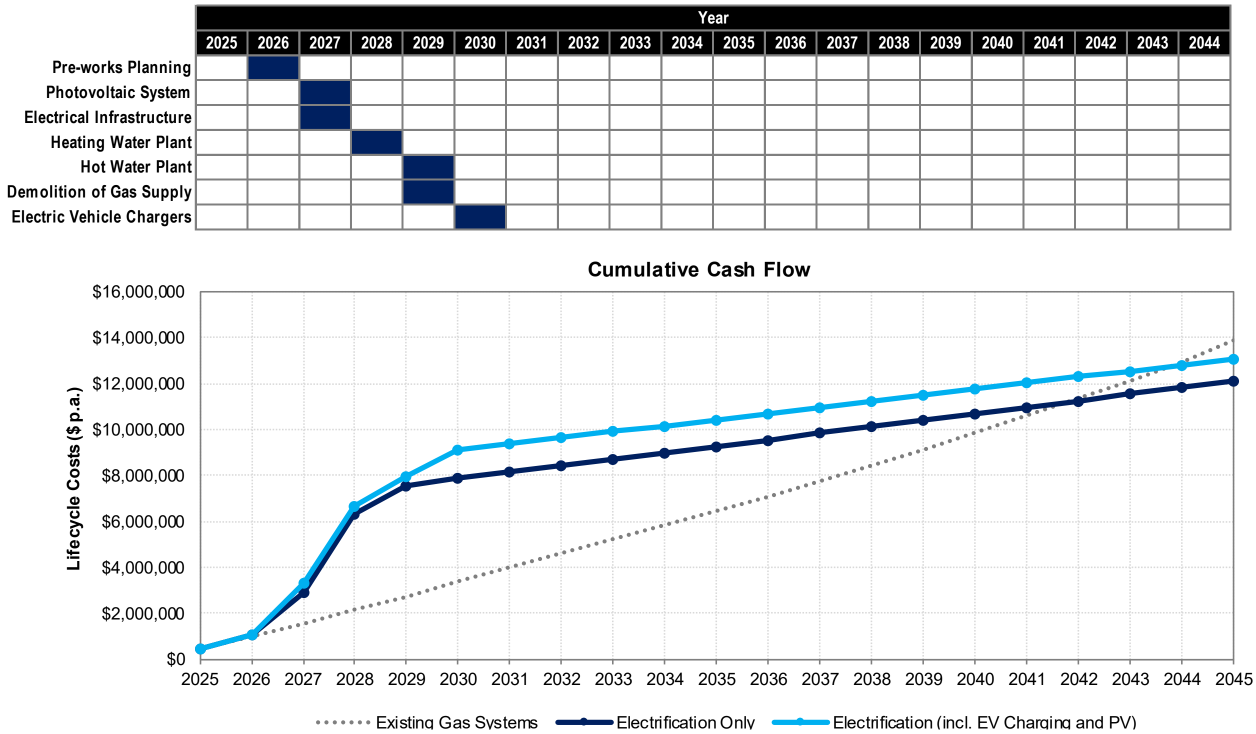


Figure 8.1 *Cumulative Cash Flows*

9. Conclusion and recommendations

As part of the Sustainable Apartments Pilot (SAP) program delivered by the ACT Government, GHD undertook a feasibility study to electrify the New Acton South apartment building.

This study identified and analysed options to replace existing gas assets with electric options. The work also included an assessment of the potential to use solar power to offset ongoing electrification costs, and to consider the inclusion of Electric Vehicle charging facilities into the building.

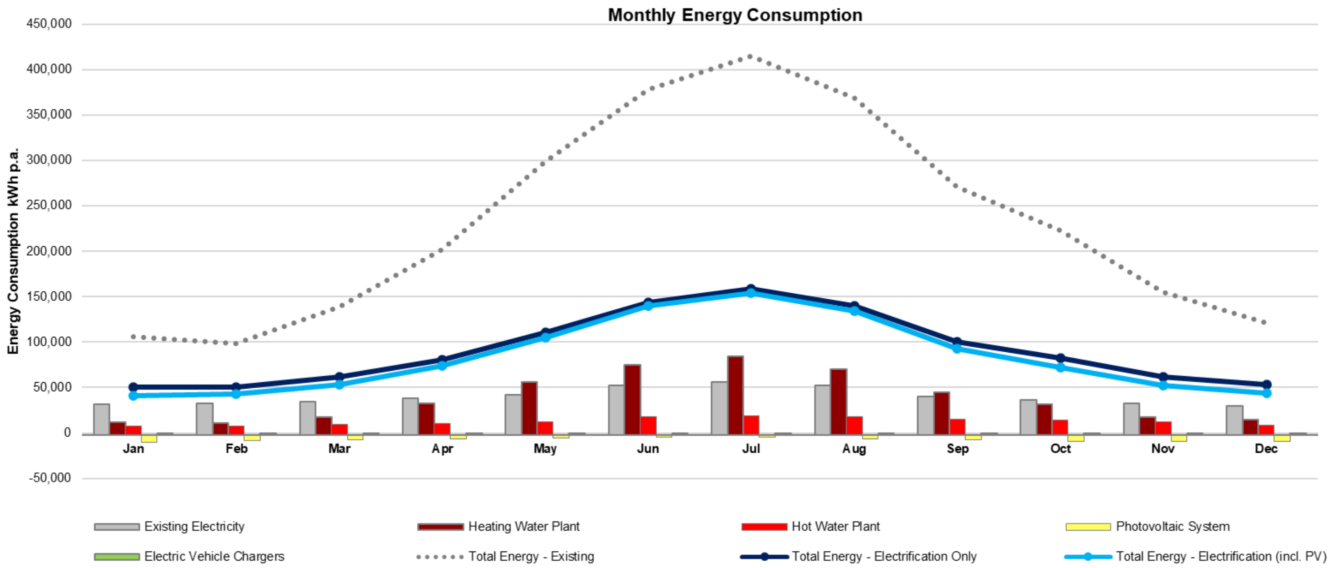
The study determined that there were a range of all-electric equipment available to replace the existing gas assets. A range of options were canvassed with the Owners Corporation and these were integrated into the concept design for further consideration, being:

– Heating System – Central hydronic water-source heat pump, injecting heat into the condenser water system.
– Hot Water System – Water-source heat pumps with storage, connecting to the heating water system as a heat source.
– Photovoltaic System – Maximise to available roof space.
– Electric Vehicle Charging Facilities – Individual Level 2 chargers.

An analysis of the costs of each option demonstrated that the heat pump option, although more expensive initially, provided the best financial return over the 20-year period. This is due to the fact that heat pumps are the most energy efficient option, with significantly reduced running costs as compared to the other options.

The feasibility assessment also showed that it was cost-effective to install a solar system to offset running costs with a pay-back period of slightly over five years.

An analysis of energy consumption shows that the preferred solution substantially reduces overall energy usage at New Acton South. It also correspondingly cuts greenhouse gas emissions to a nominal amount with the only greenhouse gas emissions due to refrigerant leakage from the heat pumps. This reduction in total energy used was achieved due to the ability to substantially reduce the hot water capacity and by the use of energy efficient heat pumps.



An implementation strategy was developed to demonstrate how the owners could consider a staged approach to electrification. If the owners are interested in pursuing electrification it is recommended that further detailed investigations are carried out to confirm the outcomes of this feasibility assessment and finalise the design and expected costs.

Appendices

Appendix A

OC Meeting 01 – Notes and Meeting Minutes

Notes & Meeting Minutes

Sustainable Apartments Pilot – New Acton South, 19 Marcus Clarke St Acton

16 June 2025

Project name	ACT Gov. Sustainable Apartments Pilot	**From**	GHD
Subject	New Acton South OC Meeting #1	**Tel / email address**	**sustainablebusiness@act.gov.au**
Date / Time	23/05/2025 8am	**Project no.**	12656728
Attendees inc. company	Anna Turnbull (ACT Gov) Jacinta Evans (ACT Gov) Adrian Piani (GHD) Gerry Hackett (GHD) Chathurika Peiris (GHD) Members of the EC, residents and strata managers	**Location**	MS Teams Ngunnawal meeting room, Peppers Gallery

Notes & Minutes

1. Introduction

– The Sustainable Apartments Pilot is carrying out electrification feasibility studies for a representative sample of multi-residential buildings in ACT, to build knowledge on the technical challenges to electrification and develop potential solutions and costings. The Pilot aims to gather learnings that will inform community on how electrification works can be undertaken in similar buildings as ACT transitions towards zero emissions by 2045.

– New Acton South was one of 7 Apartment complexes selected to take part in the Pilot. Sites were selected to cover a range of building types, sizes, ages, types of gas-dependent systems. Additionally sites that posed challenges to electrification were also preferred.

– Key reasons for New Acton South's selection in the Pilot:
  - Included a diverse range of gas equipment present (i.e. space heating, hot water).
  - Mixed-use (residential and commercial).
  - Represented a large apartment complex, in terms of building height, number of dwellings, etc.
  - Planning constraints (building heights and NCA).
  - Geographically represented the North Canberra (central) region.

– The Program is being led by ACT Government's Environment Planning and Sustainable Development Directorate (EPSDD), with assistance from GHD in the role as Technical Consultants.

– The Pilot is currently in the data collection stage. This stage consists of:
  - Initial site visit, conducted on 15/5/2025.
  - As-built drawings and documentation review.
  - Owner's Corporation meeting, conducted on 23/5/2025, providing residents, OC members and Strata Managers the opportunity to provide input or feedback that will feed into the electrification feasibility studies.

– These notes summarise the findings from the site visit and discussion from the OC meeting. They capture:
  - An overview of the buildings and it's services.
  - Constraints and opportunities to electrification.
  - Requirements and opportunities.

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• Potential electrification options for consideration.

2. Observations from site visit and as-built documentation review

Site overview:

- Building constructed in 2010.
- Single 18-storey residential building with common areas and basement parking:
  - 1, 2 and 3-bedroom standard apartments, single and multi-level apartments.
  - Level 4 BBQ area (electric)
  - Gym
  - Theatre
- 2 commercial tenancies on ground floor:
  - Café – all electric cooking appliances.
  - Office
- Heating and cooling: Each apartment contains 1 or more water-cooled reverse-cycle packaged AC unit. Each unit connects to a central condenser water system which is served by rooftop plant consisting of adiabatic coolers and hot water condensing boilers. In heating, the boilers provide a heat into the condenser water system in the AC unit use to heat the apartments, and likewise in cooling the adiabatic coolers reject heat to atmosphere that the AC unit reject from each apartment. Billing for heating and cooling is currently apportioned based on unit entitlement.
- Hot water: 2x central systems, serving levels 1-9 and 10-17 respectively. Hot water meters are provided in each apartment to apportion and bill the gas consumption associated with hot water usage, however these are currently not used and hot water gas usage is on-charged based on unit entitlement.
- Cooking: electric cooktops.
- Gas enters the site on the eastern side near the carpark entry with multiple meters serving the building:
  - 2x meters for the hot water system, ground level and rooftop.
  - 1x meter for the heating system on the roof.
  - Gas meters are reportedly inside 5x apartments (1405,1601,1602,1603,1607).
- Power supply to site from a dedicated chamber substation on the southeastern corner. The mains switchroom is located above. An additional substation that was on the site prior to construction is off Kendal Lane and does not appear to serve the site.
- No photovoltaic system.
- 2x electric vehicle chargers are provided to resident parking bays for personal use. This is provided via a dedicated switchboard in the basement, in which residents connect their own EV chargers near their allocated carpark, and connect to this switchboard with a meter for on-charging.

Summary of gas equipment:

- Heating system: 2x hot water condensing boilers located externally on rooftop, that provide a heat source to the condenser water system to allow the reverse-cycle packaged AC units in each apartment to provide heating.
  - Boiler sizing is approximately 1MW and 500kW.
  - The current boilers were installed in 2018.
  - Condition of hot water units appeared good, noting they are housed in enclosures to provide protection from weather.
- Hot water systems: 2x central hot water systems, each consisting of banks of gas instantaneous hot water units with storage tanks, as follows:
  - System 1 located in carpark on ground level (alongside switchroom). This serves Levels 1-9 and contains 12x 48kW gas hot water units and 3x storage cylinders.
  - System 2 located externally on rooftop. This serves Levels 10-17 and contains 6x 48kW gas hot water units and 2x storage cylinders.
  - Condition of hot water units appeared reasonable, noting that some units have been replaced over the years.
- Gas equipment in residential apartments:
  - Apartments 1405, 1601, 1602, 1603, 1607 are shown on drawings to be provided with gas supplies, supposedly for gas fireplaces and gas connections on balconies (presumably for BBQs). Although apartment 1603 was inspected during the site visit and we noted the gas connection on the balcony, GHD had not noticed a gas fireplace. Further investigations are required to determine whether there are any additional gas appliances inside these apartments.

Challenges / constraints identified:

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- Large-capacity gas systems (notably heating system 1500kW and hot water systems 875kW). Electric replacement options for such capacities may introduce issues with electrical supply, require larger outdoor plantroom spaces, increase structural loadings on roofs, etc.
- Limited available external areas for equipment (limited slab areas on roof, no ground level external space). Potentially will need to consider use of areas within carpark.
- Planning constraints are applicable, notably the building is at the RL617 Canberra height limit (which may limit placement of plant and PV panels on rooftops). Additionally building is subject to planning requirements of the National Capital Authority (NCA) as it is located within Designated Areas.
- Constraints identified by EC members:
  - EV charging restrictions are currently in place by EC for any new connections due to concerns around electrical maximum demand.
  - Building survey on EV charging noted 75% of residents unwilling to share EV charging bays.
  - Even if residents were more open to sharing, there is no available shared parking spaces that could be converted to EV charging spaces. Parking bays are all allocated within the basement, with no visitor parking spaces available. The public carpark located behind the building is outside of block boundary.
  - EC members asked how can solar solutions achieve equitable outcomes to benefit tenants. Jacinta advised that the ACT Government has multiple energy related schemes through Climate Choices that are applicable for apartments including a solar program. The current schemes have not overlapped to date, as such, all may be accessible.
  - 1 apartment has their own dedicated roof mounted equipment. Electrification solutions should be capable of serving this apartment, and not assuming in the long-term they will remain separated from central systems.

Opportunities identified:

- Potential to reduce heating and hot water systems capacity to limit unnecessary oversizing and associated costs and implications. This is based on feedback from residents that active heating and cooling is often not required due to high-performing façade. Furthermore hot water systems are often conservatively sized for apartments and there may be value in undertaking logging of hot water meter usage to understand actual demands.
- Reconfiguration of rooftop plant may be able to house majority of equipment.
- Opportunities to use the HVAC condenser water as a heat source for domestic hot water units. Additionally option to use thermal storage to save on heating plant space.
- Opportunities identified by EC members:
  - There are several unused spaces (non-parking) in basement that could be repurposed as plant areas.
  - Local split system AC systems could be provided per apartment as an option for residents to decentralise, however NCA requirements may limit the opportunities to achieve this.

3. Requirements & Priorities:

- Requirements and priorities were presented as follows to the EC members for consideration. These will form the basis for assessing the options during the feasibility study. Note the items highlighted as red have been edited post OC meeting to reflect discussions during the meeting:

Essential Requirements	
– *Achieve full electrification of all gas equipment* – *Provide Electric Vehicle charging facilities* – *Comply with Territory Planning requirements and Noise Limits* – *Avoid significant disruptions to occupants during works* – *Works within Constraints of Building* – *Electrification options proposed must consider how the service (heating, hot water) can be on-charged to residents*	
Desirable Requirements	
Low Cost	***45%***
– *Low capital costs*	*20%*
– *Low operating costs (energy, maintenance)*	*20%*
– *Low replacement costs*	*5%*
High Performance & Robustness	***20%***
– *High climate adaptability*	*5%*
– *High usage adaptability*	*5%*
– *Resilient*	*5%*
– *Simple systems*	*5%*
Low Environmental Impacts	***25%***
– *Low aesthetic impact*	*5%*
– *Low acoustic impact*	*10%*
– *Environmentally sustainable solutions*	*10%*
Other	***10%***
– *Address existing deficiencies (e.g. age, condition, etc.)*	*5%*
– *Minimise disruptions to occupants*	*5%*

- Specific comments provided by EC members regarding requirements for electrification:

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• For heating and hot water electrification options, it was requested that these options need to incorporate a means for how the EC can on-charge residents for their consumption. This requirement has been made an essential requirement. – It was acknowledged that there will unlikely be complete agreement on priorities and relative importance of each across a large group of owners and residents. The intent of the above requirements and % weightings is to provide a reasonable framework to assess options against. GHD will use the above requirements and weightings as a basis for the options assessment during the feasibility study.
4. Upgrade Options:
Electrification upgrades: – GHD proposed electrification upgrade options to the OC members for the gas equipment identified. The options cover a range of technologies that have different strengths and weaknesses with respect to the requirements and existing building constraints. These options are summarised below: – Heating replacement options: a. Electric flow boilers to directly replace gas boilers (pros – lower capital cost, potentially reuse existing rooftop plant areas; cons – high power draw, high energy costs). b. Air-source heat pumps to directly replace gas boilers (pros – lower power draw / energy costs; cons – higher capital costs, larger outdoor plant space required, performance impacted by ambient conditions). c. Air-source heat pumps with thermal storage tank (similar to Option 2 although thermal storage allows for downsizing heat pump capacity). d. Room split system air conditioners, with condensers located outdoors on balconies (pros – simpler to on-charge residents, less rooftop plant space required; cons – NCA constraints, noise, aesthetics, loss of amenity on balconies, etc). – Hot Water replacement options: a. Electric-resistive storage units (pros – lower capital cost, potentially reuse existing plant areas on ground and rooftop; cons – high power draw, high energy costs). b. Air-source heat pumps, with CO_2 refrigerant and storage tanks (pros – lower power draw / energy costs; cons – higher capital costs, larger outdoor plant space required, noisier, performance impacted by ambient conditions). c. Water-source heat pumps connected to the HVAC condenser water system, with storage tanks: System uses the waste heat from the heating system (pros – smaller plant footprint than air-source heat pumps, heat recovery energy savings when building is cooling; cons –) – If any additional options become available as the feasibility study progresses, GHD may consider these.
EV charging and PV panels: – As part of the electrification feasibility study, GHD will also assess options for providing Electric Vehicle charging facilities and increasing the solar power capability of the site. The proposed options include: – EV charging: a. Shared – Shared parking bays. Common service with residents charged per use via an app. This option may not be possible with no parking bays available and limited support of shared charging by the residents, however will still be considered for information purposes. b. Individual per apartment – Expanding the existing provision of common dedicated EV charging switchboards with metering. This system will require expansion to accommodate a higher number of EV users in future. Energy management system would be required as full take-up would require significant electrical upgrade. – Photovoltaic panels: a. Provide new PV system on roof and determine maximum capacity achievable on the existing rooftop. b. Consider battery storage with the PV panels. Other: – EC requested consideration of using batteries for off-peak charging to help with mitigating demand increases from the electrification works.
5. Where to from here: – Progress the options analysis: • Potentially additional site visits to check feasibility and log the hot water demand profiles. • Complete options analyses, impacts assessment, costings, energy estimates, ROI, etc. – Deliverable - Electrification Feasibility & Pathway Report (incl. options, costings, etc).

☒ Attachments: GHD slide pack

This confirms and records GHD's interpretation of the discussions which occurred and our understanding reached during this meeting. Unless notified in writing within 7 days of the date issued, we will assume that this recorded interpretation or description is complete and accurate.

NOTE: If the information in this report does not agree with your record of this meeting or if there are any omissions, will you kindly advise this office immediately, otherwise we shall assume its contents to be correct.

Distribution: All Present/Absent

→ Adrian Piani – Project Director
Gerry Hackett – Project Manager

Sustainable Apartments Pilot

Owner’s Corporation Meeting

New Acton South

Welcome

Agenda

1. Introductions & Overview of Pilot
2. Observations from Site Visits:
   a) General Overview
   b) Summary of gas equipment
   c) Identify challenges / constraints
   d) Identify opportunities we have noted
3. EC Requirements
4. Electrification Upgrade Options:
   1) Options Proposed
   2) Feedback

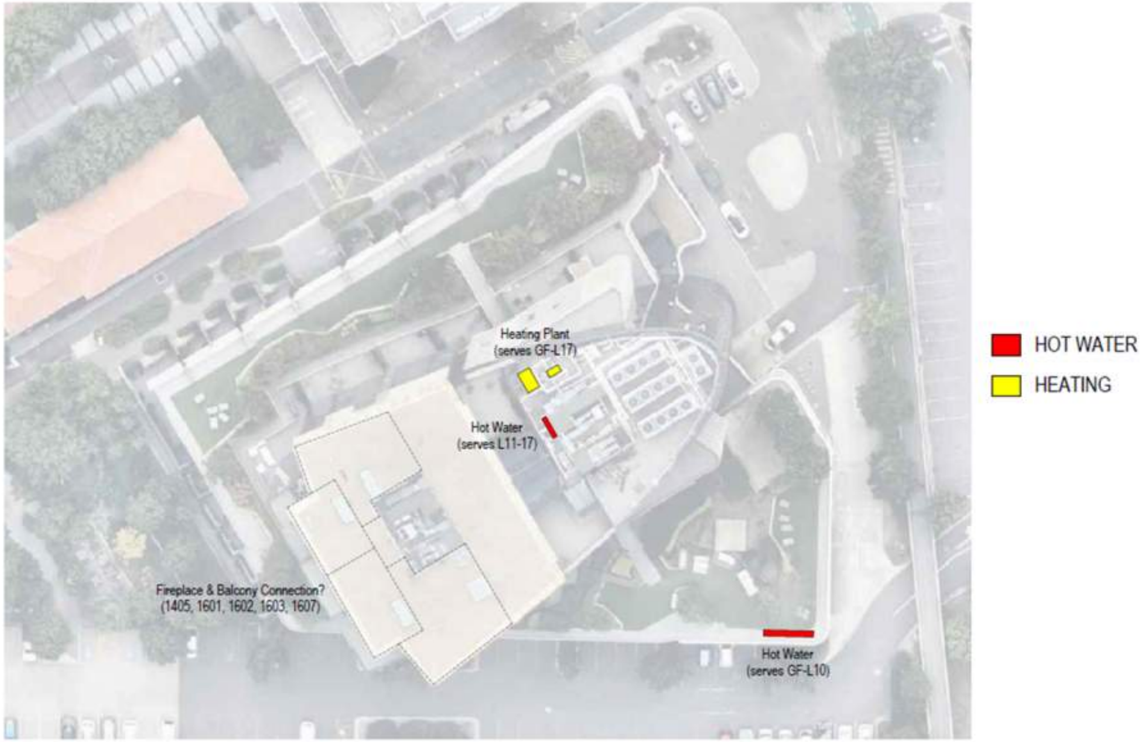
New Acton South – General Overview

- Constructed 2009-2010
- 186 apartments
- Commercial tenancies
  - o Café – all electric
  - o Office
- Common Facilities:
  - o Basement parking
  - o Outdoor areas
  - o Gym
  - o Theatre

New Acton South – Services

- Electrical
- Heating & Cooling (central)
- Hot Water (central x2)
- EV Charging – x2 (owner dedicated)
- Solar - None

Summary of Gas Equipment



Hot Water (Roof Plant)

Hot Water (Ground Floor)

Heating Plant (Rooftop)

Electrification Considerations

Constraints / Challenges:

- Large-Capacity Gas Systems – (Heating 1,500kW, Hot Water 875kW)
- Heating system
- Gas equipment distributed
- Limited Useable Outdoor Space
- Planning challenges - Building Height, NCA
- Electrical Capacity?

Opportunities:

- Potential oversizing of systems – Heating & Hot Water
- Use of storage (Hot Water & Thermal Storage for heating)
- Use Condenser Water for Hot Water

Any others?

Requirements & Priorities

Essential Requirements
- Achieve full electrification of all gas equipment
- Provide Electric Vehicle charging facilities
- Comply with Territory Planning requirements
- Comply with Noise Limits
- Avoid significant disruptions to occupants during works
- Works within Constraints of Building

Desirable Requirements	
Costs	**45%**
- Capital costs	*20%*
- Operating costs (energy, maintenance)	*20%*
- Replacement costs	*5%*
Performance & Robustness	**20%**
- Climate Adaptability	*5%*
- Usage Adaptability	*5%*
- Resilience	*5%*
- Simplicity	*5%*
Environment	**25%**
- Aesthetics	*5%*
- Acoustics	*5%*
- Sustainability	*15%*
Other	**10%**
- Address existing deficiencies (e.g. age, condition, etc)	*5%*
- Minimise disruptions to occupants	*5%*

- Does the EC have any specific requirements not captured above?
- Does the EC have any concerns we should be aware of addressing?

Upgrade Options

- Electrification
  - Heating
  - Hot Water
  - Fireplaces & balcony connections

- Electric Vehicle Charging

- Solar Panels

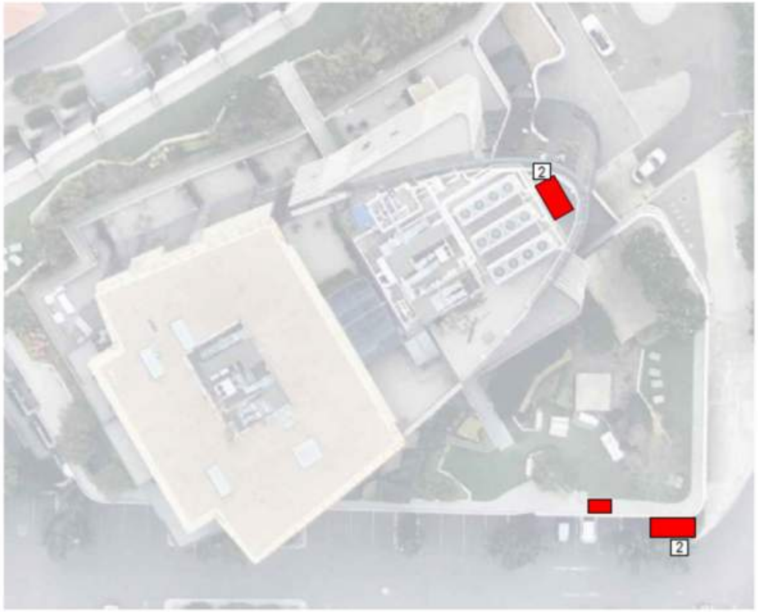
Electrification – Heating

OPTION 1 - ELECTRIC HEATERS w/ STORAGE

OPTION 2 - HEAT PUMPS

OPTION 3 - HEAT PUMPS w/ THERMAL STORAGE

Electrification – Hot Water



OPTION 1 - ELECTRIC HEATER w/ STORAGE

OPTION 2 - AIR-SOURCE HEAT PUMPS w/ STORAGE

OPTION 3 - WATER-SOURCE HEAT PUMPS w/ STORAGE

Other Options

Fireplaces & Balcony Gas Connections

- Electric Alternatives
- Are they used?

Electric Vehicle Charging

- Option 1 – Shared EV chargers
- Option 2 – Expand the dedicated switchboard for owners to connect to

Solar Panels

- Consider extent of PV that could be provided
- Consider batteries

Where to from here?

1. Provide summary of the discussions from this meeting as record. Welcome to provide additional questions or feedback after this meeting.
2. GHD to progress the options analysis:
   - Additional site visits to check feasibility
   - Complete options analyses, costings, energy estimates, ROI, etc.
3. Deliverable - Electrification Feasibility & Pathway Report (incl. options, costings, etc)

Further questions, please contact the following: sustainablebusiness@act.gov.au

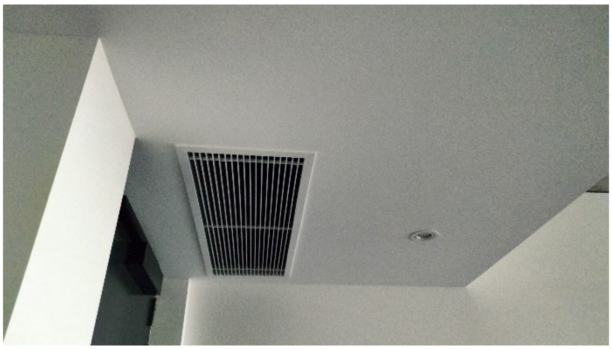
* Thank You

→ ghd.com

Appendix B

Supplementary photos

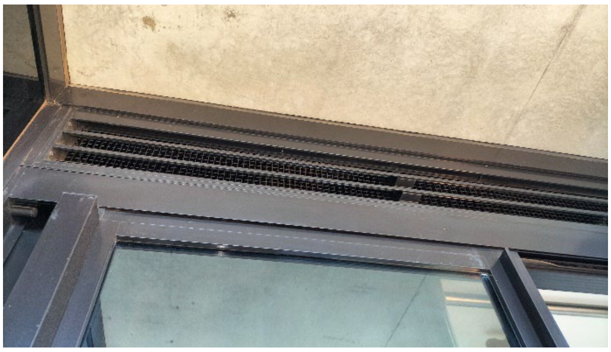
New Acton South



Apartment HVAC grill

Apartment HVAC grill

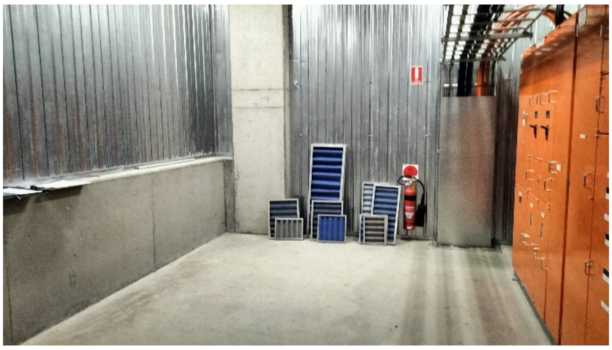
Apartment DB



Apartment above door ventilation

Apartment central AC controls

Apartment cold and hot water meter



Main swtichroom

Ground water meter

Upper roof

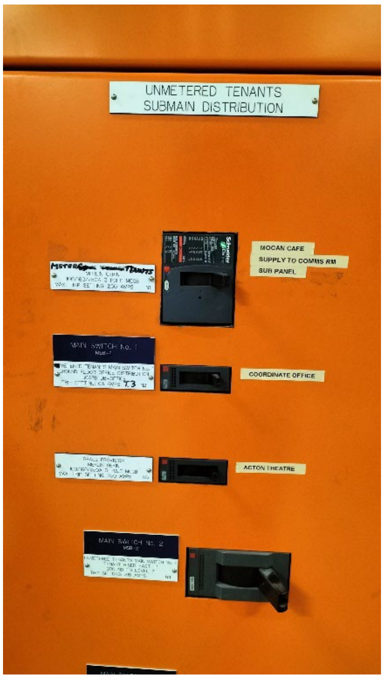
Upper roof

Roof plant area

Roof AC system

Apartment cooktop

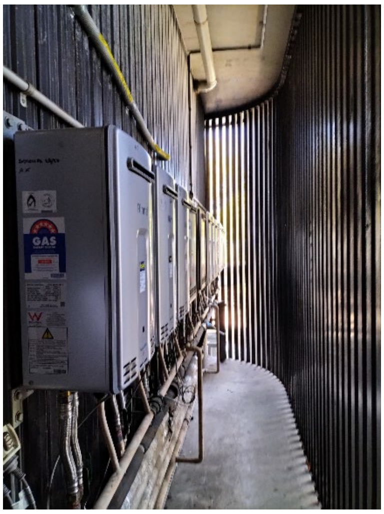
Private EV charger



Unmetered MSB section


Incoming gas regulator


Upper hot water plant



Lower hot water plant


MDL


Core meter panels


Roof gas meter

Appendix C

Cost Estimate

28 Eyre Street
Kingston ACT 2604

PO Box 5429
Kingston ACT 2604

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E mail@wwcanberra.com
W www.wildeandwoollard.com
ABN 81 058 229 404

ACT Government Sustainable Apartment Pilot

Indicative Cost Estimate

Issue No. 6
Date: 02 October 2025

Prepared by:

Wilde and Woollard Consultants Pty Ltd
28 Eyre Street
KINGSTON ACT 2604

On behalf of:

GHD
Level 7, 16 Marcus Clarke St
CANBERRA ACT 2601

2.7 - Out-Turn Cost Summary - Acton South Apartments

On the basis of the information as listed in Sections 3.0 and 4.0 of this document, the Cost Estimate of the works, is summarised as follows:-

Table 2.7 Out-Turn Cost Summary - New Acton South Apartments

Ref	New Acton South Apartments Replacement of Existing Gas System With Electrical System, and Associated Works	%	Total
01	Demolition of gas supply		$ 23,000
02	Hot water plant (Roof top and Ground Floor)		$ 559,000
03	Heating water plant (Roof top)		$ 1,914,000
04	PV panels		$ 255,000
05	Backbone infrastructure for proposed EV Chargers only		$ 586,000
06	Electrical Infrastructure		$ 905,000
07	**Total Trade Costs at Oct 2025 prices**		**$ 4,242,000**
08	Locality Allowance		EXCL
09	Stagings	5.0%	$ 213,000
10	Trade Preliminaries	13.5%	$ 602,000
11	Design and Consultant Fees	2.0%	$ 102,000
12	Design and Construction Contingency	20.0%	$ 1,032,000
13	Allowance for Cost Escalation		EXCL
14	**Total Out-Turn Cost at Oct 2025 prices (Excluded GST)**		**$ 6,191,000**

3.0 - Basis & Assumptions

The following provides an overview of the cost methodology and process used for the preparation of this Indicative Cost Estimate for the proposed 7.no pilot building sites.

3.1 Information Used

The scope of works has been generally based upon the information listed below

Documents received 29 and 30 September 2025:-

+ GHD revised cost summary

Documents and Markup Drawings received 18th, 21st, 22nd, 24th, 29th July and 6th August 2025:-

[redacted]

+ Acton South Apartments Scope of Works

+ Sustainable Apartments - Acton South Apartments mark-up

Emails regarding the scope of works for Apartment Pilot Buildings 18th, 21st, 22nd, 24th, 29th July and 6th August 2025

Emails regarding further clarification on the scope of works, assumptions, inclusions and exclusions for [redacted] buildings received on 29th July 2025

Emails regarding update on the scope of works, assumptions, inclusions and exclusions for 7 x buildings received on 29 and 30 September 2025

3.0 - Basis & Assumptions

3.2 Scope of Works, Assumptions and Inclusions:

Generals

The following works, inclusions and assumptions has been included in the Indicative Cost Estimate for 6 of the proposed 7 no. total pilot building sites:-

1 Design update

1.1 The cost estimate has been updated in accordance with the latest design update received via emails dated on 30 September 2025

2 EV Chargers

2.1 The cost estimate only includes the cost allowance for backbone infrastructure for potential EV chargers as advised by GHD via email dated on 30 September 2025

2.2 The cost allowance for the backbone infrastructure to each building is provided by GHD via email dated on 30 September 2025

3 Stagings

3.1 As advised, the new plant system will be installed alongside the existing whilst it remains operational, then a short change over to the new plant, followed by demolition of the existing (email dated on 29 July 2025). The indicative estimate includes a cost allowance for staging for a short change over to new plant with minimal building tenant disruption.

4 Cranage

4.1 The estimate is based on single visit for both delivery of the new equipment and removal of redundant equipment to the proposed works in each pilot building

5 Preliminaries and Margin

5.2 The projects will not be carried out by a head contractor but rather in separate work packages over a period of time by the owner corporations as advised by GHD via email dated on 29 July 2025. Therefore, no cost allowance for head contractor has been included in the cost estimate

5.3 Preliminaries includes for supervision, traffic management, equipment (i.e lifting and cranage)

6 Design and Consultant Fees

6.1 The cost estimate assumes the design for the works will be based upon the existing as-built documentation

3.0 - Basis & Assumptions

3.2 Scope of Works, Assumptions and Inclusions (Con't)

Sustainable Apartments - New Acton South Apartments

The following works, inclusions and assumptions has been included in the Indicative Cost Estimate:-

1 Demolition of gas supply, including:-

1.1 All works as per documents provided

1.2 Isolation, decommission and demolition of main precinct gas supply, capping off gas pipework within the building site boundary.

1.3 Demolition and removal of existing gas pipework routed through basement carparks

1.4 Make good redundant penetrations

1.5 Allowance for capping off the existing gas supply at the existing building entry location, no allowance to remove existing in ground gas pipework from the buildings to the gas main in street.

1.6 Any demolition works of main gas supply outside the precinct boundary are excluded in the indicative estimate.

1.7 Any replacement works to unit apartments (residential tenants) are excluded from the estimate, other than works listed in the provided documents

2 Hot water plant systems (1 on Ground and 1 on Rooftop)

2.1 All works as per documents provided

2.2 Demolition of gas hot water unit central plant on ground floor within the building and on the roof, associated main gas pipework from basement to risers and to roof, and capping off main gas pipes each floors.

2.3 New electric hot water plant, including associated pipework, electrical equipment, power and making good to the existing

2.4 As advised, the existing storage tanks (totalling 5.no) are to be reused alongside the new electric hot water plan system

2.5 As advised, existing water meters are to be reused, hence no cost allowance for new water meters is included in the cost estimate

2.6 No acoustic or structural works are included in the indicative estimate as per the documents provided

2.7 No cost allowance for new concrete plinths to new plants on Ground and Roof is included in the cost estimate

2.8 No cost allowance for new acoustic louvre screen is included in the cost estimate

3.0 - Basis & Assumptions

3.2 Scope of Works, Assumptions and Inclusions (Con't)

Sustainable Apartments - New Acton South Apartments (Con't)

3 Heating plant system on Roof

3.1 All works as per documents provided

3.2 Demolition of gas heating water boilers on the roof, including circulating pumps, associated main gas pipework, associated frames, connections, controls and electrical etc

3.3 New electric hot water plant, including associated pipework, electrical equipment, power and making good to the existing

3.4 As advised, the existing storage tanks (totalling 2.no) are to be reused alongside the new electric hot water plan system

3.5 As advised, existing water meters are to be reused, hence no cost allowance for new water meters is included in the cost estimate

3.6 The cost estimate also includes cost allowances for additional concrete plinths for new plant equipment and making good the existing in building work in connection (BWIC)

3.7 No acoustic or structural works are included in the indicative estimate

3.8 No cost allowance for new acoustic louvre screen is included in the cost estimate

4 PV panels

4.1 All works as per documents provided

4.2 No allowance for major making goods or replacements of roof membrane and roof structures is included in the cost estimate

4.3 No allowance for any upgrade works to existing DB and meters is included in the cost estimate

5 EV Chargers

5.1 New GPO single outlet, including electrical supply and connection to existing services

5.2 No allowance for new EV charger for individual apartment as per documents provided

5.3 New distribution boards, including associated cablings and new sub-circuits

6 Electrical Infrastructure

6.1 Upgrade only one out of two existing transformer from 500kVA to 750kVA, including associated power supply

6.2 No upgrade works to the other existing transformer (500kVA) as per documents provided

6.3 No cost allowance for new transformer chamber is included in the cost estimate

6.4 Replacement of existing main switchboard with new (1100A) located within the existing main switchroom, comprising new main cablings, conduits, submain cables and terminations.

6.5 The cost estimate also includes a cost allowance for cabling trenching and backfill in building work in connection (BWIC)

7 General

7.1 The cost estimate includes a cost allowance for testing and commissioning fee only, no allowances for other quality assessment fees

7.2 Building work in connection (BWIC) includes any works that main trades are not covered (i.e. penetrations, patching and sealings, additional signages, making goods to the existing)

7.3 No cost allowances for any major demolitions, alterations and making goods to roof membrane, roof structure, building structure and fitout

3.0 - Basis & Assumptions

3.3 Cost Benchmarking

Unit cost rates were derived from knowledge of base market rates, of projects similar in nature, local market conditions and influences. Quantities were derived from a combination of the provided documents, knowledge of the likely construction methods and additional inclusions determined through consultation with the project team

3.4 Project Program and Escalation

The proposed program for the works has not been identified at this feasibility stage. Therefore the Indicative Cost Estimate is based on Q4/2025 prices with any cost escalation beyond the date of this estimate being excluded.

3.5 Procurement

As advised, it is understood that any of the proposed works will be carried out by the building owner corporations as a separate packages based on available funding.

3.6 On-Costs

The following allowances have been included for the Cost Estimate On-Costs.

Table 3.6 On-Costs

Heading	Description	Value
Locality Allowance	No allowance for Locality Allowance as all pilot buildings are located in ACT	N/A
Stagings	The cost estimate includes 5% of total trade cost for Stagings for change over the new plant only, minimal interruption to tenant operation as advised by GHD	5.0%
Preliminaries and Margin	The cost estimate includes 13.5% of total trade cost and stagings for preliminaries and margin.	13.5%
Design and Consultant Fees	The cost estimate includes 2% of total trade cost, staging and preliminaries for Design and Consultant Fees	2.0%
Contingency	The cost estimate includes 20% of total trade cost, staging, design & consultant fees and authority fees for Contingency	20.0%
Escalation	The cost estimate excludes Escalation at this feasibility stage as the proposed program has not been identified.	EXCL

4.0 - Exclusions

4.1 The Indicative Cost Estimate Excludes the Following:-

General Items for All Apartment Building Sites

- GST
- Any works, other than indicated in the documents and markup drawings
- Works outside the existing building boundary, other than works indicated in the documents and markup drawings
- Remove existing in ground gas pipework from the buildings to the gas main in street.
- Demolition of utility gas meters
- Any replacement works to unit apartments (residential tenants) other than the works indicated for the [redacted] and [redacted] Apartments
- Major demolition or alteration works to building structure and fitout
- Strengthening roof structures
- Any works, other than indicated in the documents and markup drawings
- EV chargers
- New water meters
- Acoustic or structural works
- Trenching and modification to existing wall and slab to run EV charger cables, conduits and containment
- Special access throughout the buildings
- No additional storage requirements
- Decanting allowance
- The following items are excluded from the indicative cost estimate as it is understood that any of the proposed works will be carried out by the building owner corporations as a separate packages based on available funding:-

  + Head contractor on-costs
  + Project Management Fees
  + Major Projects Canberra Capital Works Levy
  + Escalation
- Quality assessments

4.0 - Exclusions

Sustainable Apartments - New Acton South Apartments

The additional exclusions have been included in the Indicative Cost Estimate:-

- New concrete plinths and acoustic louvre screen panels to new plants on Ground and Roof
- Major demolition, alteration and making good or any strengthening to roof structure
- Any upgrade works to existing DB and meters other than indicated on the provided documents
- No upgrade works to one of the two existing transformer (500kVA) as per documents provided
- New transformer chamber

APPENDIX A - DETAILED COST BREAKDOWN - NEW ACTON SOUTH APARTMENTS

Detailed Breakdown - New Acton South Apartments

SUMMARY

Code	Description	Quantity	Unit	Rate	Total
	SUSTAINABLE APARTMENTS - NEW ACTON SOUTH APARTMENTS				
	Demolition of gas supply				23,000
	Hot water plant (Roof top and Ground Floor)				559,000
	Heating water plant (Roof top)				1,914,000
	PV panels				255,000
	Backbone infrastructure for proposed EV Chargers only				586,000
	Electrical Infrastructure				905,000
	TOTAL CONSTRUCTION COST				**4,242,000**
	Allowance for stagings for change over to the new plant only as advised				213,000
	Preliminary and Margin, including lifting and cranage				602,000
	Design Fees (2%)				102,000
	Contingency (20%)				1,032,000
	TOTAL OUT-TURN COST				**6,191,000**
	Total				**6,191,000**

Detailed Breakdown - New Acton South Apartments

	DEMOLITION OF GAS SUPPLY

Code	Description	Quantity	Unit	Rate	Total
1.	Isolate, decommission and demolish gas supply.	1	item	4,000	4,000
2.	Demolition and removal of utility gas meters (8-off) - (item to be excluded as advised)				EXCL
3.	Demolition and removal of existing gas pipework (i.e. allow 150m of pipework to be removed, typically routed through basement carparks)	150	m	40	6,000
	EO for removal of vertical gas pipes in risers to roof top building	1	item	3,000	3,000
4.	Make-good redundant penetrations, including fire penetrations (Assume 10-off)	20	items	500	10,000
	Preliminary, Design and Contingency included elsewhere		Note		
	DEMOLITION OF GAS SUPPLY				**23,000**

Detailed Breakdown - New Acton South Apartments

	HOT WATER PLANT (ROOF TOP AND GROUND FLOOR)				
Code	**Description**	**Quantity**	**Unit**	**Rate**	**Total**
	Hot water plant - Ground Floor				
1.	**Demolish and removal from site of existing hot water plant, including:**				
	12x gas hot water units, incl. frames, pipework, connections, controls, electrical, etc	1	item	12,000	12,000
	Retain existing 3 storage tanks		Note		Note
2.	**Hot water plant (per the equipment list below):**				
	Hot water central plant within existing building, comprising 3no. x Rheem W2W YF-Series-32kW, 5no.x storage tanks (Rheem 325L),3.no circulator pump (Grundfos UPS50-120F) - Supply only as per documents provided	1	item	130,000	130,000
	Installation including support framing and associated pipework, etc.	1	item	42,000	42,000
3.	**Pipework, insulation, valves and fittings as per BOQ provided**				
	<u>New pipework to connect new equipment to existing hot water pipework</u>				
	25mm dia insulated copper pipework, including bends, tees and fixings	12	m	120	1,440
	50mm dia insulated copper pipework, including bends, tees and fixings	18	m	220	3,960
	80mm dia insulated copper pipework, including bends, tees and fixings	280	m	320	89,600
	Isolation, control and check valves	1	item	10,000	10,000
	Allowance for bends, tees and fixings				INCL
4.	**Controls/Electrical:**				
	Hot water plant central control system, including sensors and controllers, including connecting to the existing MDL	1	item	15,000	15,000
	New electricity meter (1.no) and connect to the existing metering system	1	item	3,000	3,000
	New switchboard (63A), including new sub-circuits from switchboards to heat pumps and circulators	1	no	15,000	15,000
	1mm2 Cu XLPE 1x4C+E including connection to existing	15	m	35	525
	4mm2 Cu XLPE 1 x4C+E	15	m	55	825
	16mm2 Cu XLPE 1x4C+E including connection to existing	100	m	70	7,000
	Hot water plant - Roof plant				
1.	**Demolish and removal from roof top of existing hot water plant, including:**				
	6x gas hot water units, incl. frames, pipework, connections, controls, electrical, etc	1	item	6,000	6,000
	Retain existing 2 storage tanks		Note		Note
2.	**Hot water plant (per the equipment list below):**				
	Hot water central plant within existing building, comprising 2no. x Rheem W2W YF-Series-32kW, 3no.x storage tanks (Rheem 325L),2.no circulator pump (Grundfos UPS50-120F) - Supply only as per documents provided	1	item	86,000	86,000
	Installation including support framing and associated pipework, etc.	1	item	40,000	40,000
3.	**Pipework, insulation, valves and fittings as per BOQ provided**				
	<u>New pipework to connect new equipment to existing hot water pipework</u>				
	25mm dia insulated copper pipework, including bends, tees and fixings	8	m	120	960
	50mm dia insulated copper pipework, including bends, tees and fixings	12	m	220	2,640
	65mm dia insulated copper pipework, including bends, tees and fixings	40	m	250	10,000
	Isolation, control and check valves	1	item	7,000	7,000

Detailed Breakdown - New Acton South Apartments

	HOT WATER PLANT (ROOF TOP AND GROUND FLOOR)				
Code	**Description**	**Quantity**	**Unit**	**Rate**	**Total**
	Allowance for bends, tees and fixings				INCL
4.	**Controls/Electrical:**				
	Hot water plant central control system, including sensors and controllers, including connecting to the existing MDL	1	item	15,000	15,000
	New electricity meter (1.no) and connect to the existing metering system	1	item	3,000	3,000
	New switchboard (63A), including new sub-circuits from switchboards to heat pumps and circulators	1	no	15,000	15,000
	1mm2 Cu XLPE 1x4C+E including connection to existing	10	m	35	350
	4mm2 Cu XLPE 1 x4C+E	10	m	55	550
	10mm2 Cu XLPE 1x4C+E including connection to existing	100	m	50	5,000
5.	**Commissioning and Testing**				
	Testing and commissioning only to the plant systems on Roof and on Ground(upto 2 days per plant as advised)	1	item	10,000	10,000
6.	**Building works:**				
	BWIC, including penetrations, set out penetrations from the existing plant room within the building to the existing rooftop, fire collar, patching, seals and making good the existing (i.e floor slab and roof slab after swap system etc)	1	item	27,000	27,000
	Reused water meters as advised		note		
	EXCLUDE new concrete plinth to the new plant equipment on Ground and Roof				EXCL
	EXCLUDE new acoustic louvre screen				EXCL
	EXCLUDE structural works and acoustics (noting no acoustics or structural works are proposed at this stage, although are still being assessed and will update if necessary)				EXCL
	Rounding				150
	HOT WATER PLANT (ROOF TOP AND GROUND FLOOR)				**559,000**

Detailed Breakdown - New Acton South Apartments

	HEATING WATER PLANT (ROOF TOP)				
Code	**Description**	**Quantity**	**Unit**	**Rate**	**Total**
	Heating water plant - Rooftop				
1.	**Demolish and removal from roof top of existing heating water plant, including:**				
	2x gas heating water boilers, circulating pumps, and associated frames, pipework, connections, controls, electrical, etc.	1	item	4,000	4,000
	Retain existing 2 storage tanks		Note		Note
2.	**Hot water plant (per the equipment list below):**				
	Hot water plant on roof top, including hot water heat pumps (3.no x Trane CXAF 190 HE), Circulator pumps (3.no x Grundfos TP80-240/2), buffer tank (1.no x Aquazone AVBT-1000-CO), water treatment dosing pot (1.no), expansion tank (1.no), plate heat exchanger (1.no) - supply only as per documents provided	1	item	1,093,000	1,093,000
	Installation including support framing and associated pipework, etc.	1	item	290,000	290,000
3.	**Pipework, insulation, valves and fittings as per BOQ provided**				
	New pipework to connect new equipment to existing hot water pipework				
	15mm dia insulated copper pipeworks	4	m	90	360
	65mm dia insulated copper pipework, including bends, tees and fixings	40	m	250	10,000
	80mm dia insulated copper pipework, including bends, tees and fixings	280	m	330	92,400
	150mm dia insulated copper pipework, including bends, tees and fixings	12	m	870	10,440
	200mm dia insulated copper pipework, including bends, tees and fixings	120	m	1,150	138,000
	Isolation, control and check valves for 15dia,150 dia and 200dia pipework	1	item	45,000	45,000
	Allowance for bends, tees and fixings				INCL
4.	**Controls/Electrical:**				
	Automatic control system, including sensors, controllers, programming, and connecting to the existing BMS, etc (as per documents provided)	1	item	20,000	20,000
	New electricity meter (1.no) and connect to the existing metering system	1	item	3,000	3,000
	New switchboard (400A), including new sub-circuits from switchboards to heat pumps and circulators	1	no	75,000	75,000
	4mm2 Cu XLPE 1x4C+E	15	m	55	825
	95mm2 Cu XLPE 4x1C, including connection	200	m	170	34,000
5.	**Commissioning and Testing**				
	Testing and commissioning only to the plant system on Roof (upto 2 days as advised)	1	item	5,000	5,000
6.	**Building works:**				
	BWIC, including set out, penetrations from the roof top to basement, patching, seals, fire collar, additional concrete plinths for new plant equipment and making good the existing (i.e basement and roof slab after swap system etc)	1	item	92,000	92,000
	Reused water meters as advised		note		
	EXCLUDE new acoustic louvre screen				EXCL
	EXCLUDE structural works and acoustics				EXCL
	Rounding				975
	HEATING WATER PLANT (ROOF TOP)				**1,914,000**

Detailed Breakdown - New Acton South Apartments

	PV PANELS

Code	Description	Quantity	Unit	Rate	Total
	PV PANELS				
1.	**Photovoltaic systems – 2 systems on rooftop**				
	63kW system, comprising totaling 141.no x PV Panels, incl. inverters and supporting frames	1	item	127,000	127,000
	Fixed aluminium fence panels to roof perimeters (approx. 150m)	1	item	98,000	98,000
2.	**Electrical supply – sub-mains connecting from PV system to Main-switchboard.**				
	16mm2 Cu XLPE 1x4C+E including connection to existing	130	m	70	9,100
3.	**Commissioning and Testing**				
	Testing and commissioning only (upto 2 days as advised	1	item	7,000	7,000
4.	**Building works:**				
	BWIC, including penetrations, set out for penetrations, fire collar, patching and sealings the existing slab	1	item	13,000	13,000
	EXCLUDE major making goods or replacements of roof membrane and roof structures				EXCL
	EXCLUDE any upgrade works to existing DB and meters is included in the cost estimate				EXCL
	Rounding				900
	PV PANELS				**255,000**

Detailed Breakdown - New Acton South Apartments

	BACKBONE INFRASTRUCTURE FOR PROPOSED EV CHARGERS ONLY				
Code	**Description**	**Quantity**	**Unit**	**Rate**	**Total**
	Backbone Infrastructure for proposed EV Chargers				
	The following EV chargers costs provided by GHD via email dated on 30 September 2025)		Note		
1.	**Backbone infrastructure for potential EV chargers only – supply and install**				
	EV chargers are excluded from the cost estimate as advised by GHD				EXCL
	Surface mounted isolator, cabling, conduit, tray (189.no)	1	item	128,520	128,520
2.	**Electrical supply –**				
	New distribution board (250A), including sub-circuits from DB to new EV charger (8.no)	1	item	112,000	112,000
	Submains cable 4x95mm2 +EXLPE	1	item	52,800	52,800
3.	**Communications –**				
	Data outlets, racks and reticulation	1	item	264,600	264,600
3.	**Commissioning and Testing**				
	Testing and commissioning only (upto 2 days as advised)	1	item	4,000	4,000
4.	**Building works**				
	BWIC, including penetrations, set out for penetrations, fire collar, making good the existing basement wall etc)	1	item	23,980	23,980
	Rounding				100
	BACKBONE INFRASTRUCTURE FOR PROPOSED EV CHARGERS ONLY				**586,000**

Detailed Breakdown - New Acton South Apartments

	ELECTRICAL INFRASTRUCTURE

Code	Description	Quantity	Unit	Rate	Total
	ELECTRICAL INFRATRUCTURE				
1.	**Upgrade existing transformer from 500kVA to 750kVA**				
	Replacement of existing transformer (500kVA) to new (750kVA) within existing chamber sub, including demolition of existing transformer and associated power	1	item	455,000	455,000
	EXCLUDED new transformer chamber				EXCL
2.	**Replacement of existing main switchboard with new (1100A MSB) located within existing main switchroom, including new mains and submains**				
	300mm2 x 2 x 4c, including conduits	30	m	690	20,700
	Submains reterminations with 15m additional cabling each to cross room	20	no	9,600	192,000
	Replace existing MSB with new (1100A MSB)	1	item	180,000	180,000
3.	**Commissioning and Testing**				
	Testing and commissioning only	1	item	13,000	13,000
4.	**Building works**				
	BWIC, including penetrations, set out for penetrations, trenching and backfill for main and submain cabling, making good the existing	1	item	44,000	44,000
	Rounding				300
	ELECTRICAL INFRASTRUCTURE				**905,000**

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