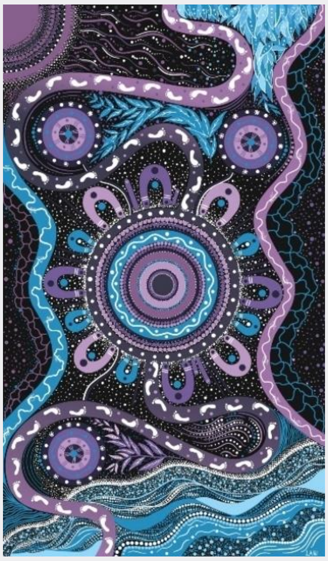
Gas-Electricity Meter Data Linking Project Report

January 2025

A report for the Australian Government Department of Climate Change, Energy, the Environment and Water



We acknowledge the Traditional Custodians of the land, seas and waters across Australia. We honour the wisdom of Aboriginal and Torres Strait Islander Elders past and present and embrace future generations.

We acknowledge that, wherever we work, we do so on Aboriginal and Torres Strait Islander lands. We pay respect to the world's oldest continuing culture and First Nations peoples' deep and continuing connection to Country; and hope that our work can benefit both people and Country.

'Journey of unity: AEMO's Reconciliation Path' by Lani Balzan

AEMO Group is proud to have launched its first Reconciliation Action Plan in May 2024. 'Journey of unity: AEMO's Reconciliation Path' was created by Wiradjuri artist Lani Balzan to visually narrate our ongoing journey towards reconciliation - a collaborative endeavour that honours First Nations cultures, fosters mutual understanding, and paves the way for a brighter, more inclusive future.

Important notice

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Executive summary

This report, prepared by the Australian Energy Market Operator (AEMO) for the Department of Climate Change, Energy, the Environment, and Water (DCCEEW), provides a comprehensive analysis of gas and electricity consumption patterns for 3 million residential and small commercial customers across Victoria, New South Wales, South Australia, the Australian Capital Territory and Queensland.

For the first time, this analysis links gas and electricity datasets at the customer level by combining gas Meter Identification Registration Numbers (MIRNs) and electricity National Metering Identifiers (NMIs). This consolidated dataset bridges critical gaps in understanding the interplay between gas and electricity use, enabling a more holistic view of household energy consumption.

This analysis includes an assessment of the impacts of electrification on household gas and electricity consumption profiles, highlights key trends in the transition from gas to electricity, and explores the socioeconomic and geographic factors influencing electrification rates.

The analysis aims to support evidence-based policy decisions, contribute to electrification forecasts, and inform planning for future gas and electricity infrastructure. The project has been undertaken as part of the Regional and Cross-sectoral Demand Transition workstream under the National Energy Transformation Partnership.

Residential sector insights

Impact of electrification on household energy consumption

This analysis examines energy consumption patterns across various dwelling cohorts, categorised by dwelling type (house or unit/apartment), dwelling age, space and water heating (gas or electric), and the presence of rooftop solar. It evaluates the impact of electrifying heating and hot water on household gas and electricity consumption. Electrification of vehicles is excluded from the analysis.

The analysis reveals a substantial reduction in household energy consumption for homes with electric heating and hot water compared to gas-heated counterparts:

- Stand-alone houses in Melbourne and Geelong with electric heating, electric hot water and rooftop solar were found to use approximately 54 gigajoules (GJ) less gas and import just 0.1 megawatt hour (MWh) more electricity from the grid per year compared to houses with gas heating, gas hot water and no solar (as well as exporting 3.8 MWh back to the grid).
  - When combined with other energy performance[1] measures, the reduction in gas use can be even more significant for older homes, with houses constructed prior to 2005 with gas heating and hot water typically consuming around 30% more gas than new houses with gas heating and hot water.
- While gas reductions are less pronounced in milder climates due to reduced heating demand, houses with electric heating and hot water in Newcastle, Sydney and Wollongong were still found to use an average of 23 GJ less gas per year compared to homes reliant on gas for heating and hot water. In addition, houses with electric heating, electric hot water and rooftop solar imported an average of 0.6 MWh less electricity from the

[1] Energy performance includes energy efficiency, demand flexibility and electrification or fuel switching, as outlined in the National Energy Performance Strategy (https://www.dcceew.gov.au/energy/strategies-and-frameworks/national-energy-performance-strategy).

grid than those with similar electric devices without PV, as well as exporting an additional 5 MWh back to the grid per year.

While these findings highlight potential reductions in energy consumption due to residential electrification, it is important to note that the datasets used in this analysis are not homogenous. Differences in dwelling characteristics, heating behaviours and household energy needs mean that reductions will vary substantially across households.

Impact of household electrification on daily demand profiles

The transition to electric heating, hot water and rooftop solar significantly alters daily electricity demand patterns. Homes with electric heating exhibit more pronounced peaks in electricity imports[2] during colder months, particularly in the morning and evening hours, as they meet heightened heating demands. These peaks are further intensified on the coldest days. In Victoria, the findings highlight that with widespread electrification, peak demand may shift from summer to winter as heating demand surpasses cooling demand, which is consistent with AEMO's longer term demand forecasts. Furthermore, during winter, homes with rooftop solar exhibit a sharp surge in demand as they transition from being net exporters during the day to significant importers during the evening peak.

This highlights the importance of home energy storage and advanced load-shifting technologies to balance peaks and troughs in demand and reduce ramping pressures on the grid, underscoring the importance of the National Energy Performance Strategy[3] and the National Consumer Energy Resources Roadmap[4].

Household electrification trends

The trend analysis examines the rate of electrification of residential heating and hot water from gas to electric alternatives, for homes with an active gas connection. Household electrification trends reveal a steady shift from gas to electricity for heating, with variations by region. Queensland is excluded from the heating analysis due to relatively limited use of gas heating.

- **Australian Capital Territory** – the Australian Capital Territory has higher rates of electrification than other regions, with new homes almost exclusively using electric heating, even before the introduction of the ban on new residential gas connections. This reflects a consistent and comprehensive suite of policies and incentives to promote electrification and improve energy performance over the past decade.
- **Victoria** – the analysis reveals a gradual but consistent shift toward electric heating in Victoria. There is evidence of retrofitting in older homes, likely accelerated by the Victorian Energy Upgrades[5] program. Electric heating adoption has also been gradually increasing in new homes, however gas heating persists in a majority of new residential gas connections, with an estimated 59% of gas-connected homes constructed in 2022 using gas heating. The recently introduced ban on new residential gas connections is expected to change this,

[2] Electricity drawn from the grid, as opposed to onsite generation (for example, from rooftop solar).

[3] DCCEEW 2024, The National Energy Performance Strategy, Department of Climate Change, Energy, the Environment and Water, Canberra. CC BY 4.0, https://www.dcceew.gov.au/sites/default/files/documents/national-energy-performance-strategy.pdf.

[4] DCCEEW 2024, National Consumer Energy Resources Roadmap, Department of Climate Change, Energy, the Environment and Water, Canberra. CC BY 4.0, https://www.energy.gov.au/sites/default/files/2024-07/national-consumer-energy-resources-roadmap.pdf.

[5] Victorian Government, Victorian Energy Upgrades, https://www.energy.vic.gov.au/victorian-energy-upgrades.

alongside other measures within Victoria's Gas Substitution Roadmap[6], which are expected to further influence the pace of electrification.

- **New South Wales and South Australia** – the pace of heating electrification has been slightly slower in New South Wales and South Australia, potentially influenced by a milder climate reducing the incentive for households to electrify heating. The slower pace of electrification suggests there may be a need for additional information and incentives to address the persistent reliance on gas heating in new and existing dwellings.

Socioeconomic influences

This analysis examines the intersection between socioeconomic factors and electrification, highlighting some of the barriers and opportunities.

Renters face significant barriers to electrification due to the dynamics of rental markets, where landlords are not adequately incentivised to invest in energy performance upgrades like electric heating, and rooftop solar, as the upfront costs can be high and landlords do not directly benefit from the energy bill savings. This dynamic is evident in the data, which shows a strong negative correlation between rental density and rooftop solar uptake. Similar trends are emerging with electrification rates, with the data indicating that areas with a high proportion of rental properties have slower electric heating adoption rates. This underscores the importance of targeted policies that address these split incentives and promote equitable access to the benefits of electrification.

Income levels also influence electrification trends, although not always as expected. Higher-income areas do not uniformly exhibit faster electrification trends. For instance, in Melbourne, affluent suburbs in the inner east have been slower to retrofit older homes with electric heating, despite showing higher electric heating adoption rates in newly constructed housing. At the same time, lower income residential growth zones also lag in the transition away from gas, due to recent investment in gas appliances that are unlikely to reach replacement age in the near term. These trends highlight the importance of tailored information and incentives to accelerate electrification across diverse socioeconomic contexts, ensuring all communities can benefit from improved energy performance and associated cost savings.

Commercial sector insights

The commercial sector presents a diverse range of gas and electricity consumption patterns, reflecting the complexity and variation in energy use across sectors.

Analysis of Australia and New Zealand Standard Industrial Classification (ANZSIC) divisions reveals key sectors and regions where electrification efforts can have the most significant impact. The Food and Beverage Services sector stands out as a candidate for electrification as it has a high reliance on gas, and the majority of its gas dependent processes can likely be electrified using commercially available technologies.

[6] Victorian Government (2024), Gas Substitution Roadmap Update. The State of Victoria Department of Energy, Environment and Climate Action 2024. CC BY 4.0, https://www.energy.vic.gov.au/renewable-energy/victorias-gas-substitution-roadmap/gas-substitution-roadmap-update-2024.pdf.

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1 Introduction

The Australian Energy Market Operator (AEMO) and the Department of Climate Change, Energy, the Environment, and Water (DCCEEW) have partnered to address critical gaps in understanding the interplay between electricity and gas consumption for residential and small commercial customers. As Australia accelerates electrification for a net zero future, understanding trends in gas and electricity consumption is essential for informed policy and planning decisions. Household electrification has the potential to both reduce emissions and ease reliance on gas, alleviating supply pressures and mitigating the risk of shortfalls. However, robust data is needed to support decision-making.

For the first time, this project has enabled AEMO to link gas and electricity consumption data at the customer level, creating a substantial consolidated dataset that provides new insights into household and small commercial energy use. Gas Meter Identification Registration Numbers (MIRNs) and electricity National Metering Identifiers (NMIs) have been linked based on address data provided by gas distributors. This dataset offers insights into the implications of electrification on household energy consumption and energy infrastructure, residential electrification trends and socioeconomic influences. These insights may support policy development, contribute to AEMO's electrification forecasts, and support system planning.

1.1 Project objectives and scope

Project objectives

The primary objective of this project, as defined in collaboration with DCCEEW, is to link gas and electricity consumption data at the customer level for residential and small commercial customers, to better understand the interplay between gas and electricity consumption as customers transition away from gas.

The project has been undertaken as part of the Regional and Cross-sectoral Demand Transition workstream under the National Energy Transformation Partnership. The Partnership identifies a better understanding of changing energy demand, and improved coordination of gas and electricity planning, as priority themes for focus by Commonwealth, state and territory governments. The project aims to:

- **Support the formulation of targeted policies** that accelerate electrification, promote energy equity and enhance energy performance.
- **Contribute to AEMO's electrification forecasts** by improving the understanding of electrification trends and the associated impact on household energy consumption to assist in validating multi-sectoral modelling electrification outcomes. In the future, this kind of analysis may even form the basis of AEMO's electrification forecasting.
- **Support system planning** through an improved understanding of the impact on electricity and gas networks when customers transition away from gas.
- **Enhance public understanding** of the impacts of electrification.

Project scope

The project focuses on residential and small commercial customers across Victoria, New South Wales, the Australian Capital Territory, South Australia, and Queensland. The analysis is summarised at the state and territory level, with major population centres such as Melbourne/Geelong and Sydney/Newcastle/Wollongong examined in greater detail in some instances.

The analysis is based on a point-in-time dataset that includes only active gas MIRN connections as of June 2024, meaning it excludes all abolished MIRNs. As a result, this analysis captures trends only among dwellings that still have an active gas connection. Dwellings that have fully electrified – either by abolishing their gas connection or as part of a new all-electric development – are not included in this dataset. For this reason, the trend analysis does not capture the overall rate of residential electrification and instead reflects incremental electrification trends among dwellings that remain connected to the gas network.

2 Methodology

2.1 Gas and electricity integration

The integration of gas and electricity data formed the foundational step in developing a consolidated dataset for analysis. This process aimed to establish a robust link between gas MIRNs and electricity NMIs, enabling a more comprehensive household energy view. The key components of this integration are outlined below.

Data collection

Approximately 4.9 million MIRNs were obtained from gas distributors via the *Gas Statement of Opportunities* (GSOO) survey process. Each MIRN included address data, which was a critical input for matching to corresponding NMIs in electricity datasets.

Address matching process

To ensure accurate and reliable matching between gas MIRNs and electricity NMIs, a systematic address matching process was undertaken, which involved the following key steps:

- **Matching criteria** – the MIRNs were matched to NMIs using two key identifiers:
  - **Delivery Point Identifier (DPID)** – a unique identifier provided by Australia Post that ensures precise address validation.
  - **Geocoded National Address File (GNAF)** – a standardised dataset for geocoded addresses across Australia.
- **Matching tools** – IQ Office software was employed to perform address matching. Using advanced address matching software ensures a high level of accuracy by handling variations in address formats and geocoding addresses for precise spatial identification.
- **Quality assurance** – address matches were subjected to quality checks, categorised as:
  - **Correct matches** – fully validated against DPID or GNAF.
  - **Amended matches** – minor adjustments made by the software to align with standard formats.
  - **Unmatched records** – where no match was found.
  - **Multiple matches** – scenarios where a single MIRN linked to multiple NMIs, or multiple MIRNs matched to a single NMI. For the final dataset, only unique MIRN-to-NMI matches were retained to avoid ambiguity in energy consumption analysis.
  - **Valid electricity and gas data** – data verification checks were carried out to verify that matched MIRNs and NMIs had adequate electricity and gas data to proceed to the analysis stage. This step ensured that only dwellings with comprehensive energy data were included, enhancing the robustness of subsequent analyses.

Success rate

Out of almost 5 million MIRNs received from gas distributors, around 3 million proceeded to the analysis stage of the project. Queensland had the lowest rate of MIRNs proceeding to the analysis stage, due to a combination of inexact address data and gaps in gas metering records. Victoria also experienced some gaps in gas metering data, although to a lesser extent than Queensland. Address data issues were more prevalent in units and apartments compared to standalone houses, leading to some bias in the housing mix.

Despite the data limitations, the 3 million dwellings that did proceed to the analysis stage represent a substantial and statistically significant sample size, providing a strong foundation for deriving robust insights into the impacts of electrification. This extensive dataset enables an in-depth exploration of the impact of electrification on gas and electricity consumption patterns, electricity demand profiles, and electrification trends, offering valuable evidence to inform energy policy, electrification forecasts and system planning.

Table 1 Address matching success rate

	MIRNs received	MIRNs matched to a NMI	MIRN/NMIs with valid 2023 data	Success rate
Victoria	2.39 M	1.88 M	1.34 M	56%
New South Wales	1.67 M	1.24M	1.13 M	68%
South Australia	0.490 M	0.366 M	0.338 M	69%
Queensland	0.239 M	0.167 M	0.071 M	30%
Australian Capital Territory	0.147 M	0.126 M	0.113 M	77%
Total	**4.94 M**	**3.78 M**	**2.99 M**	**61%**

2.2 Cohort allocation

The cohort allocation process was designed to group dwellings based on shared characteristics, allowing for targeted analysis of energy consumption patterns. This classification considered a range of dwelling attributes, as outlined in Table 2.

Table 2 Cohort allocation methodology

	Cohort	Allocation methodology
Customer type	Residential or business	Customer Administration and Transfer Solution (CATS) standing data
	Gas and electricity, or electricity only	Based on successful MIRN/NMI address match
Consumer energy resources (CER)	Rooftop solar	Defined as having rooftop solar based on either: • Commissioning date in the distributed energy resources (DER) register • Presence of non-zero electricity exports (noting that this may also represent storage, however the percentage of dwellings with a battery and no solar is likely to be low)
Dwelling characteristics	Dwelling age	Connection year assumed based on the first record of the NMI in CATS database
	Dwelling type	Classified as either a house or a unit/flat/apartment based on the address
Residential space heating	Gas heating	Estimated based on regression analysis described in Section 2.2.1
	Electric heating	
Residential water heating	Gas hot water	Estimated based on summer gas consumption > 15 megajoules (MJ)/day

2.2.1 Gas and electric heating methodology

A constrained linear regression model was employed to determine whether a residential dwelling uses electric heating, gas heating, or both, by analysing energy consumption versus Heating Degree Days (HDD) and Cooling Degree Days (CDD).

Interval electricity meters

For interval electricity meters, AEMO has access to half-hourly electricity imports and exports. To mitigate distortions caused by solar self-consumption, the regression analysis was based on evening electricity imports, when solar generation is minimal. Electricity imports from the grid corresponding to intervals 36 to 48 (spanning 17:30 to midnight) were aggregated and defined as “evening electricity imports”.

Each regression point represents a 14-day aggregation of evening electricity imports and corresponding weather data. This approach smooths short-term fluctuations that could arise from factors such as electric vehicle charging or differences in consumption patterns between weekdays and weekends.

The regression model is expressed as follows:

$$\sum_{i=day\ 1}^{day\ 14} evening\ electricity\ imports_i = \beta_0 + \beta_1 \cdot \sum_{i=day\ 1}^{day\ 14} HDD_i + \beta_2 \cdot \sum_{i=day\ 1}^{day\ 14} CDD_i$$

Basic electricity meters

Basic electricity meters are manually read devices that provide a cumulative record of electricity usage over a defined billing period, typically every 60 or 90 days. Unlike interval meters, they do not record time-of-use data but instead capture a single consumption value for the entire billing cycle.

In this analysis, each meter read was treated as a single data point representing the cumulative electricity consumption for the billing period. To account for variations in billing periods, electricity consumption was normalised by dividing by the number of days in the billing period.

The regression model is expressed as follows:

$$\frac{electricity\ meter\ read}{billing\ days} = \beta_0 + \beta_1 \cdot \frac{\sum_{i=day\ 1}^{last\ billing\ day} HDD_i}{billing\ days} + \beta_2 \cdot \frac{\sum_{i=day\ 1}^{last\ billing\ day} CDD_i}{billing\ days}$$

Basic gas meters

Similar to basic electricity meters, basic gas meters provide cumulative gas consumption values over the billing cycle, which is typically every 60 or 90 days. CDD are not included in the residential gas consumption analysis, as cooling is almost exclusively provided by electric appliances and therefore not a direct driver of gas consumption.

The regression model used to analyse gas consumption is as follows:

$$\frac{gas\ meter\ read}{billing\ days} = \beta_0 + \beta_1 \cdot \frac{\sum_{i=day\ 1}^{last\ billing\ day} HDD_i}{billing\ days}$$

where:

- β_0 denotes baseline energy consumption independent of temperature.
- β_1 represents the sensitivity of energy consumption to HDD.
- β_2 represents the sensitivity of energy consumption to CDD.

- β_0 is constrained to be non-negative.

Identifying gas heating and electric heating

To determine whether each dwelling relied on gas and/or electric heating, separate least-squares regression models were applied to both electricity and gas usage data for each year. The following criteria were used to identify homes using gas and/or electric heating:

- The regression models had to achieve at least a moderate correlation, indicated by a minimum R^2 value of 0.5. This ensures a sufficiently strong relationship between energy use and HDD to indicate heating dependence, while still allowing for real-world household energy variability.
- For gas heating, the home's gas consumption needed to be at least 5 megajoules (MJ) per HDD. This represents a lower bound designed to capture a broad range of gas heating systems and account for variation in dwelling thermal efficiency.
- For electric heating, the home's electricity consumption needed to be at least 0.3 kilowatt hours (kWh) per HDD (for basic meters) or 0.2 kWh per HDD during evening periods (for interval meters). These lower-bound thresholds were designed to capture a wide range of electric heating systems while accounting for differences in appliance efficiency and thermal characteristics of dwellings.

2.3 Gas and electricity consumption patterns by cohort

Gas and electricity consumption patterns across the 2023 calendar year have been analysed for different dwelling cohorts and geographical areas to understand the impact of gas versus electric heating and hot water on residential electricity and gas consumption. This analysis was based on gas and electricity metering data and was subject to the following limitations:

- **Electricity data source limitations:**
  - Electricity data comes from a combination of interval meters and manually read basic meters. For basic meters, energy use has been averaged across the billing period, which means seasonal peaks may be diminished. In contrast, interval meters provide much greater insight into maximum and minimum demand, with electricity data available in 30-minute increments. The penetration of interval meters varies across states – Victoria, for example, has near-universal smart meter deployment, while other states still have a significant portion of basic meters in use.
  - Electricity usage in this analysis is based on energy imported from the grid, as behind-the-meter generation (such as rooftop solar self-consumption) is not visible. This means electricity usage analysed throughout this report is lower than total consumption within each premise.
- **Gas data source limitations** – all gas meter data used in this analysis comes from manually read basic meters, and is averaged across the billing cycle. Consequently, seasonal peaks in winter heating demand may be diminished.

2.4 Trend analysis

Seven years of gas and electricity data, from 2017 to 2023, were examined for dwellings with active gas connections, capturing changes in heating preferences over this period and providing insight into emerging electrification trends. However, this analysis only includes homes that still have an active gas connection as of June 2024, meaning fully electrified dwellings – those that have abolished their gas connection or are part of new all-electric developments – are not captured. As a result, the findings reflect incremental shifts in heating preferences among gas connected homes rather than the overall rate of residential electrification. Furthermore, the trends included in this report reflect the specific geographic regions analysed within this project and may not apply to areas outside of the NEM.

2.5 Socioeconomic insights

To understand the broader context of electrification, energy usage data was compared against socioeconomic indicators from the Australian Bureau of Statistics (ABS), including the percentage of renters and median family income. By mapping electrification patterns to these demographic factors at postcode level, the analysis aimed to highlight how underlying economic and social conditions influence the adoption of electric heating technologies. This approach provides a contextual understanding of how community-level characteristics may shape electrification trends.

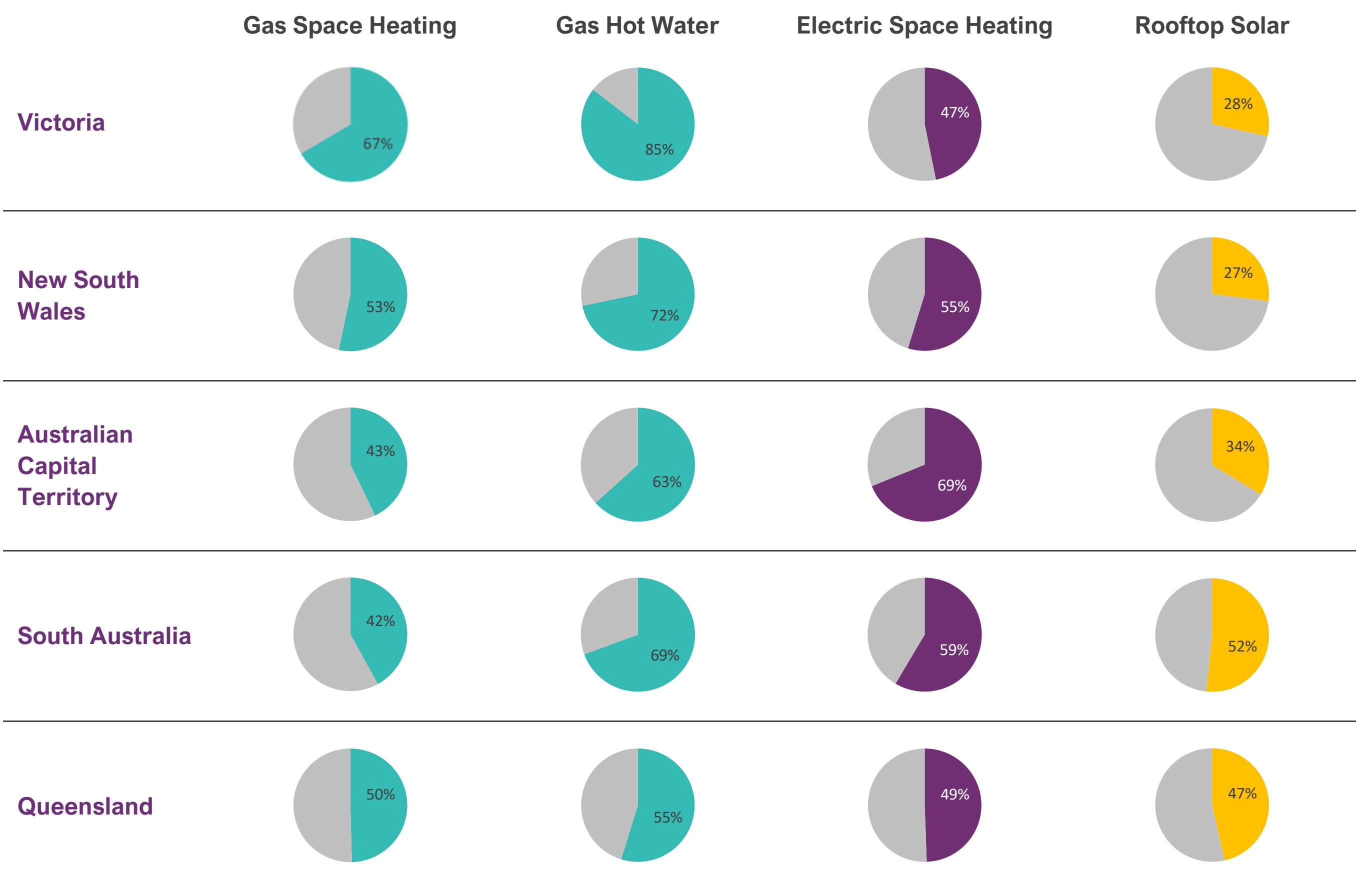
3 Residential results

3.1 Cohort analysis

3.1.1 Cohort allocation summary

The initial cohort allocation analysis, summarised in **Figure 1**, highlights notable regional variations in the adoption of gas and electric heating, as well as gas hot water and rooftop solar among residential dwellings with a gas connection. It is important to note that the address matching process had a higher success rate for standalone houses compared to units and apartments, which may introduce some bias in the reported adoption rates. For this reason, solar adoption rates are not reflective of the entire housing stock, as rooftop solar is particularly sensitive to bias in the housing mix.

Figure 1 Estimated appliance adoption rates in residential dwellings with a gas connection, by region – 2023 CY



Note by region:

- **Victoria** – the predominance of gas heating and hot water systems reflects the state's cooler climate and historical investment in gas infrastructure.

- **New South Wales** – gas hot water is widely adopted across New South Wales gas networks, and while gas heating adoption is lower than Victoria, it remains higher than the Australian Capital Territory and South Australia.
- **Australian Capital Territory** – strong electric heating uptake in the Australian Capital Territory suggests that early and consistent electrification and energy performance initiatives, including rebates and stringent building standards, and direct policy influencing new developments, have been effective in encouraging electric technologies.
- **South Australia** – widespread adoption of rooftop solar systems is evident in South Australia, stemming from supportive policy frameworks. Gas heating adoption is also lower than in Victoria and New South Wales.
- **Queensland** – high rooftop solar and relatively low gas heating and hot water uptake in Queensland can be linked to abundant solar resources, generous solar feed-in-tariffs and warmer temperatures.

3.1.2 Regional variation in residential gas and electricity consumption

Seasonal residential gas consumption and electricity imports from the grid demonstrate distinct regional patterns across states and territories, influenced by local climate conditions and regional energy policies. It is also important to note that the prevalence of gas connections varies significantly between regions, with approximately three-quarters of households in Victoria and the Australian Capital Territory connected to gas, just over half in South Australia, around 40% in New South Wales, and just 10% in Queensland. This analysis is focused solely on those dwellings with an active gas connection.

As Figure 2 below illustrates:

- **Victoria** – shows a pronounced seasonal peak in gas consumption during the colder months, reflecting its cooler climate and well-established gas infrastructure.
- **New South Wales** – exhibits moderate seasonal variation in gas and electricity consumption, reflecting its milder climate. Gas consumption reflects relatively low use of gas heating, and moderate use of both electric heating and cooling.
- **Australian Capital Territory** – despite its cold climate, the Australian Capital Territory demonstrates a much lower reliance on gas heating than Victoria, and much higher electric heating load. This reflects a consistent and comprehensive suite of policies and incentives to promote electrification and improve energy performance over the past decade.
- **South Australia** – demonstrates a much lower reliance on gas than Victoria and the Australian Capital Territory, with moderate seasonal variation in both gas and electricity usage across the year.
- **Queensland** – experiences relatively low and consistent gas consumption year-round, and a seasonal electricity profile that reflects Queensland's high cooling load in the warmer months.

Figure 2 Average daily gas usage and electricity imports for dwellings with a gas connection, by region – 2023 CY

Note: Electricity imports means electricity drawn from the grid, as opposed to onsite generation (for example, from rooftop solar).

Variation across Victoria

Given the high gas loading that exists in Victoria, and the substantial variation in gas and electricity consumption across the region, AEMO has applied a more detailed spatial analysis.

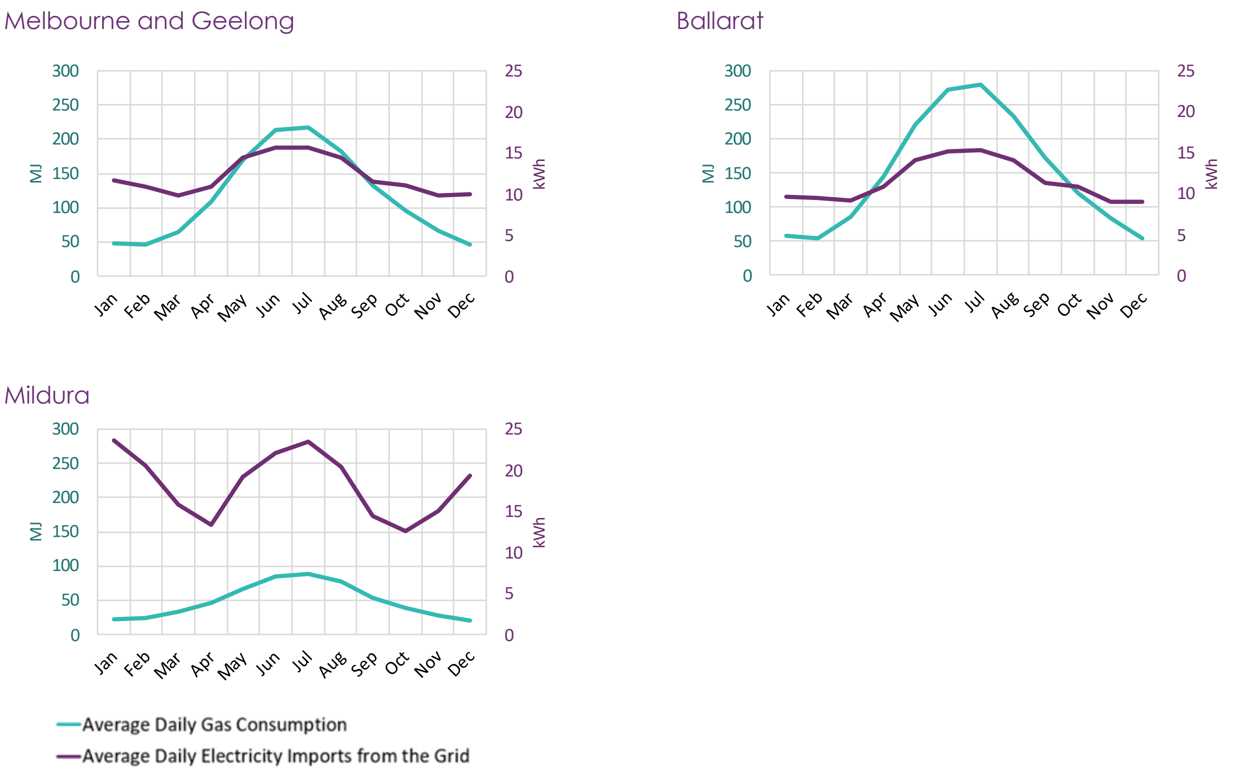
Figure 3 illustrates the considerable variation in residential gas and electricity consumption in Victoria, reflecting the influence of local climate conditions:

- Statewide averages are largely defined by the highly populated metropolitan areas of Melbourne and Geelong, yet regional patterns can vary markedly.
- In Ballarat, the pronounced winter peak in gas usage reflects its colder climate, while Mildura's flatter gas consumption profile and higher electricity cooling load reflect its much warmer local climate. The Mildura data also suggests a notable difference in heating preferences compared to most of Victoria, with winter electricity imports increasing more sharply than gas consumption. This may reflect a growing uptake of reverse-cycle air

conditioners, potentially installed for summer cooling but also increasingly used for winter heating due to their cost efficiency compared to gas heating.

- These intra-state variations demonstrate that even within a single jurisdiction, residential energy supply and demand dynamics can differ significantly.

Figure 3 Average daily gas usage and electricity imports for dwellings with a gas connection, Victoria – 2023 CY



Note: Electricity imports means electricity drawn from the grid, as opposed to onsite generation (for example, from rooftop solar).

3.1.3 Energy consumption profiles by cohort

This section explores how distinct cohort combinations of energy technologies, housing characteristics, and regional factors shape residential consumption patterns. Segmenting dwellings into cohorts – such as "Gas Dwellings" that rely solely on gas heating, have a gas hot water system and do not have a solar system, or "Mostly Electric Dwellings" that rely solely on electric heating and have electric hot water systems, and possibly rooftop solar – allows a more nuanced understanding of how these attributes influence gas and electricity consumption.

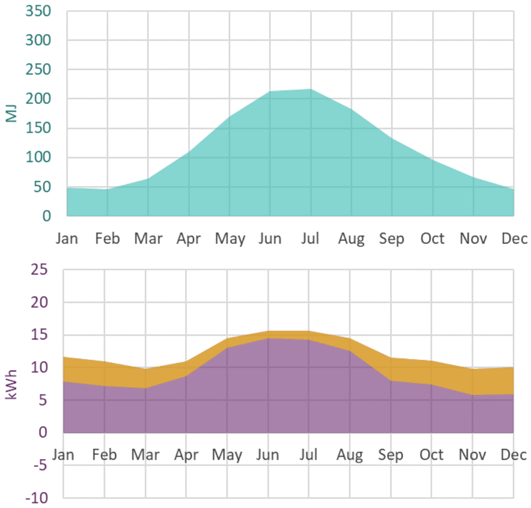
It is important to note, however, that the datasets analysed in cohort comparisons are not homogenous, and differences in dwelling characteristics and consumer behaviours mean the examples provided are not exact like-for-like comparisons. Instead, they represent averages based on the available dataset, offering insights into broader consumption patterns rather than precise equivalences between cohorts.

Throughout this analysis, electricity imports and exports refer specifically to electricity flows to and from the grid. This does not capture behind-the-meter consumption from consumer energy resources (CER) such as rooftop solar. As a result, actual electricity demand may be higher than what is reflected in the import data.

Melbourne/Geelong case study

Figure 4 Melbourne/Geelong average dwelling – 2023 consumption

Gas consumption, electricity imports from grid, electricity exports



Annual Consumption

42 GJ + 4.4 MWh – 1.0 MWh

Figures 4-6 illustrate the annual consumption profiles for selected cohorts in the Melbourne/Geelong region.

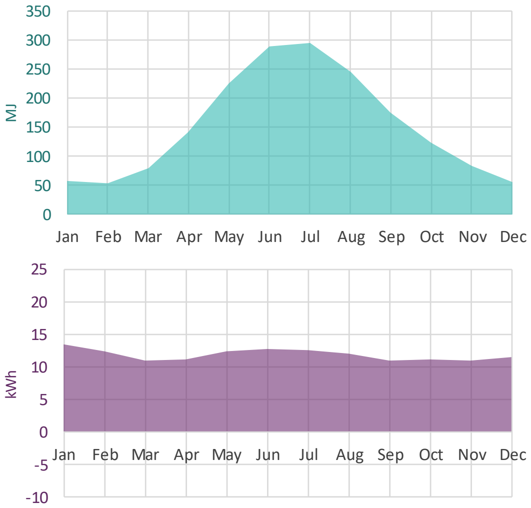
The "Gas Dwelling" cohort in Figure 5 shows a pronounced winter peak in gas use, reflecting a reliance on gas heating during cooler months, while electricity remains relatively steady. In contrast, the "Mostly Electric with Solar" cohort in Figure 6 uses minimal gas (primarily for cooking) and exhibits a clear winter peak in electricity imports due to heating.

The analysis suggests that in the Melbourne/Geelong region, dwellings with gas heating and hot water consume approximately 51 gigajoules (GJ) less gas per year, and only 0.3 megawatt hours (MWh) more electricity from the grid compared to dwellings with electric heating, electric hot water and rooftop solar.

Figure 5 Melbourne/Geelong gas dwelling – 2023 consumption

Gas heating only, gas hot water, no solar

Gas consumption, electricity imports from grid



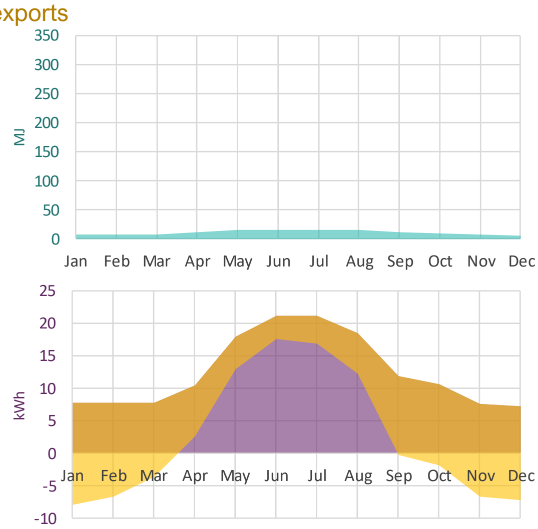
Annual Consumption

55 GJ + 4.3 MWh – 0 MWh

Figure 6 Melbourne/Geelong mostly electric dwelling with solar – 2023 consumption

Electric heating only, electric hot water, with solar

Gas consumption, electricity imports from grid, electricity exports



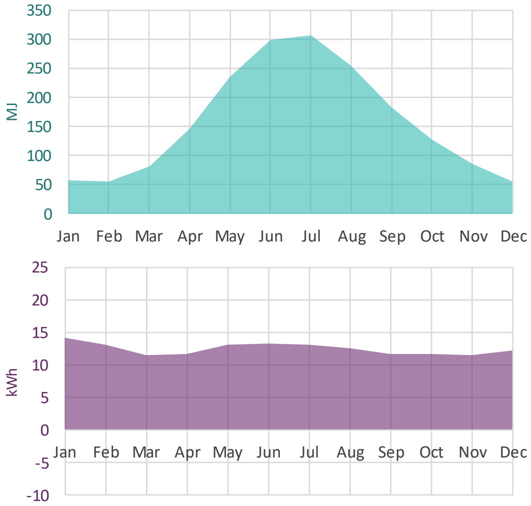
Annual Consumption

4.0 GJ + 4.6 MWh – 3.72 MWh

Melbourne/Geelong **houses only** (units and apartments excluded)

Figure 7 Melbourne/Geelong gas house – 2023 consumption

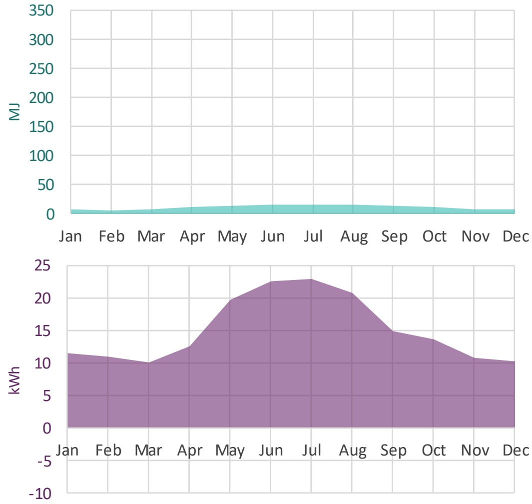
Houses with gas heating only, gas hot water, no solar
Gas consumption, electricity imports from grid



Annual Consumption
58 GJ + 4.6 MWh – 0 MWh

Figure 8 Melbourne/Geelong mostly electric house – 2023 consumption

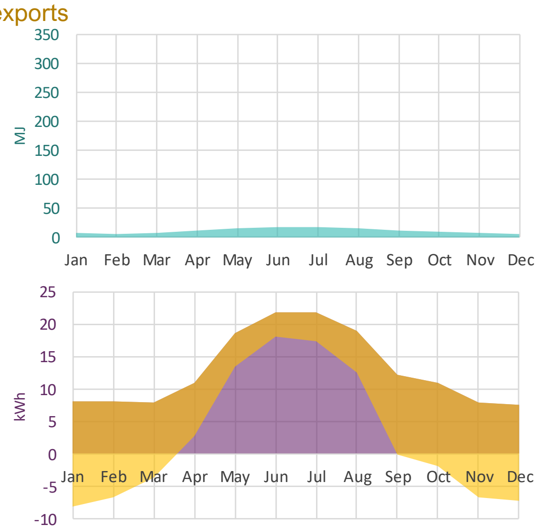
Houses with electric heating only, electric hot water, no solar
Gas consumption, electricity imports from grid



Annual Consumption
4.0 GJ + 5.5 MWh – 0 MWh

Figure 9 Melbourne/Geelong mostly electric house + solar – 2023 consumption

Houses with electric heating only, electric hot water, with solar
Gas consumption, electricity imports from grid, electricity exports



Annual Consumption
4.0 GJ + 4.7 MWh – 3.8 MWh

A standalone house in the Melbourne/Geelong region that uses electric heating and hot water without rooftop solar consumes an average of 54 GJ less gas and 0.9 MWh more electricity annually than a house with gas heating, gas hot water and no rooftop solar.

Electrified houses with solar also use an average of 54 GJ less gas, but just 0.1 MWh more electricity annually than houses with gas heating and hot water without solar, as well as exporting an average of 3.8 MWh of electricity back to the grid.

Despite importing a similar annual volume of electricity as those with gas heating and hot water without solar, electrified houses with solar exhibit distinctly different seasonal patterns. During the warmer months, they are net exporters of electricity, while in winter they experience a marked increase in electricity imports to meet heating loads at a time of reduced solar irradiance.

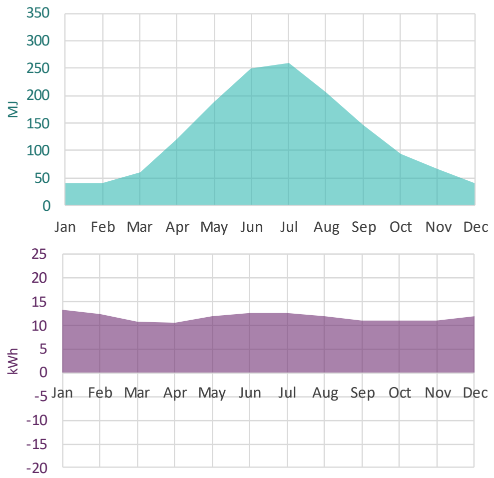
Notes:

- This example focuses exclusively on detached houses to reduce distortion caused by the housing mix within each cohort. It also gives a comparison with and without solar to isolate the impacts of electrification and solar adoption.

Melbourne/Geelong **newer houses versus older houses** (units and apartments excluded)

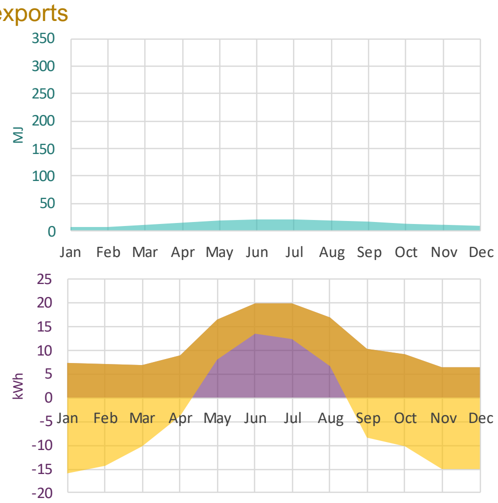
Figure 10 New house in Melbourne/Geelong (connected 2020-2022) – 2023 consumption

Houses with gas heating only, gas hot water, no solar
Gas consumption, electricity imports from grid



Annual Consumption
46 GJ + 4.3 MWh – 0 MWh

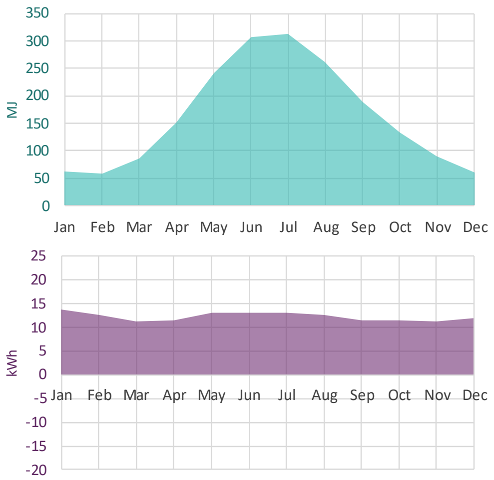
Houses with electric heating only, electric hot water, with solar
Gas consumption, electricity imports from grid, electricity exports



Annual Consumption
5.0 GJ + 4.1 MWh – 5.7 MWh

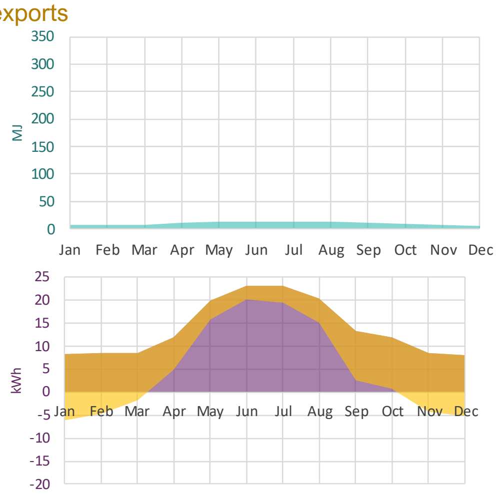
Figure 11 Older house in Melbourne Geelong (connected before 2005) – 2023 consumption

Houses with gas heating only, gas hot water, no solar
Gas consumption, electricity imports from grid



Annual Consumption
60 GJ + 4.5 MWh – 0 MWh

Houses with electric heating only, electric hot water, with solar
Gas consumption, electricity imports from grid, electricity exports



Annual Consumption
3.4 GJ + 5.0 MWh – 3.3 MWh

Notes:

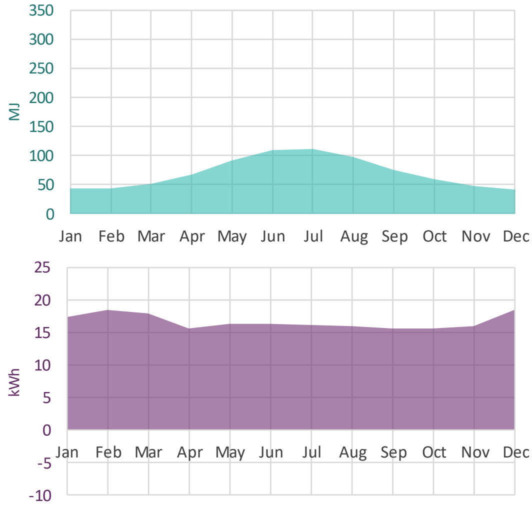
- Comparisons between newer (Figure 10) and older (Figure 11) houses highlight the influence of building standards and energy performance on potential household energy consumption. Older houses, built before 2005, typically consume around 30% more gas for heating and hot water than houses built between 2020 and 2022.

Sydney/Newcastle/Wollongong **houses** (units and apartments excluded)

Figure 12 Sydney/Newcastle/Wollongong gas house – 2023 consumption

Houses with gas heating only, gas hot water, no solar

Gas consumption, electricity imports from grid



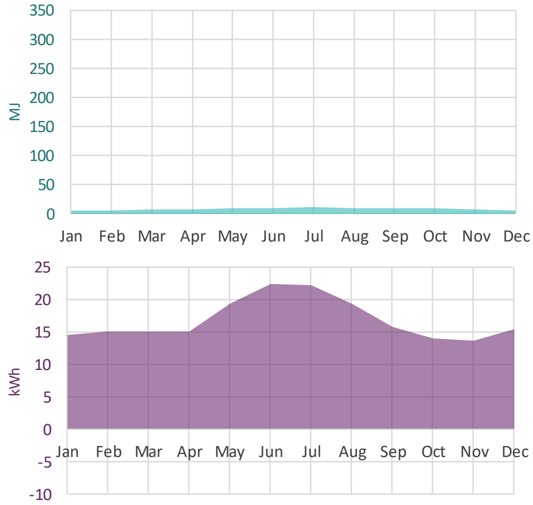
Annual Consumption

26 GJ + 6.1 MWh – 0 MWh

Figure 13 Sydney/Newcastle/Wollongong mostly electrical house – 2023 consumption

Houses with electric heating only, electric hot water, no solar

Gas consumption, electricity imports from grid



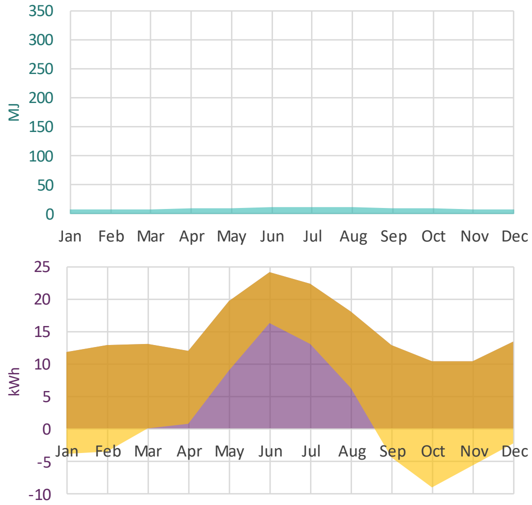
Annual Consumption

3.0 GJ + 6.2 MWh – 0 MWh

Figure 14 Sydney/Newcastle/Wollongong electric house + solar – 2023 consumption

Houses with electric heating only, electric hot water, with solar

Gas consumption, electricity imports from grid, electricity exports



Annual Consumption

3.2 GJ + 5.5 MWh – 5.0 MWh

Figures 12-14 extend the analysis to the Sydney/Newcastle/Wollongong region. Here, milder climatic conditions produce a more moderate winter peak in gas consumption. Consequently, the reduction in gas consumption due to electrification is less pronounced than in colder climates.

A house in the Sydney/Newcastle/Wollongong region using electric heating and hot water consumes an average of 23 GJ less gas and only 0.1 MWh more electricity annually than a comparable home with gas heating and hot water. The limited increase in electricity use reflects the high efficiency of electric heat pumps compared to gas heating, and the tendency for electrified homes to be newer or recently renovated, and therefore more thermally efficient. When focussing solely on older houses (connected before 2005), electrified homes consume an additional 0.44 MWh of electricity compared to their gas counterparts.

Interestingly, homes with solar import more electricity from the grid during winter, potentially reflecting a tendency for households with solar to increase electricity usage due to perceived cost savings from self-generation (solar rebound effect).

These findings highlight how the shift to electric heating and hot water, combined with the integration of rooftop solar, can significantly reduce energy consumption for households, especially in climates where winter heating demand heavily influences annual gas usage.

Older homes in cooler climates, such as Melbourne, offer the greatest potential for gas reduction and associated cost savings. While the impacts are less pronounced for households in milder climates, such as the Sydney, Newcastle, Wollongong area, the potential reduction in purchased energy remains meaningful, particularly when electrification is paired with rooftop solar.

These insights emphasise the need for state and territory level electrification strategies that account for local climate conditions and housing characteristics to maximise both economic and environmental benefits. State and territory efforts could be further supported by broader Commonwealth programs such as the Household Energy Upgrades Fund[7].

3.1.4 Electricity demand profiles by cohort combination

This section examines the hourly electricity demand profiles for different dwelling types across population centres Melbourne/Geelong, the Australian Capital Territory, Sydney/Newcastle/Wollongong, and South Australia. The analysis highlights variations in electricity imports and exports among three distinct cohorts:

- Homes with gas heating and hot water without solar.
- Homes with electric heating and hot water without solar.
- Homes with electric heating and hot water combined with rooftop solar.

The profiles are presented for four scenarios:

- ***Annual Average*** – average hourly demand across 2023 CY.
- ***Winter*** – average hourly demand across the winter months of 2023.
- ***Extreme Cold Day*** – average hourly demand on the day with the highest HDD in 2023:
  - Victoria: 21 June 2023.
  - ACT: 20 June 2023.
  - New South Wales: 20 June 2023.
  - South Australia: 21 July 2023.
- ***Extreme Heat Day*** – average hourly demand on the peak demand day for the NEM region, or on the day with the highest CDD in 2023:
  - Victoria: 17 January 2023 (based on peak demand for the Victorian NEM region).
  - ACT: 28 January 2023 (based on the highest CDD in 2023).
  - New South Wales: 6 March 2023 (based on peak demand day for the New South Wales NEM region).
  - South Australia: 2 February 2023 (based on peak demand day for the South Australian NEM region).

By comparing these profiles, the analysis demonstrates how widespread electrification may influence system demand, present challenges during peak periods, and create opportunities for optimising energy use through

[7] See https://www.dcceew.gov.au/energy/programs/household-energy-upgrades-fund.

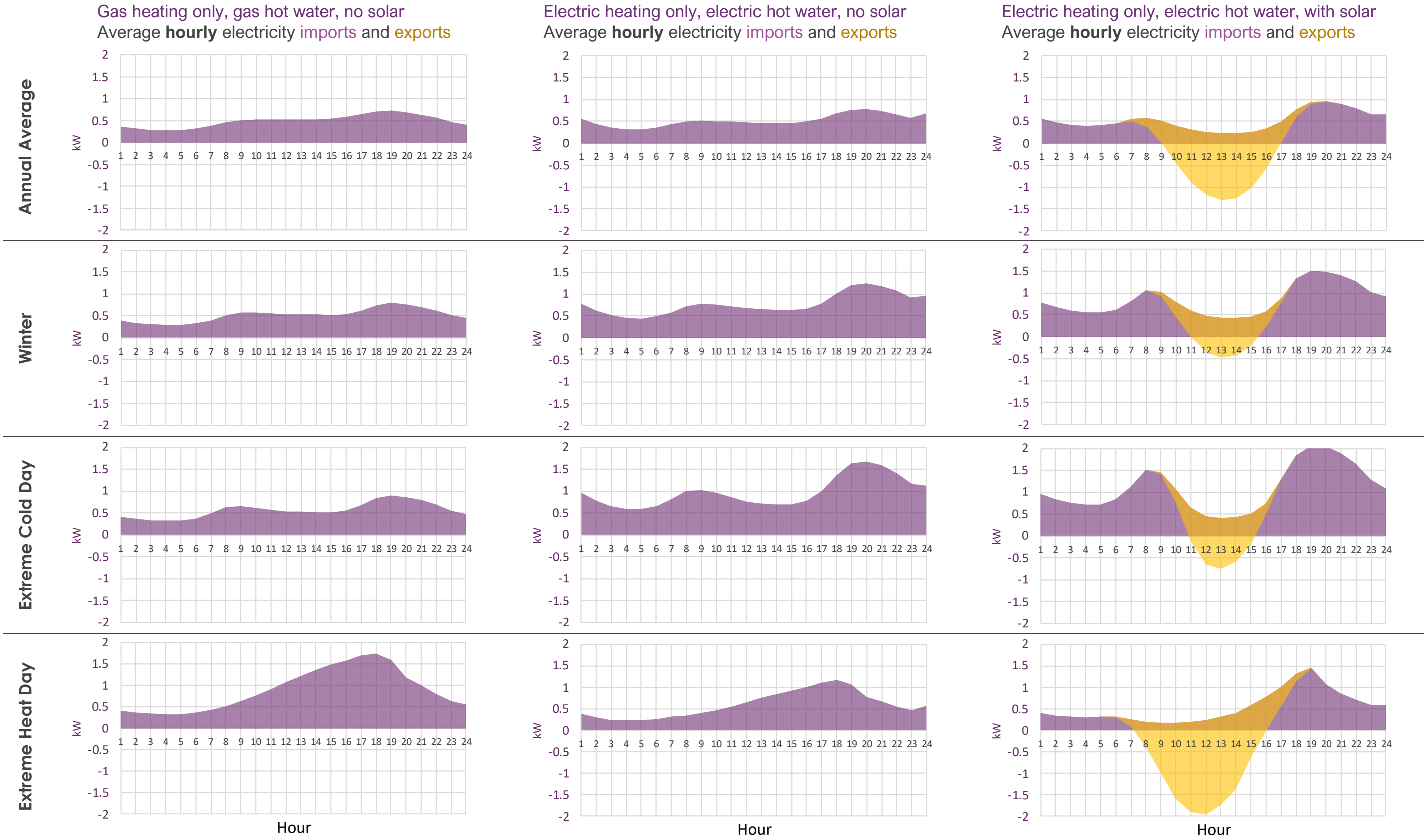
smart technologies and load-shifting strategies, such as home batteries, smart electric vehicle (EV) charging or vehicle-to-grid (V2G), and other automated demand response systems.

This underscores the importance of the National Energy Performance Strategy[8], which emphasises demand flexibility as a key component of an efficient and resilient energy system.

[8] DCCEEW 2024, The National Energy Performance Strategy, Department of Climate Change, Energy, the Environment and Water, Canberra. CC BY 4.0. https://www.dcceew.gov.au/sites/default/files/documents/national-energy-performance-strategy.pdf.

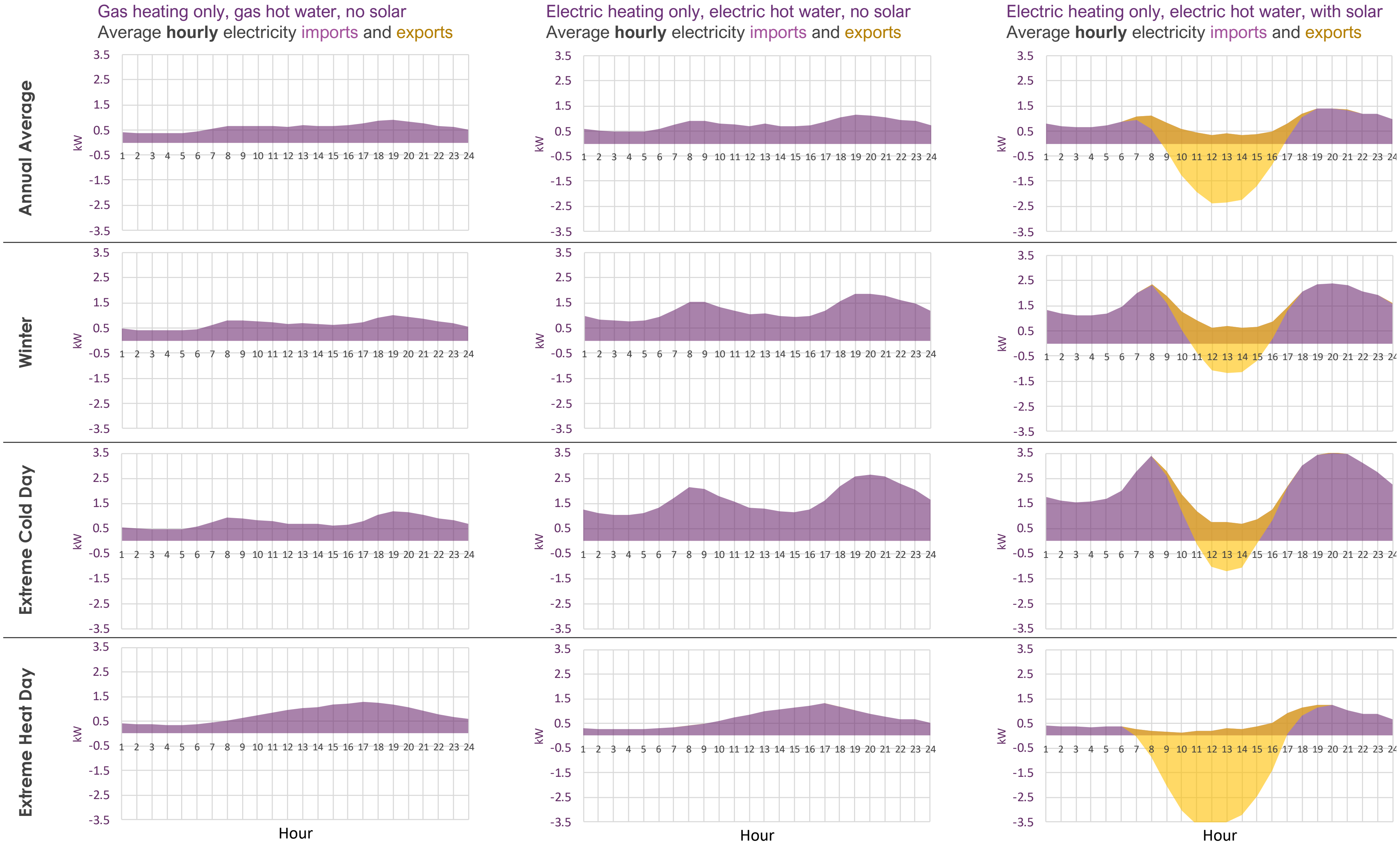
Melbourne/Geelong

Figure 15 Average hourly demand for dwellings with a gas connection, Melbourne/Geelong – 2023 CY



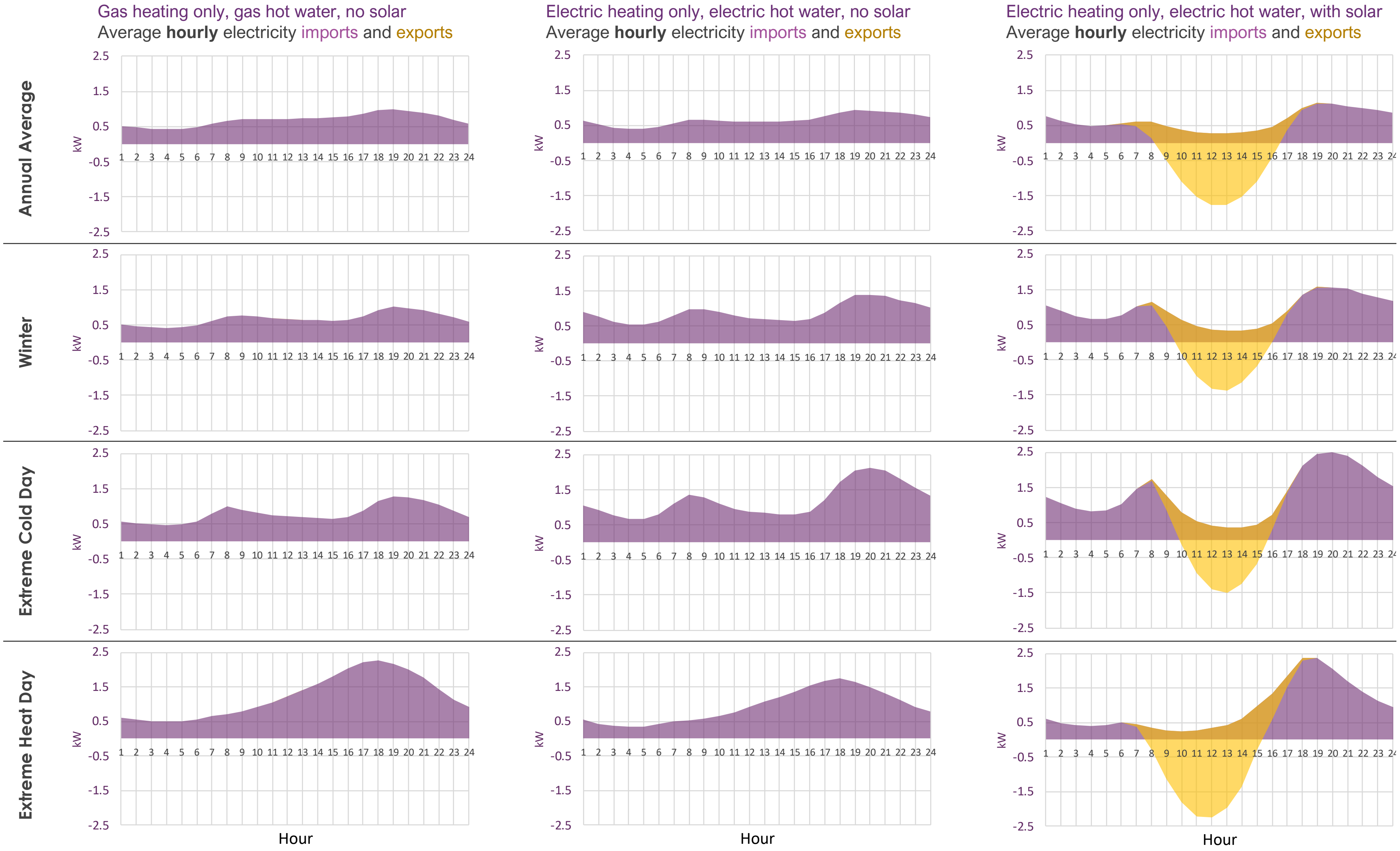
Australian Capital Territory

Figure 16 Average hourly demand for dwellings with a gas connection, Australian Capital Territory – 2023 CY



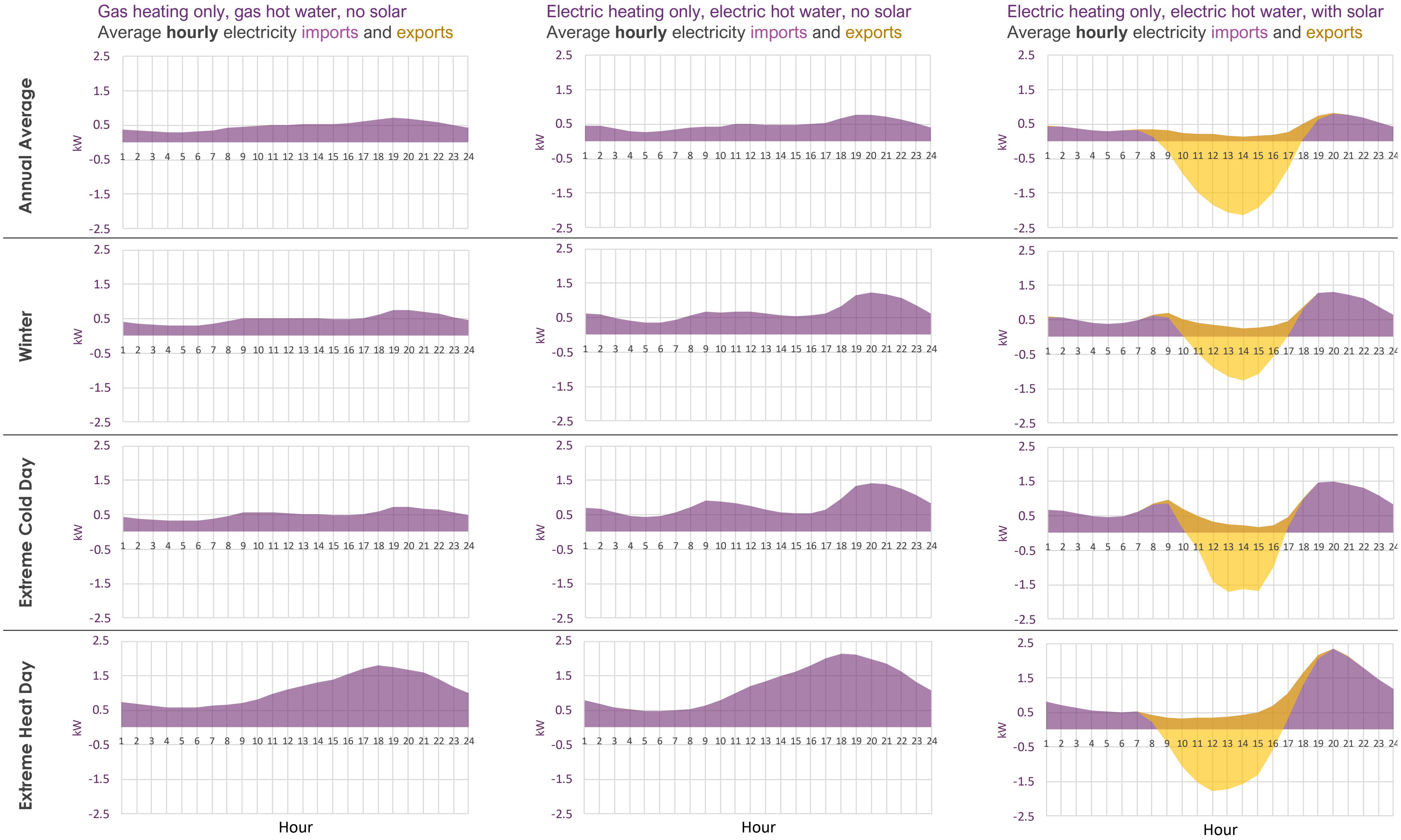
Sydney/Newcastle/Wollongong

Figure 17 Average hourly demand for dwellings with a gas connection, Sydney/Newcastle/Wollongong – 2023 CY



South Australia

Figure 18 Average hourly demand for dwellings with a gas connection, South Australia – 2023 CY



Key observations by cohort

- **Gas heating and hot water, no solar** – homes with gas heating only (no electric heating) and gas hot water were identified partly due to their stable electricity consumption across seasons, and this is reflected in their consistent demand curves across the year. With the exception of very hot days, these dwellings exhibit moderate increases during evening hours when household activities typically peak. However, during heatwaves, cooling demand causes a surge in electricity usage, as shown by the regional profiles for extreme heat.
- **Electric heating and hot water, no solar** – transitioning to electric heating and hot water introduces more pronounced seasonal and daily variations. In winter, electricity imports increase significantly during the early morning and evening hours to meet heating demand. On extremely cold days, this peak is further amplified, reflecting the strain on heating systems during extreme weather. Interestingly, in Victoria and New South Wales, peak cooling demand was lower for this cohort compared to gas-heated homes, possibly due to electrified homes being newer or recently upgraded, with better insulation and more efficient heating and cooling systems, such as heat pumps.
- **Electric heating with solar** – the integration of rooftop solar significantly alters the hourly demand profile by reducing midday electricity imports, with many homes becoming net exporters during the day. Interestingly, homes with solar tend to exhibit higher evening peak demand than those without. This behaviour could reflect a tendency for households with solar to increase electricity usage due to perceived cost savings from self-generation (referred to as the solar rebound effect, and a feature of AEMO's demand forecasting methodology). Ramping requirements for this cohort are extreme, as high solar exports quickly transition to steep evening peak demand. These patterns underscore the importance of integrating home storage solutions and advanced load-shifting technologies, such as smart EV charging and automated energy management systems, to balance peaks and troughs in demand and reduce ramping pressures on the grid.

Regional insights

- **Melbourne/Geelong** – the cold climate in Melbourne and Geelong results in significant winter peaks for electric-heated homes. Shorter daylight hours, reduced solar irradiance, and high heating loads during winter drive a heavy reliance on grid energy. For homes with electric heating, hot water and solar, evening demand on the coldest day in 2023 was higher than the summer peak. This indicates that peak demand may shift from summer to winter with widespread electrification in Victoria.
- **Australian Capital Territory** – the Australian Capital Territory exhibits the most distinct difference between the demand profiles of homes with gas heating versus those with electric heating. The local climate, characterised by cold winters with frequent sub-zero temperatures, drives a pronounced morning peak for electric-heated homes that is comparable to the evening peak. For electrified homes in 2023, peak heating demand surpassed cooling loads through summer.
- **Sydney/Newcastle/Wollongong** – the warmer climate in this region results in a particularly high summer peak. Interestingly, homes with electric heating, hot water and solar experienced a surge in heating load on the coldest day that was comparable with the summer peak in 2023.
- **South Australia** – South Australia experiences slightly lower winter heating loads than Melbourne. Even in homes with electric heating and solar, the summer peak exceeded the additional cooling load on the coldest day in 2023.

3.2 Residential trends

3.2.1 Overview of gas and electricity heating trends

This section explores evolving trends in residential heating, highlighting shifts from gas to electric heating across regions, dwelling types and construction periods. The analysis draws on historical consumption data for a static set of dwellings (those with an active gas connection as of June 2024) to identify changes in heating source.

The trend analysis is subject to the following limitations:

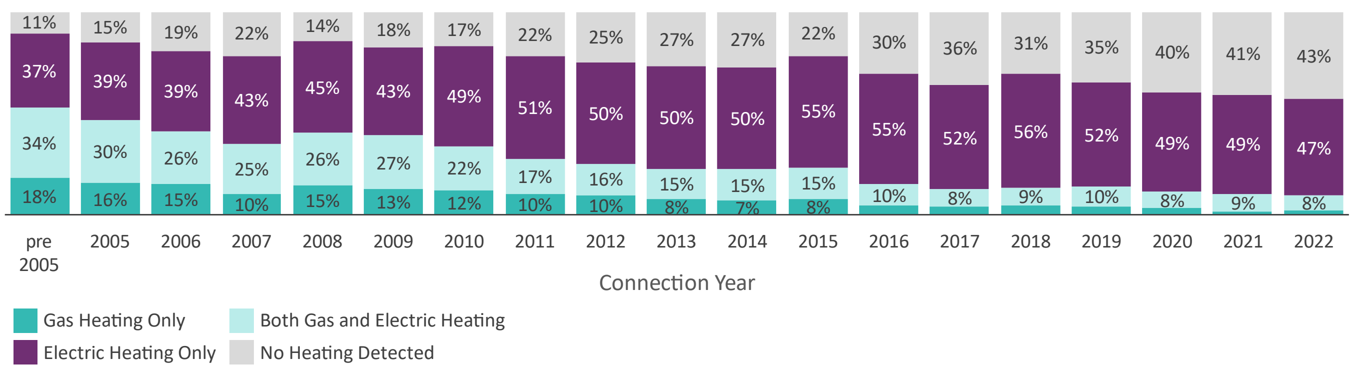
- **Active MIRN connections only** – this analysis is limited to active gas connections as of June 2024, excluding abolished MIRNs. As such, it does not capture households that have fully electrified and disconnected from the gas network.
- **Exclusion of newly constructed fully electric homes** – trends in the construction of new fully electric homes have not been investigated as this analysis is limited to dwellings with an active gas connection. As such, the trends presented here do not reflect overall electrification trends across the housing stock.

3.2.2 Heating trends in the Australian Capital Territory

The Australian Capital Territory stands out as having a higher rate of residential electrification, driven by consistent policies and incentives that have encouraged a shift toward energy-efficient electric homes. Historical gaps in Australian Capital Territory electricity and gas data prevent precise trend tracking over time. However, examining trends by construction year provides insight into the pace of electrification.

Figure 19 illustrates the distribution of heating sources for Australian Capital Territory residential dwellings with a gas connection by connection year (used as a proxy for construction year).

Figure 19 2023 heating type by connection year (dwellings with a gas connection in 2023), Australian Capital Territory



Note: No Heating Detected means there was not a strong correlation between either electricity or gas consumption and HDD. This may be due to high energy performance resulting in minimal heating load, the dwelling being unoccupied for long periods, electric heating with solar and battery, heating with another source such as a fireplace or a mild weather year reducing the use of heating.

Of the dwellings built before 2005, 52% used gas heating in 2023. In contrast, of the dwellings connected in 2022, just 10% used gas heating in 2023 (comprising 8% using both gas and electricity, and just 2% using gas alone). This suggests that gas heating had all but been eliminated in newly constructed homes even prior to the 2023 ban on gas connections for new residential developments.

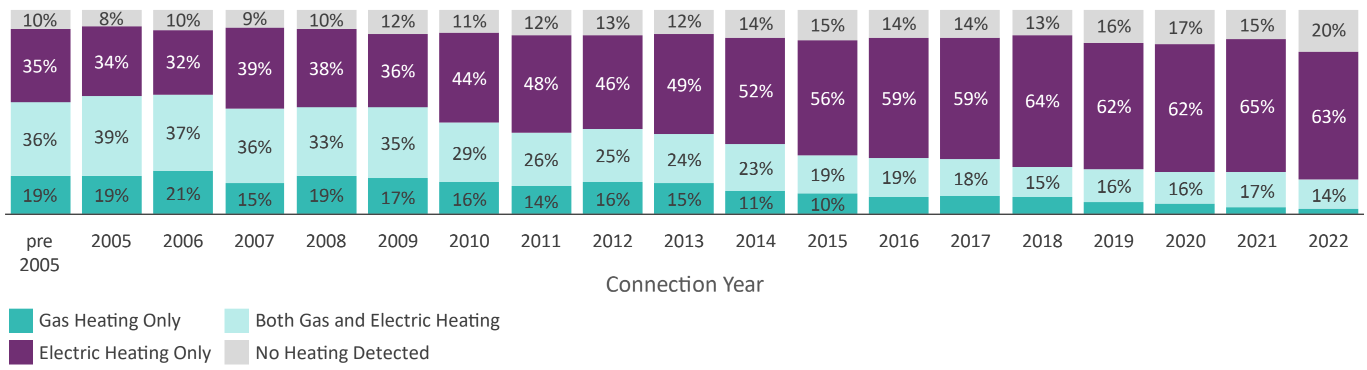
There is also a sharp increase in dwellings with no detected heating source, which could occur due to a variety of reasons. This classification applies to dwellings where neither gas nor electricity consumption showed a strong correlation with HDD, suggesting the home is either well-insulated with highly efficient heating, unoccupied for long periods, primarily relies on electric heating with solar and battery, or uses an alternate heating source such as a fireplace (noting that wood heaters are likely to become less prevalent, due to the Australian Capital Territory's commitment to phasing them out, with installation already prohibited in new suburban developments[9]).

The following sections break this trend down by dwelling type to remove any distortion caused by a change in the housing mix and further explore the substantial increase in dwellings with no heating detected.

Houses

Figure 20 presents the heating source distribution by connection year for houses only (excluding units and apartments), removing any distortion caused by the changing housing mix in newly constructed dwellings. It shows a significant rise in the proportion of dwellings using electricity as the only heating source. For houses connected in 2005, only 34% relied solely on electric heating in 2023. For houses connected in 2022, this figure had risen to 63%, with an additional 14% using both electric and gas heating, and 20% showing minimal heating load. Gas use has reduced dramatically, with electric heating replacing it as the dominant heating source in newer houses.

Figure 20 2023 heating type by connection year – houses (with a gas connection in 2023), Australian Capital Territory



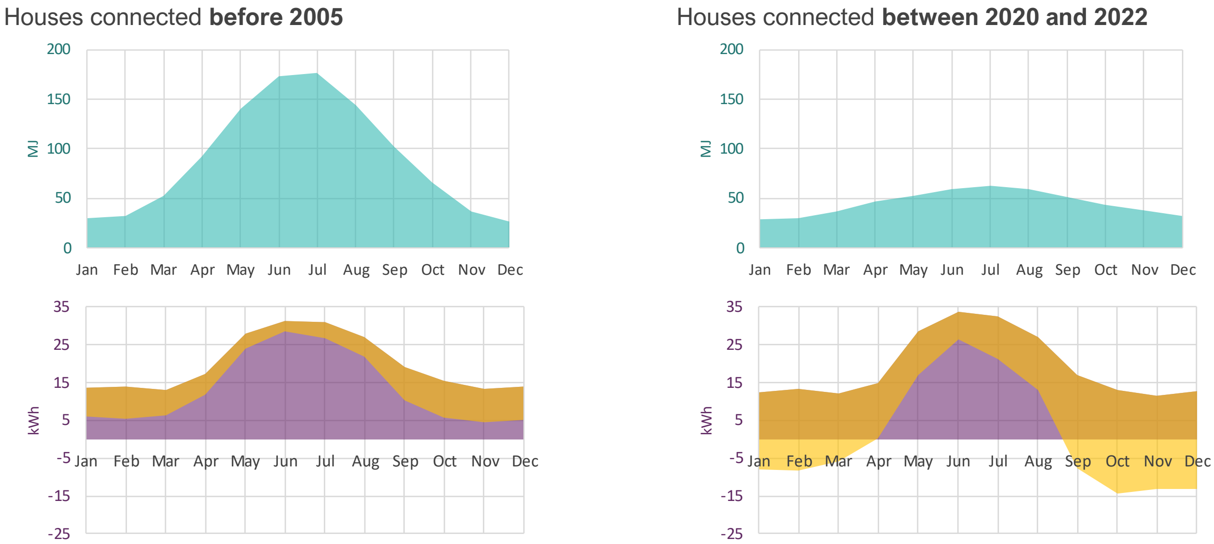
Note: No Heating Detected means there was not a strong correlation between either electricity or gas consumption and HDD. This may be due to high energy performance resulting in minimal heating load, the dwelling being unoccupied for long periods, electric heating with solar and battery, heating with another source such as a fireplace or a mild weather year reducing the use of heating.

Figure 21 compares 2023 consumption profiles for older houses (connected before 2005) and newer houses (connected between 2020 and 2022). The gas heating load has almost been eliminated in newer houses, with electricity replacing it as the dominant heating source. Interestingly, the quantity of electricity imported from the grid has only increased marginally, due to a combination of increased rooftop solar penetration and system size, and higher energy performance.

[9] ACT Government, 2023. https://www.cmtedd.act.gov.au/open_government/inform/act_government_media_releases/vassarotti/2023/act-government-moves-to-phase-out-wood-heaters-by-2045.

Figure 21 Changing consumption profile – older houses versus new houses, Australian Capital Territory – 2023

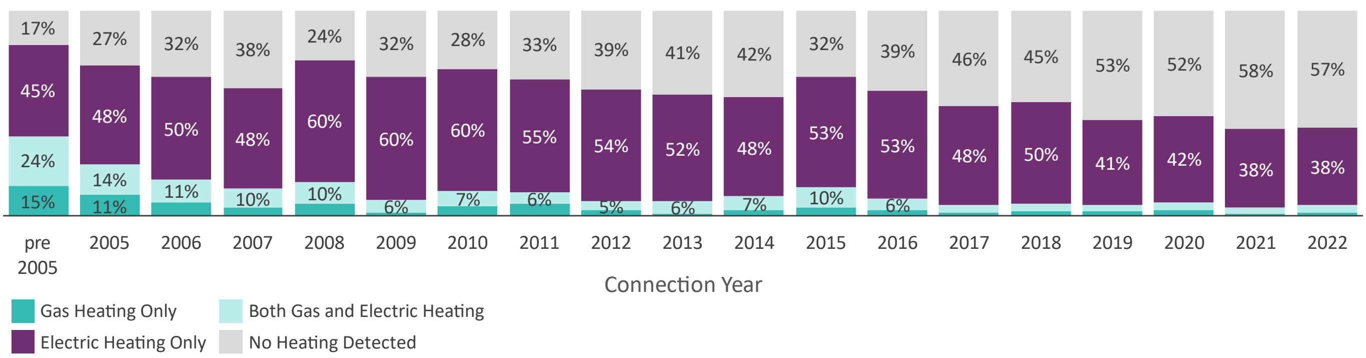
Gas consumption, electricity imports from grid, electricity exports



Units/apartments

Figure 22 shows the heating source distribution by connection year for units and apartments. Gas heating has almost been eliminated in newly constructed units and apartments. Interestingly, more than half of newly constructed units and apartments had no detectable heating source in 2023. This is explored further in the consumption profiles in **Figure 23**. The third column presents the seasonal gas and electricity consumption profiles for units and apartments in the "no heating detected" cohort. The heating load is so minimal that the regression model is unable to detect a correlation at an individual dwelling level, indicating very high energy performance.

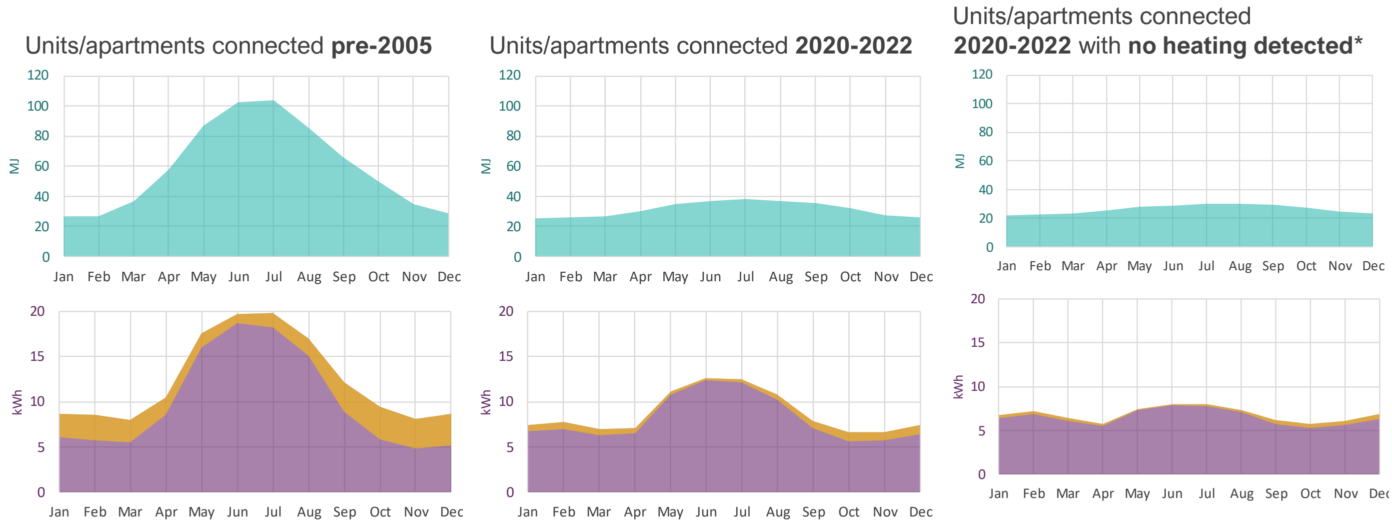
Figure 22 2023 heating type by connection year – units/apartments (with a gas connection in 2023), Australian Capital Territory



Note: No Heating Detected means there was not a strong correlation between either electricity or gas consumption and HDD. This may be due to high energy performance resulting in minimal heating load, the dwelling being unoccupied for long periods, electric heating with solar and battery, heating with another source such as a fireplace or a mild weather year reducing the use of heating.

Figure 23 Changing consumption profile – older units/apartments versus new units/apartments, Australian Capital Territory – 2023

Gas consumption, electricity imports from grid, electricity exports



Summary

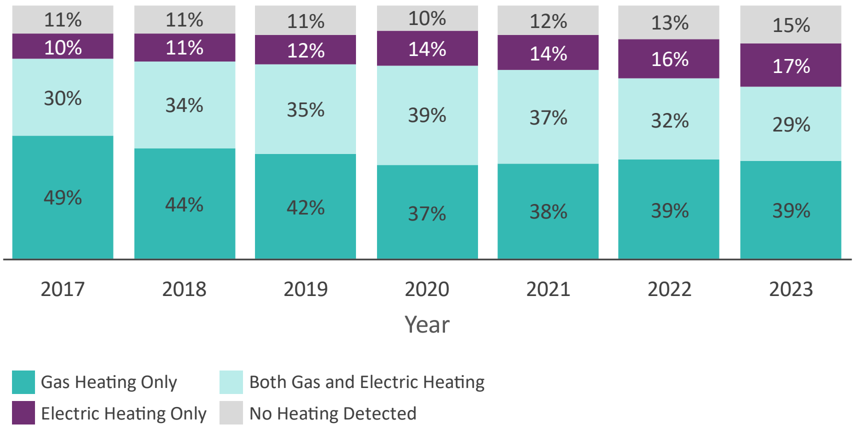
The Australian Capital Territory's consistent policies and robust energy performance standards have accelerated the transition from gas heating to electric heating, particularly in newly constructed dwellings. This shift has resulted in significant reductions in gas usage, without correspondingly large increases in electricity imports. These trends highlight the Australian Capital Territory's success as a model for electrification and energy performance, demonstrating the benefits of targeted incentives and building standards.

3.2.3 Heating trends in Victoria

Victoria has seen a gradual shift away from gas heating over the past decade, reflecting an emerging trend toward household electrification. As one of the colder states in Australia, the demand for gas heating remains substantial. However, trends indicate a growing adoption of electric heating in both newly constructed dwellings and retrofitted older homes.

Figure 24 illustrates the estimated heating trend for residential dwellings in Victoria with a gas connection. Between 2017 and 2023, the proportion of homes using gas heating declined steadily from 79% in 2017 to 68% in 2023. During the same period, the proportion of dwellings using electric heating increased from 40% to 46% (with the proportion relying solely on electric heating increasing from 10% to 17%). Additionally, the share of homes with no clear heating load detected rose steadily, which is likely a reflection of increased energy performance.

Figure 24 Estimated heating trend for residential dwellings (with a gas connection in 2023), Victoria



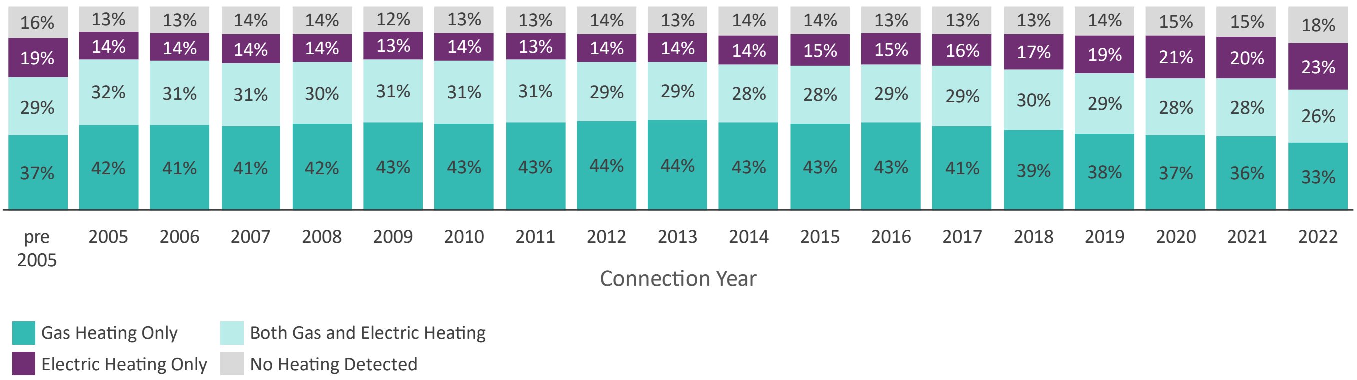
Note: No Heating Detected means there was not a strong correlation between either electricity or gas consumption and HDD. This may be due to high energy performance resulting in minimal heating load, the dwelling being unoccupied for long periods, electric heating with solar and battery, heating with another source such as a fireplace or a mild weather year reducing the use of heating.

Figure 25 examines the heating source distribution in 2023 by connection year for homes with a gas connection.

The data reveals that newly constructed homes have gradually moved away from gas heating, with 74% of homes connected in 2005 using gas heating in 2023, versus 59% of homes connected in 2022. This demonstrates a gradual transition but highlights that a significant portion of new housing developments still rely on gas heating. The recently introduced ban on new gas connections in residential developments, supported by other measures in Victoria's Gas Substitution Roadmap[10], is expected to accelerate the transition to electric heating, with implications for electricity demand profiles in new dwellings.

Interestingly, homes connected before 2005 show higher electric heating rates and lower gas heating rates than homes connected between 2005 and 2019. This suggests a gradual replacement of gas heating with electric heating when appliances are due for replacement or as homes undergo renovations.

Figure 25 2023 heating type by connection year (with a gas connection in 2023), Victoria



Note: No Heating Detected means there was not a strong correlation between either electricity or gas consumption and HDD. This may be due to high energy performance resulting in minimal heating load, the dwelling being unoccupied for long periods, electric heating with solar and battery, heating with another source such as a fireplace or a mild weather year reducing the use of heating.

[10] Victorian Government (2024), Gas Substitution Roadmap Update. The State of Victoria Department of Energy, Environment and Climate Action 2024. CC BY 4.0, https://www.energy.vic.gov.au/renewable-energy/victorias-gas-substitution-roadmap/gas-substitution-roadmap-update-2024.pdf.

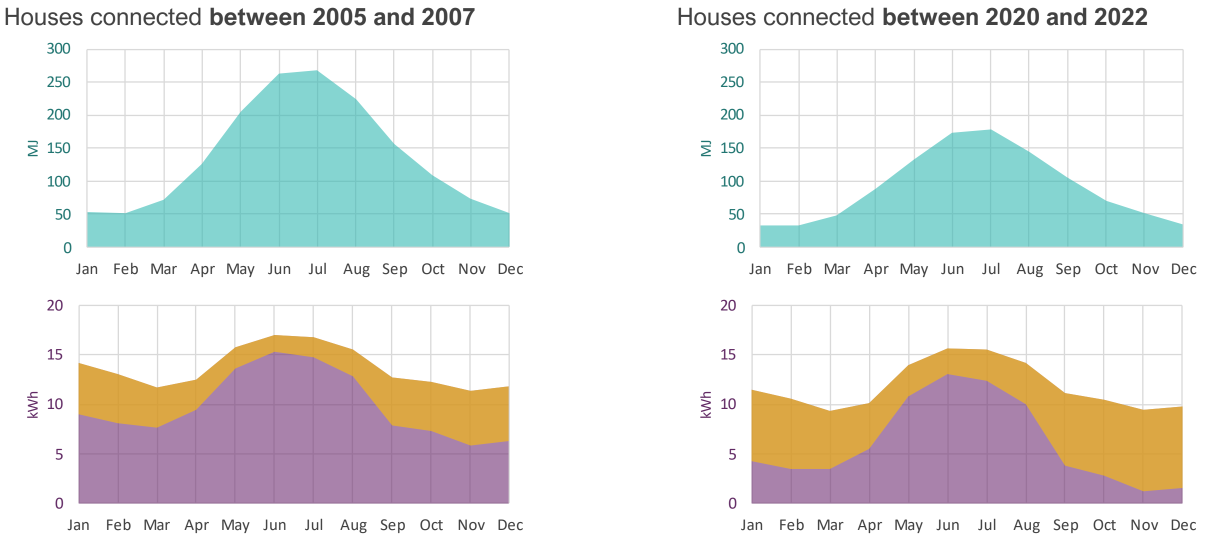
Changing consumption profile in Melbourne/Geelong

Figure 26 compares 2023 consumption profiles for older houses (connected between 2005 and 2007) and newer houses (connected between 2020 and 2022) in Melbourne and Geelong, excluding units and apartments to remove any distortion due to changes in the housing mix.

The data highlights substantial differences in energy consumption patterns driven by electrification of heating, improved energy performance, and increased adoption of rooftop solar. Newer homes exhibit a significant reduction in gas heating load, driven by a shift toward electric heating and improved energy performance. Notably, electricity imports are also slightly lower in newer homes, despite the increased adoption of electric heating. This reflects expected improvements in energy performance and increased rooftop solar uptake and system size, but may also reflect a reduction in the relative size of newer dwellings compared with older construction homes.

Figure 26 Changing consumption profile – older houses versus new houses, Melbourne/Geelong – 2023

Gas consumption, electricity imports from grid, electricity exports



Heating intensity trend in Melbourne/Geelong

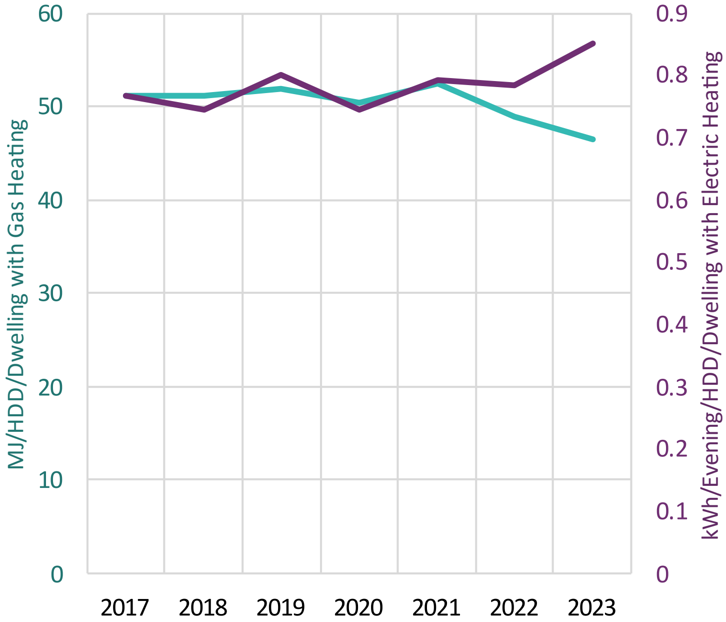
Figure 27 presents heating intensity trends from 2017 to 2023, offering insight into how extensively gas and electric heating systems are used. Gas heating intensity (MJ/HDD for dwellings with gas heating) saw a notable decline between 2021 and 2023, indicating that homes with gas heating used those systems less, potentially driven by increasing gas costs. This is reinforced by an upward trend in electric heating intensity (kWh/evening/HDD for dwellings with electric heating). This may also be influenced by the solar rebound effect – where households with rooftop solar increase their electricity consumption because their daytime generation offsets costs.

While heating intensity is normalised for temperature, 2023 was a notably warm winter, with above-average temperatures in Melbourne and Australia experiencing its warmest winter on record[11]. This milder winter may have made households more comfortable relying on electric heating in place of gas.

[11] See http://www.bom.gov.au/climate/current/annual/aus/2023/.

Figure 27 Electricity and gas heating intensity – Melbourne/Geelong

Gas heating intensity: Average MJ/HDD for dwellings with gas heating
Electric heating intensity: Average kWh/evening/HDD for dwellings with electric heating



Retrofitting

Older Victorian homes are steadily transitioning away from gas heating, driven by gradual adoption of electric heating systems at the end of the system life cycle or during home renovations.

Figure 28 illustrates the change in gas heating adoption between 2017 and 2023 by dwelling age. The data highlights that homes built prior to 2005 have seen the most significant reduction in gas heating reliance, with gas heating adoption decreasing by around 15%, compared to a 5% reduction for homes connected in 2015. This suggests that older gas heating systems are being replaced with electric alternatives, supported by targeted incentives such as the Victorian Energy Upgrades program.

To quantify the change in gas heating adoption, **Figure 28** applies the following formula, focusing only on dwellings connected before 2017 to ensure consistency in the comparison:

$$\frac{\text{dwellings with gas heating in 2023} - \text{dwellings with gas heating in 2017}}{\text{dwellings with gas heating in 2017}}$$

The map in **Figure 29** further supports this trend. It highlights regional variations in heating electrification across Victoria. The darker blue regions, indicating faster electrification, often correspond to established suburbs with older housing stock, while lighter blue areas in Melbourne’s outer west and northern suburbs align with newer residential growth zones, where gas heating systems are likely to be newer and will not reach replacement age for some time.

Figure 28 Change in gas heating adoption between 2017 and 2023 by dwelling age, Victoria

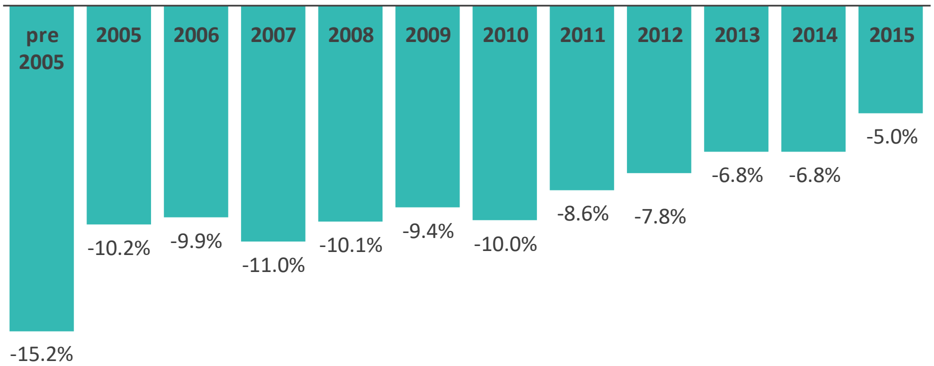
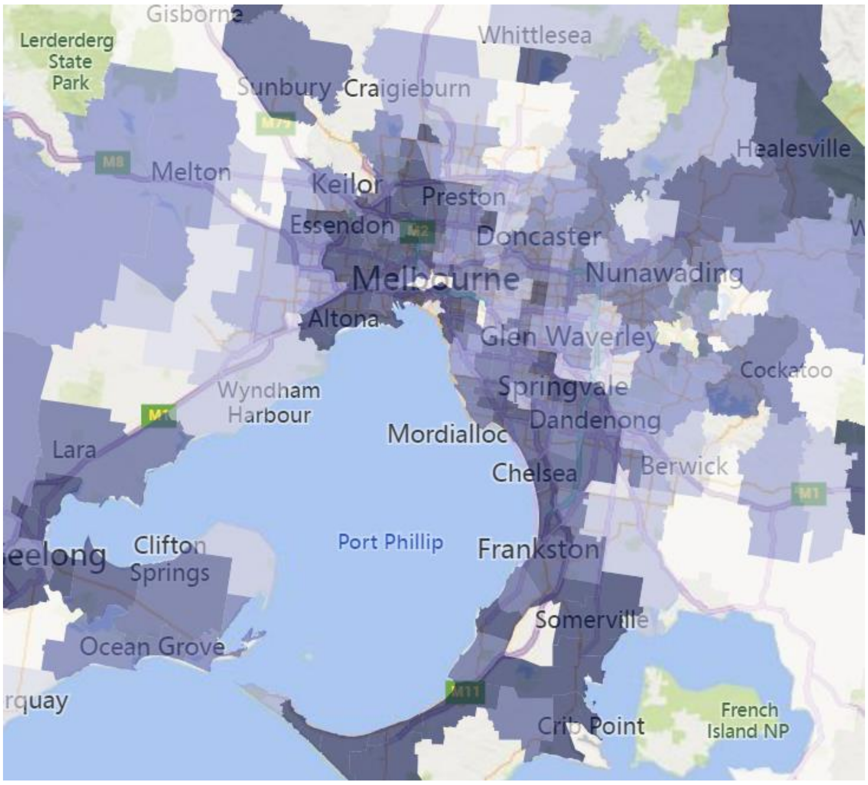


Figure 29 Heating electrification rate by postcode – Melbourne/Geelong



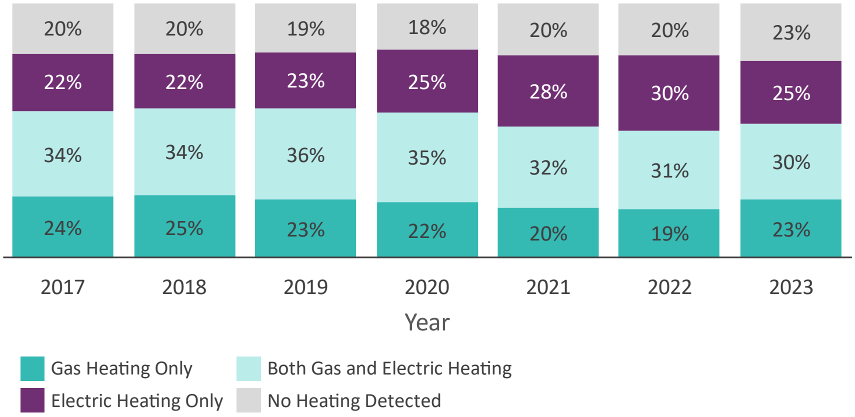
Note: Percentage change in dwellings with gas heating between 2017 and 2023. Darker blue regions indicate a faster shift away from gas heating systems, reflecting higher electrification rates.

3.2.4 Heating trends in New South Wales

New South Wales has been slightly slower to electrify than the Australian Capital Territory and Victoria. This is likely due to its milder climate, which reduces the reliance on heating and decreases the incentive for widespread household electrification.

Figure 30 illustrates the estimated heating trend for residential dwellings with a gas connection in New South Wales between 2017 and 2023. During this period, the proportion of homes using gas heating has decreased from 58% in 2017 to 53% in 2023. While this represents progress, the pace of electrification remains slower than in other states. Ongoing policy initiatives, such as the New South Wales Consumer Energy Strategy[12], may accelerate this transition by providing incentives for energy-efficient upgrades.

Figure 30 Estimated heating trend for residential dwellings (with a gas connection in 2023), New South Wales



Note: No Heating Detected means there was not a strong correlation between either electricity or gas consumption and HDD. This may be due to high energy performance resulting in minimal heating load, the dwelling being unoccupied for long periods, electric heating with solar and battery, heating with another source such as a fireplace or a mild weather year reducing the use of heating.

Figure 31 illustrates the heating source distribution in 2023 by connection year for homes with a gas connection. While there has been a shift from gas heating to electric heating in newly constructed homes, 43% of homes connected in 2022 still relied on gas heating. The high prevalence of gas heating in homes connected before 2005 contrasts the trend seen in Victoria, where older homes have been more likely to replace gas heating with electric alternatives. This suggests that replacement of ageing gas heating systems with electric alternatives is occurring at a slower pace in New South Wales than in Victoria, either due to replacement purchase decisions that differ from Victorian consumers, or reflecting the slower rate of replacement as lesser use of gas heating may be prolonging the technical life of these ageing appliances. New South Wales also has a higher proportion of rented dwellings, which may be contributing to the slower pace of retrofitting gas heating systems with electric alternatives.

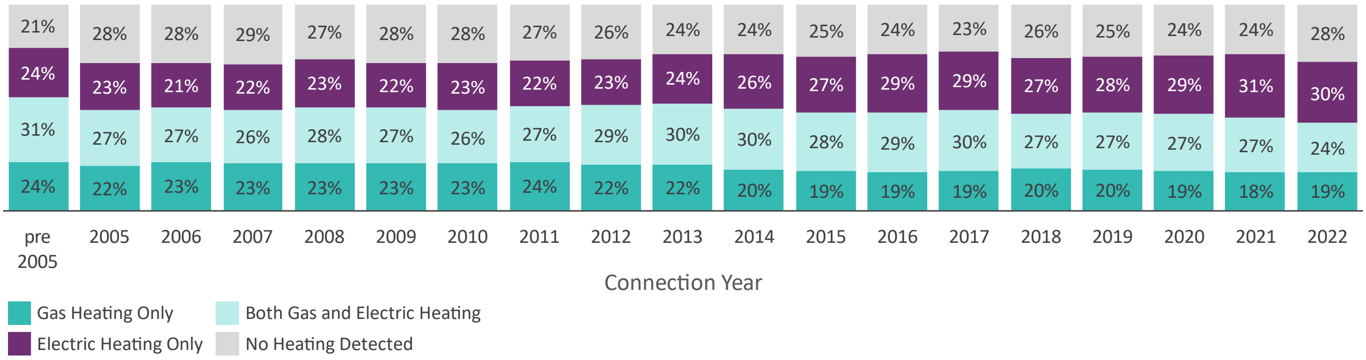
While New South Wales has implemented programs to support energy efficient upgrades and retrofits, the slower pace of electrification suggests there may be a need to further tailor these interventions to address the persistent reliance on gas heating in new and existing dwellings, if the state government considers it necessary.. To further accelerate this transition, the New South Wales Government has committed to developing a Gas Decarbonisation Roadmap[13]. New South Wales has also committed to strengthening its efficiency standards for buildings, including disclosure requirements and other measures similar to those implemented in the Australian Capital Territory[14].

[12] See https://www.energy.nsw.gov.au/nsw-plans-and-progress/government-strategies-and-frameworks/energy-strategy.

[13] See https://www.energy.nsw.gov.au/sites/default/files/2024-09/NSW_Consumer_Energy_Strategy_2024.pdf, page 73.

[14] See https://www.energy.nsw.gov.au/sites/default/files/2024-09/NSW_Consumer_Energy_Strategy_2024.pdf.

Figure 31 2023 heating type by connection year (with a gas connection in 2023), New South Wales



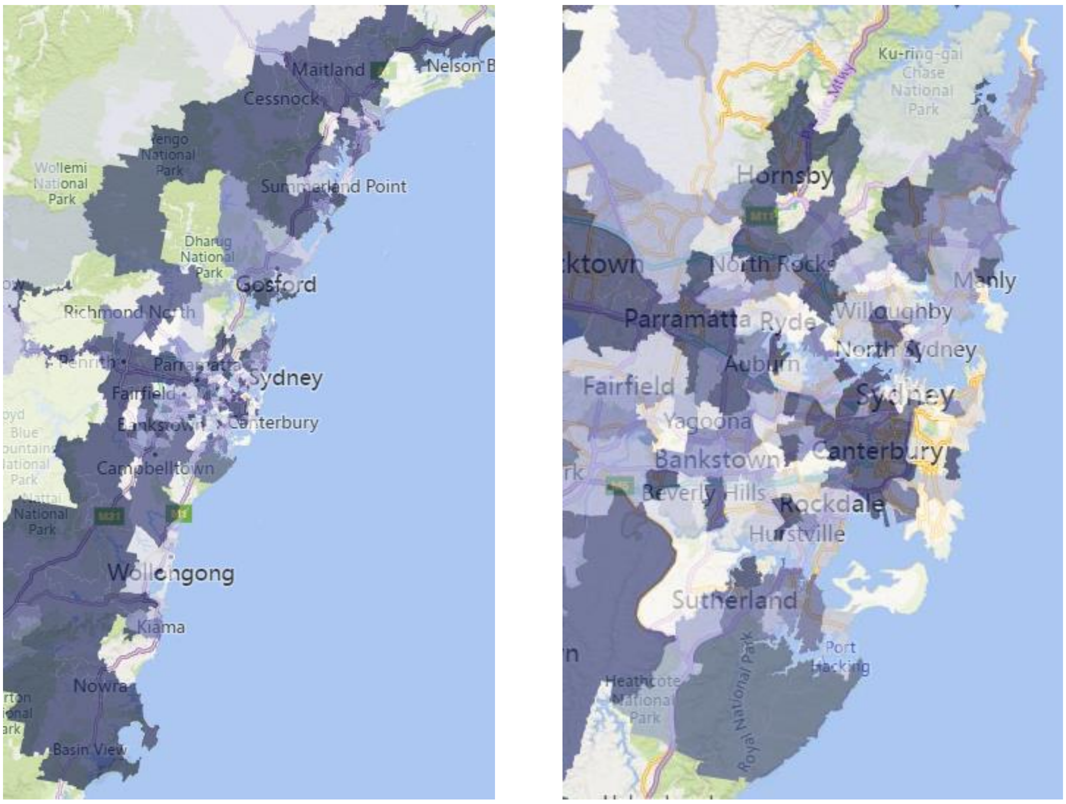
Note: No Heating Detected means there was not a strong correlation between either electricity or gas consumption and HDD. This may be due to high energy performance resulting in minimal heating load, the dwelling being unoccupied for long periods, electric heating with solar and battery, heating with another source such as a fireplace or a mild weather year reducing the use of heating.

Figure 32 illustrates the spatial distribution of heating electrification across Sydney, Newcastle and Wollongong between 2017 and 2022. Darker blue areas on the map represent a faster transition away from gas heating, highlighting significant regional variation in electrification rates.

Electrification has progressed more rapidly in regional areas compared to metropolitan Sydney. Within Sydney, the rate of electrification is mixed, likely influenced by socioeconomic factors, as well as housing stock age and residential growth rates. The spatial analysis highlights the importance of targeted interventions to address disparities in electrification, particularly in slower-transitioning areas where financial or structural barriers might inhibit progress.

Figure 32 Heating electrification rate by postcode, Sydney/Newcastle/Wollongong

Sydney/Newcastle/Wollongong **Sydney**

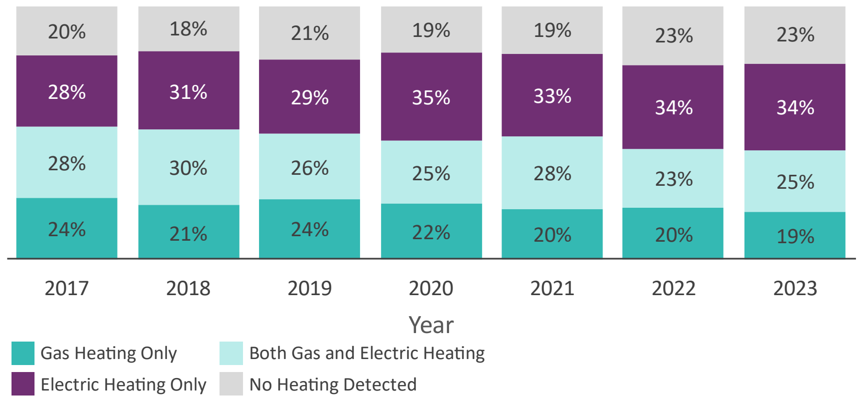


Note: Percentage change in dwellings with gas heating between 2017 and 2022. Darker blue regions indicate a faster shift away from gas heating systems, reflecting higher electrification rates.

3.2.5 Heating trends in South Australia

Electrification of heating in South Australia has progressed gradually over recent years, although the reliance on gas heating remains significant. **Figure 33** illustrates the heating trend for residential dwellings with a gas connection in South Australia between 2017 and 2023. During this period, the proportion of homes using gas heating has declined from 52% in 2017 to 44% in 2023, indicating a gradual transition toward electrification.

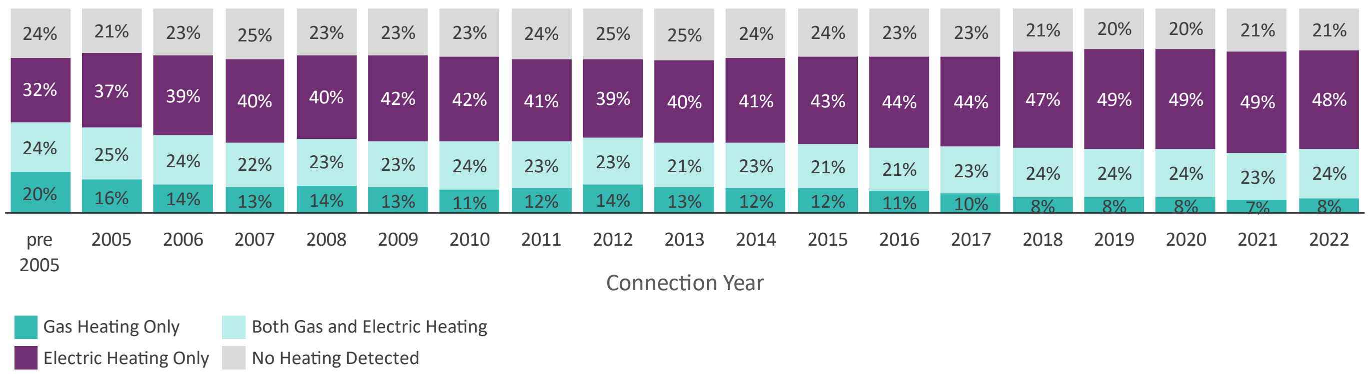
Figure 33 Estimated heating trend for residential dwellings (with a gas connection in 2023), South Australia



Note: No Heating Detected means there was not a strong correlation between either electricity or gas consumption and HDD. This may be due to high energy performance resulting in minimal heating load, the dwelling being unoccupied for long periods, electric heating with solar and battery, heating with another source such as a fireplace or a mild weather year reducing the use of heating.

Figure 34 provides further insight into heating trends by connection year. There has been a gradual shift from gas to electric heating in newly constructed homes over the last 20 years. However, the distribution of heating has remained fairly stable since 2019, with progress appearing to have plateaued. While gas heating rates in new homes are much lower in South Australia than in Victoria, around 32% of new homes (connected to the gas network between 2018 and 2022) still rely on gas heating, highlighting ongoing reliance in some segments of the housing stock. Ongoing incentives encouraging gas use in South Australia may be contributing to this[15]. This persistence in gas heating adoption among newer dwellings suggests that additional policy support may be able to assist in accelerating the transition to electric alternatives. This would mitigate the risk of new gas infrastructure becoming stranded assets as the transition progresses.

Figure 34 2023 heating type by connection year (with a gas connection in 2023), South Australia



Note: No Heating Detected means there was not a strong correlation between either electricity or gas consumption and HDD. This may be due to high energy performance resulting in minimal heating load, the dwelling being unoccupied for long periods, electric heating with solar and battery, heating with another source such as a fireplace or a mild weather year reducing the use of heating.

[15] See https://www.australiangasnetworks.com.au/rebates-sa.

3.2.6 Gas hot water trends

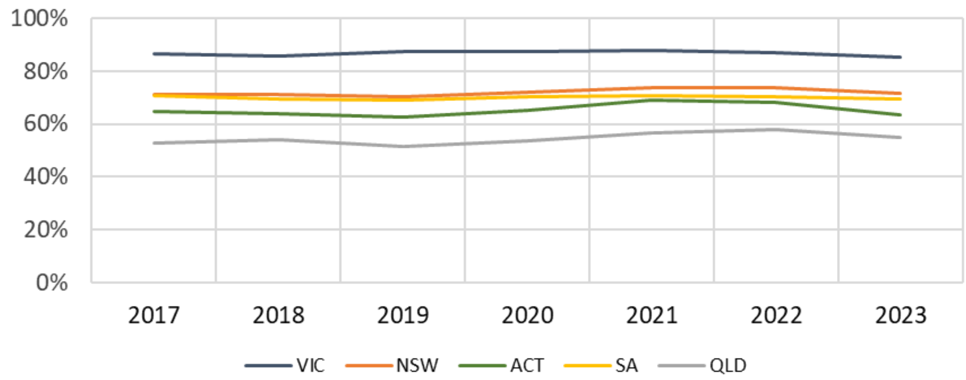
Analysis of gas hot water trends across regions, shown in **Figure 35**, suggests that electrification of gas hot water has not progressed as quickly as heating. The proportion of gas-connected residential dwellings with gas hot water systems has remained relatively stable from 2017 to 2022, suggesting that hot water is a lower priority for electrification compared to space heating. However, 2023 did see a slight decline in gas hot water usage across all regions, which may indicate the early stages of an emerging trend toward electrification of water heating.

The slower transition to electric hot water systems could be attributed to several factors. Unlike heating, which incurs sharp increases in gas bills during winter, hot water usage is relatively consistent throughout the year and may not prompt immediate action from households to switch systems. Other barriers may include the size and noise level of heat pump hot water systems compared to instantaneous gas alternatives.

There are also limitations to this analysis that may affect interpretation of the results:

- **Data limitations:** The analysis is limited to active gas MIRNs and therefore cannot detect trends for households that have fully transitioned off gas. This means the observed trends may underrepresent the true extent of hot water electrification.
- **Allocation challenges:** The current allocation approach analyses summer gas consumption to identify homes with gas hot water systems. Hot water allocation could be enhanced by also analysing smart meter data to independently identify homes with electric hot water systems and combining the results.

Figure 35 Estimated percentage of dwellings (with a gas connection) with a gas hot water system



3.3 Socioeconomic insights

This section explores the relationship between electrification metrics and socioeconomic data, with a particular focus on renters and income levels. By analysing data from the Australian Bureau of Statistics (ABS), key patterns emerge that highlight potential barriers to electrification for certain demographic groups. Understanding these barriers is essential for ensuring that the transition to electrified homes is equitable and accessible to all who want to electrify, given the scale of electrification forecast to achieve net zero by 2050.

3.3.1 Proportion of renters and electrification rates

Analysis of electrification rates and the proportion of renters in a postcode indicates that renters may face significant barriers to electrification, as they have with rooftop solar. **Figure 36** demonstrates a strong negative correlation between the percentage of rental properties in a postcode and rooftop solar uptake. While electrification trends are still emerging, **Figure 37** highlights that areas with higher rental rates have experienced a lower increase in electric heating adoption between 2017 and 2023 than areas with fewer renters.

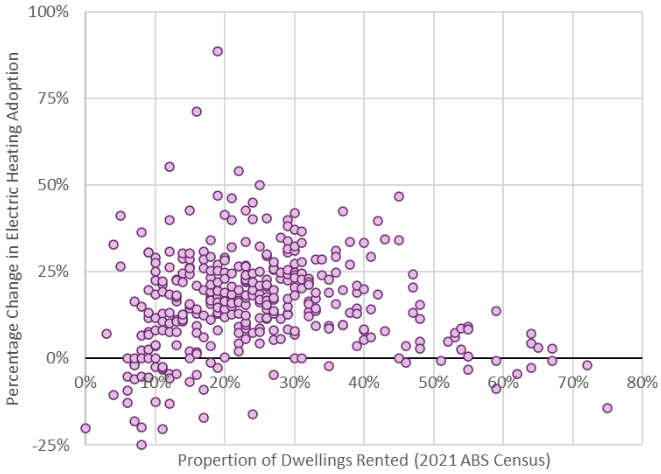
Renters are likely to face similar barriers to electrification as they do to rooftop solar adoption[16]. Landlords are not adequately incentivised to invest in upgrades like electric heating and rooftop solar, as the upfront costs are high and energy bill savings primarily benefit tenants. Instead, landlords are reliant on increased rental income to provide a return on investment, which may be less predictable. Further, the common practice of short lease agreements means that tenants may be less likely to advocate for long-term changes due to uncertainty around how long they will be in a certain dwelling.

Slower electrification among renters exacerbates cost of living pressures, as the data has demonstrated that homes with gas heating and hot water systems use substantially more energy than electrified homes Addressing these split incentives is crucial to ensuring equitable access to the benefits of electrification.

Figure 36 Percentage rooftop solar versus percentage renters (ABS Census 2021), by region

[16] Enabling electrification: addressing the barriers to moving off gas faced by lower-income households, https://library.bsl.org.au/bsljspui/bitstream/1/13361/3/BSL_LCC_Enabling_electrification_2023v3.pdf. Enabling electrification: addressing the barriers to moving off gas faced by lower-income households, https://library.bsl.org.au/bsljspui/bitstream/1/13361/3/BSL_LCC_Enabling_electrification_2023v3.pdf.

Figure 37 Change in electric heating (2017-2023) versus percentage renters by postcode, Victoria



3.3.2 Income levels and electrification rates

The analysis of income levels and electrification rates reveals nuanced patterns across regions. Contrary to expectations, higher income levels do not appear to correlate with a faster transition away from gas. In some cases, areas with higher incomes demonstrate slower electrification rates, particularly in older dwellings. **Figure 38** shows the change in gas heating adoption versus median weekly family income by postcode. While the data shows a broad spread, it is evident that some of the highest income areas have been slow to shift away from gas heating. This is potentially driven by the complexity of retrofitting older homes, means testing of rebates, energy bill savings not offering sufficient incentive for higher income households, status quo bias, or the perception that gas is an affordable luxury relative to electric alternatives.

Figure 38 Percentage change in gas heating 2017-2023 versus median weekly family income

The maps in Figures 39-41 provide a more granular perspective by focusing on Melbourne and Geelong:

- **Figure 39** displays median family income by postcode, with darker orange areas representing higher incomes.
- **Figure 40** illustrates the rate of transition away from gas heating by postcode, with darker blue shading indicating faster rates of electrification.
- **Figure 41** examines the proportion of new homes (built between 2018 and 2022 with a gas connection) with gas heating, with darker blue shading indicating a higher prevalence of gas heating in these areas.

These maps reveal a complex interplay between income and electrification trends. While there is a correlation between higher income areas and electrification of heating in newly constructed homes, the overall electrification trend is lower in Melbourne's inner east than some of the surrounding areas, despite very high average incomes. This suggests that this area has been slower to retrofit older homes. One possible explanation is that there may be a reluctance to retrofit older homes in this area due to heritage considerations, or the complexities involved in retrofitting older homes. Additionally, reduced financial pressure on higher income households means that energy bill savings may not be a strong enough incentive to switch from gas to electricity. Given that high income households tend to use more energy than lower income households, transitioning these areas off gas will be important in reducing overall gas consumption in Victoria.

Figure 39 Median family income by postcode

Darker orange represents higher income

Figure 40 Change in gas heating (2017-2023)

Darker blue represents faster electrification of heating

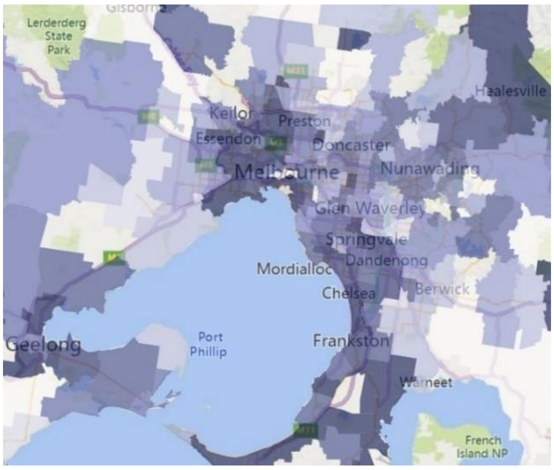
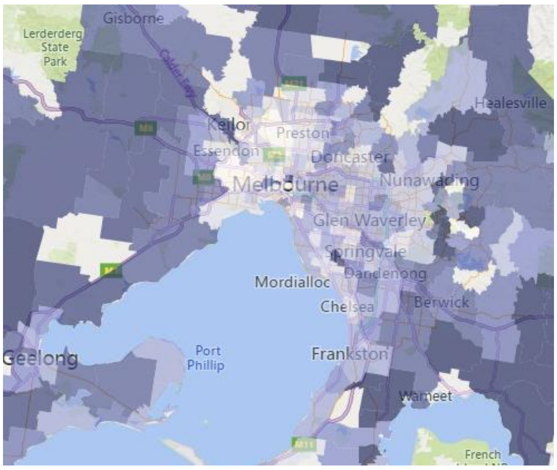


Figure 41 Percentage new homes (2018-2022) with gas heating

Darker blue represents higher percentage with gas heating



4 Commercial results

4.1 Limitations to commercial analysis

The analysis of commercial gas and electricity consumption profiles is inherently more complex than residential users due to the diverse nature of commercial operations. The drivers of commercial energy consumption are complex and vary significantly across sectors.

The dataset used in this analysis encompasses a wide spectrum of commercial facilities, from small businesses to smaller industrial customers with unique energy applications. Trends are also far more complex, with larger commercial customers disproportionately impacting consumption trends when they make operational changes.

Due to these complexities, the commercial analysis presented in this report focuses on the gas and electricity consumption profiles of commercial customers grouped by Australia and New Zealand Standard Industrial Classification (ANZSIC) division. This approach intends to highlight divisions with the most substantial gas use that could be prioritised for electrification, and to provide a foundation for more detailed sectoral investigations in future analyses.

4.2 Commercial gas and electricity profiles

This section explores gas and electricity consumption of small commercial dwellings across ANZSIC divisions, highlighting sector-specific consumption patterns that may help identify priority areas for electrification.

The Food and Beverage Services sector stands out as a prime candidate for priority electrification, with high gas consumption across all regions. According to the Institute for Energy Economics and Financial Analysis[17], the majority of gas dependent processes in the Food and Beverage sector can be electrified using commercially available technologies, presenting an immediate opportunity for electrification. However, barriers to adoption exist such as the need to upgrade electrical infrastructure to accommodate increased demand.

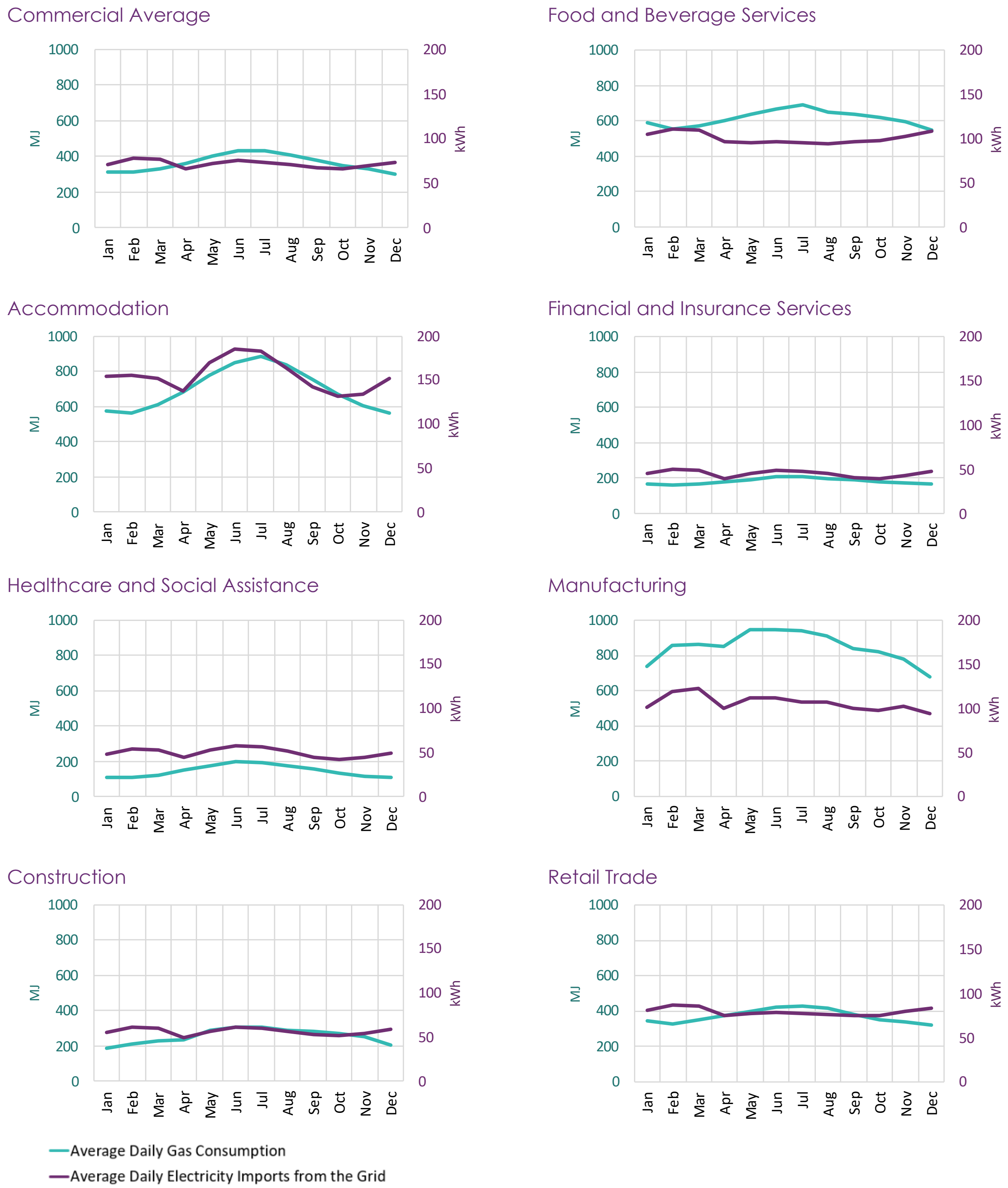
[17] Institute for Energy Economics and Financial Analysis (IEEFA) 2024, Industrial heat pumps key to addressing excess gas demand, https://ieefa.org/sites/default/files/2024-10/Industrial%20heat%20pumps%20key%20to%20addressing%20excess%20gas%20demand_Oct24.pdf. Institute for Energy Economics and Financial Analysis (IEEFA) 2024, Industrial heat pumps key to addressing excess gas demand, https://ieefa.org/sites/default/files/2024-10/Industrial%20heat%20pumps%20key%20to%20addressing%20excess%20gas%20demand_Oct24.pdf.

Victoria

Figure 42 Commercial gas consumption and electricity imports from the grid, Victoria – 2023 CY

New South Wales

Figure 43 Commercial gas consumption and electricity imports from the grid, New South Wales – 2023 CY



South Australia

Figure 44 Commercial gas consumption and electricity imports from the grid, South Australia – 2023 CY

Australian Capital Territory and Queensland

Due to limited sample sizes, Queensland and the Australian Capital Territory cannot be provided by ANZSIC division.

Figure 45 Commercial gas consumption and electricity imports from the grid, Australian Capital Territory and Queensland – 2023 CY