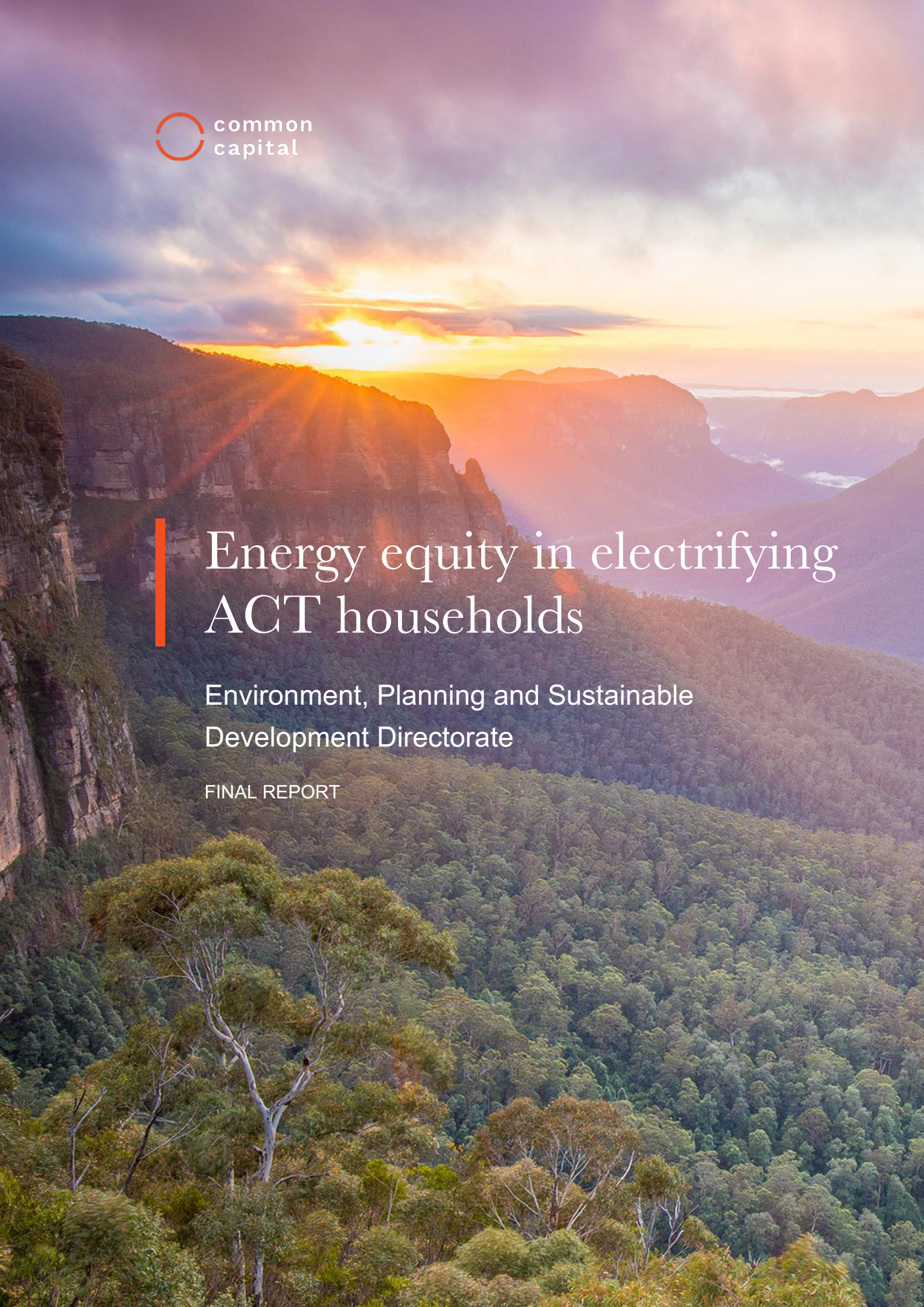

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Energy equity in electrifying ACT households

Environment, Planning and Sustainable Development Directorate

FINAL REPORT

Title:	Energy equity in electrifying ACT households
Client:	Environment, Planning and Sustainable Development Directorate
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Executive Summary

This paper covers the findings of a study to help understand high-level policy options to support the electrification of ACT households at risk of being left behind in the energy transition. It outlines findings from an economic analysis that seeks to understand the funding level, staging distribution, costs and benefits of electrifying ACT households in, or vulnerable to, energy hardship (outside of public housing). It then identifies and qualitatively considers options for a suite of complementary policy measures to support as many households as possible (across different cohorts) to electrify, while managing Government budget impacts. It then provides seven best practice principles that outline key design and delivery considerations that help ensure an effective allocation of resources i.e. the program reaches those in greatest need.

The electrification of ACT homes can deliver climate, economic and social benefits, if managed carefully

To meet its 2045 net zero emissions commitments, the ACT Government has committed to converting homes from gas to electricity by 2045 [1]. The Government wants to ensure that this transition is managed to minimise impacts to housing affordability and availability, rental stress, and housing suitability under the ACT Wellbeing Framework.

Electrification of the ACT will require transitioning around 125,050 private and 5,940 public ACT household gas customers from gas to high efficiency electric appliances for cooking, space, and water heating. For private dwellings this includes approximately 97,646 space heaters, 113,140 water heaters and 105,393 cooktops: totalling 316,179 gas appliances. Households that electrify will typically benefit from material energy bill savings due to both the improved efficiency of electrical appliances and avoidance of an additional fixed daily charge to remain connected to the gas network. The electrification of a typical home that uses gas for all three end uses could expect to save around $450 each year on energy bills. These savings are approximately $960 each year for households that electrify and have solar PV. Conversely, those homes that do not electrify, stand to forego these bill savings and face a risk of rising gas connection charges as the cost of the network are distributed over a shrinking customer base.

A key challenge is that households who are most vulnerable to current and rising energy costs also face significant economic and structural barriers to electrifying. Energy costs represent a much higher share of disposable income for lower income households, spending up to 8% more on energy when compared with the average ACT home. In addition, there are prohibitively high upfront costs associated with the measures that materially reduce costs – like electrification and solar. For example, the complete electrification of a typical ACT household requires around $11,000 in up front upgrade costs – approximately $4,900 more than replacing these appliances with new gas appliances. This compares with income of less than $1,333 per week for the bottom 20% of ACT households[1] – a common benchmark of the most

[1] ABS source: Australian Bureau of Statistics - 2021 Census - selected dwelling characteristics: TENLLD Tenure and Landlord Type by HIND Total Household Income (weekly) by SA4 (EN).
Methodology: we have taken 20% of the residential housing stock which equates to 37,393. Then, we have added the number of households starting at negative income, increasing upwards until reaching $1,250. Finally, we have assumed that in the next income bracket – those earning between $1,250 – $1,499 - there is an even distribution of households across this bracket. We reached 37,341 households at $1,333.

economically vulnerable in Australia. These economic barriers are further compounded by a lack of structural power to take action for the 25% of these households that rent their homes.

In the order of 25,000 ACT private households will require material assistance to transition off gas by 2045 and reduce energy hardship.

There are various ways of characterising "lower income households", and therefore various ways of grouping the target population for this report. Four methods were tested to determine an appropriate target cohort of households – with most estimating at least 25,000 private homes on lower incomes will need a degree of support for electrification (as detailed in section 1.2). Of these around 17,890 (67%) own their own homes and 8,310 (25%) are in private rentals and 3,126 private or community households. This compares with an additional 5,942 households in public housing with gas accounts, for whom alternative support measures are being investigated outside this project.

Energy Equity Work Program (EEWP) is currently undertaking a major national research project to more accurately and wholistically measure and identify those in, or vulnerable to, energy hardship. Crucially, EEWP has found that hardship is neither limited to lower income earners or a binary state. It varies by both severity and duration. EEWP has identified concession cards as a sub-optimal proxy for those in energy hardship.

Australian jurisdictions (including the ACT) currently draw on a range of social support programs as proxies to help predict and identify households who are likely to be in need of greater assistance. Rental households are currently excluded under the eligibility criteria used for the major current ACT Government programs providing financial support for these households to electrify.[2]

EEWP found there are many households on lower incomes or in challenging circumstances without some form of concession. Challenging life circumstances can also cause and compound the impact of energy costs and barriers to overcoming them. These include serious personal/family health conditions, domestic violence, and mental health crises [2].

However, these lower income numbers can be considered conservative because energy hardship is not limited to lower income households or concession card holders.

There are higher upfront costs associated with electrifying households early but greater long-term energy bill savings

Given the high number of households that will likely need some form of support, we considered the costs and benefits of three energy transition scenarios:

- Business-as-usual (1.5% of households annually are electrified until gas network closure in 2045, when residual households must be rapidly electrified)
- Electrification now (vulnerable households pro-actively electrified between 2024-2028)

[2] These include subsidies under the Energy Efficiency Incentive Scheme (EEIS) priority group targets, HESP and the Chronic Health Conditions programs. The Sustainable Household Scheme zero interest loans program inadvertently limits accessibility to rental priorities.

- Electrification at end-of-life (appliances only upgraded when they fail between 2024-2036, incurring only incremental additional replacement costs)

The total capital cost of electrifying the bottom 20% of gas customers over the next four years would be around $221.1 million but would deliver these customers a net present value (NPV) of $347.8 million in energy bill savings (to 2045). Alternatively, these capital costs could be substantially reduced to NPV $184.2 million if gas appliances were electrified only when they failed. This is because only the incremental cost difference between electric and gas appliances would be required, and costs could be spread over 12 years. However, this slower timeline results in lower overall bill savings – NPV $251.7 million.

Both capital costs and bill savings would increase if solar PV was also installed. This is because solar would dramatically further reduce energy costs in households that electrify. For an end-of-life electrification program, the NPV of capital costs would be around $328 million and bill savings would be $339.4 million.

If all other associated public and private costs and benefits are also considered, all three scenarios deliver similar benefit to cost ratios – just over 2:1. However, the longer the delays on appliance upgrades, the more the total net societal benefit decreases. This is because the benefits of delayed spending on upgrades remain lower than the benefits of energy bill savings (which are foregone due to the delay). The different net societal benefits across the electrification now and four different scenarios below.

Table 1: Net societal benefit of electrifying the bottom 20% of ACT gas connected homes (NPV)

Electrification now (2024-2028)	Electrification now + solar (2024-2028)	End-of-life electrification (2024-2036)	End-of-life + solar (2024-2036)
$193,731,316	$344,034,704	$134,594,490	$77,918,034

Policy design needs to optimise between maximising the net benefit, and managing the budget feasibility

Without material levels of assistance, it is unlikely a significant number of households in, or vulnerable to, energy hardship will be able to electrify. End-of-life electrification allows governments to support more people by spreading upfront costs over a greater number of years. This would require policy measures that can unlock $15 million per year over 12 years, or $26.6 million including solar, compared with a $221.1 million or $394.3 million for a four-year early electrification scenario ($55.3 million and $98.6 million per year).

Note that net societal benefits reflect the total costs and benefits of electrification regardless of which policy mechanism is used to support them. However, allocation of public and private costs, and likely uptake, will vary significantly depending on how electrification is supported.

A suite of complementary policy measures can spread electrification costs across households, landlords and the public – with the greatest assistance provided to those in most need

The full upfront costs of electrification do not need to be fully met by the Government or any single policy. Different cohorts will require different levels and forms of assistance, including full subsidisation, partial rebates, subsidised debt, and budget neutral debt. Government costs can be prioritised to those in greatest need and split across a mix of budget neutral, off budget and regulatory mechanisms. We have identified seven complementary policy options that could be adopted to spread this cost and minimise the impact on the ACT budget. An overview of these options has been provided in the table below and more detail provided in Section 2.1.

Options	Primary target cohort(s)	Budget impact
1. Zero-interest loan for rental properties through improving SHS accessibility	~Bottom 20% rental and owner-occupied properties	~70% of funds can be recovered, subject to Government borrowing costs
2. Low interest loan for electrification upgrades in rental properties	~Bottom 20% rental properties	Budget neutral over ten years (loan period)
3. Implement a gas network decommissioning bond	~Bottom 20% rental properties	Budget neutral/positive
4. New 100% point-of-sale rebate for a new program or reformed HESP	Lowest ~2.5–7.5% owner occupiers Households with chronic health conditions	Direct cost to budget
5. Lower income energy rebate swap for full electrification	All home owning energy concession rebate holders	Budget neutral/positive
6. Expansion of the Minimum Energy Efficiency Standards for Rental Homes	~Bottom 20% rental properties	Budget neutral
7. Expand EEIS support for electrifying lower income households	~Bottom 20% rental, owner occupied and community housing	Budget neutral

Refinements to energy concession rebates can have potentially significant budget savings.

There are currently a high number of households with solar PV who receive substantial negative energy bills as a result of government energy concessions. Best practice principles can inform the design of policy options to ensure funding helps those in greatest need to completely electrify.

The EEWP provides seven best practice principles for designing energy equity programs. We synthesised interview findings against these principles to identify the following priority considerations.

Energy equity principle	Implications for electrification support in the ACT
1. Clearly define the driver or state of energy hardship you are trying to address and develop a policy/program that will have a material impact	• Combined support provides sufficient funding for those in greatest need to be able to afford to completely electrify. • Expand eligibility to include rental households and include protections against rent increases. • Permanently disconnect properties from gas to ensure electrification benefits are sustained.
2. Ensure your policy/program is designed for scalability	• Design a complementary suite of programs with sufficient combined long-term funding sources that can cover the full cost of electrifying 25,012 households.
3. Assess costs and benefits at a whole-of-government level	• Seek to quantify health and social policy benefits and seek cross-portfolio funding/support.
4. Improve accessibility by reducing friction and burden for the households you are trying to help	• Expand eligibility criteria beyond concession cards to consider the income to occupancy ratio, and life circumstances. • Work with delivery partners to provide a concierge service with nuanced and less administratively burdensome evidentiary criteria. • Provide a mix of policy measures to support differing levels of funding support based on differing abilities to pay. • Work with partners to proactively drive awareness and uptake by those in greatest need. • Provide flexibility and consumer choice in the timing and range of electrification options.

Energy equity principle	Implications for electrification support in the ACT
	• Consider additional market research into the framing, technologies, funding mechanisms and evidentiary requirements that resonate with target households.
5. Use inclusive framing in all of your policy/program communications	• Maintain ACT's practice of inclusive framing for program names. Avoid terms like "lower income households".
6. Be aware of your strategic context	Design a program logic and outcomes hierarchy to contribute materially to the ACT's Net Zero and Wellbeing Framework goals.
7. Incorporate your evaluation approach into the design of your policy/program.	Implement a monitoring and evaluation plan from Day 1 to support continuous improvement, including measurement and verification to ensure savings benefits are realised, housing price monitoring to protect renters, and an audit and compliance framework to maintain quality and safety.

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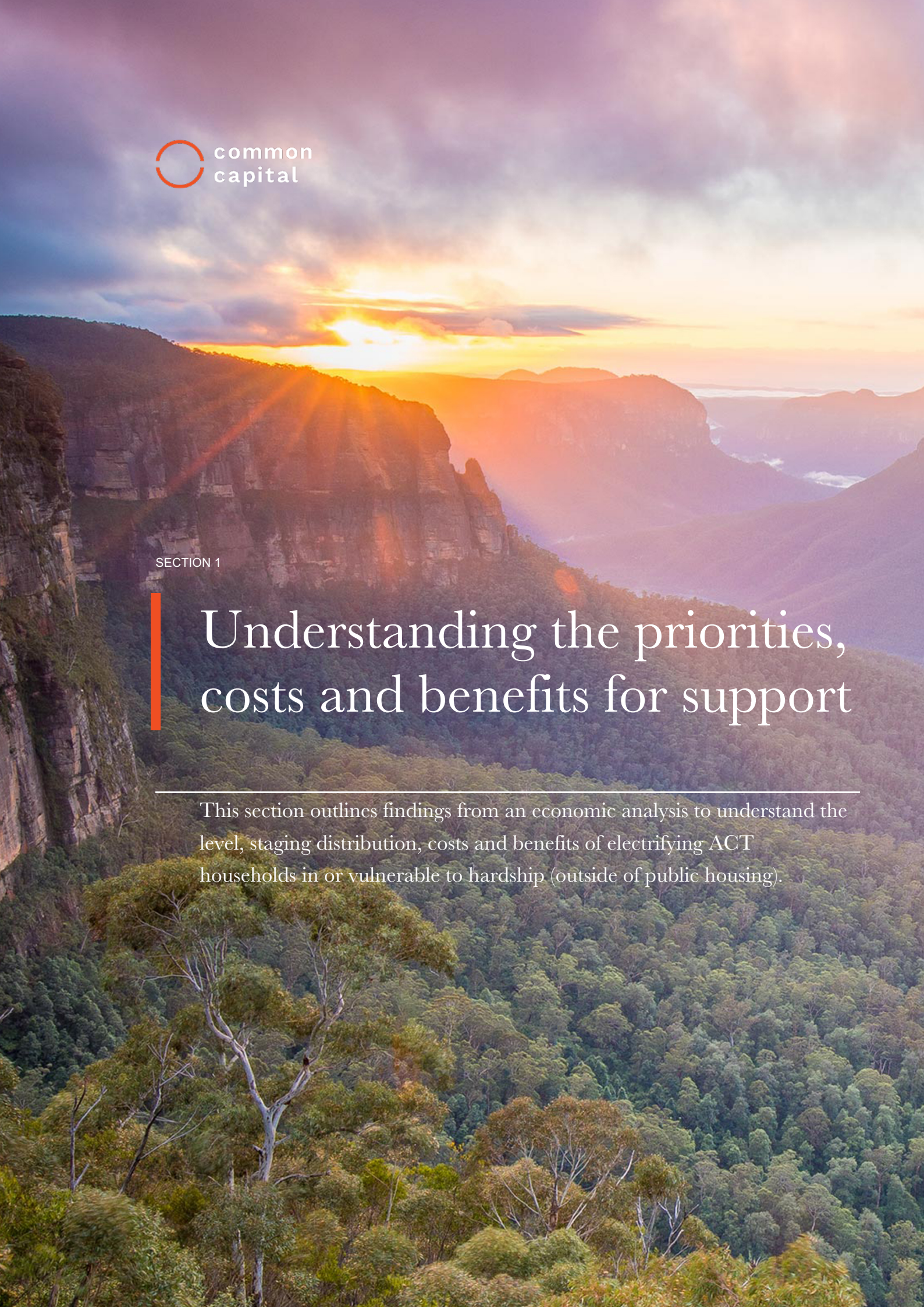

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SECTION 1

Understanding the priorities, costs and benefits for support

This section outlines findings from an economic analysis to understand the level, staging distribution, costs and benefits of electrifying ACT households in or vulnerable to hardship (outside of public housing).

1.1 Lower income households face greater cost barriers to electrification

In August 2022, the ACT Government published a report outlining their commitment to shift from fossil fuel gas to renewable electricity by 2045 [1]. Part of that commitment includes shifting households from a reliance on gas to using electricity to power their homes. This transition will partly fulfill the Government's Climate Change Strategy commitment. However, it will also benefit electrified homes through reduced energy bills and the associated health outcomes of not inhaling gas.

Larger high-efficiency electrical appliance costs, coupled with lower average incomes, can make electrification challenging

All home gas appliances, such as water heating, cooktops and space heating/cooling need to be upgraded to electrify a home. Upgrading to electric appliances (from gas) is more expensive than upgrading to new gas appliances. These high upfront costs can be a barrier to electrification for lower income households, and in some cases prohibitive.

Lower income households tend to have less disposable income when compared with the ACT average. Weekly household income in the bottom 20% ranges from $0 to $1,333, whereas the median ACT household income is $2,373 [3] [4]. Lower income households will consequently disproportionately face more cost barriers when it comes to electrifying their appliances.

All appliances need to be upgraded periodically as they come to end of life. However, because electric appliances generally cost more than gas appliances, lower income households may choose a gas appliance as the replacement. The comparative cost difference is illustrated in Table 2 below.

Table 2: Assumed average cost of gas and electric home appliance[3]

Appliance (gas)	Gas appliance cost	Electric appliance cost
Water heater	$1,927	$5,500
Space heater	$2,250	$2,450
Cooktop	$1,927	$3,027
Total	**$6,104**	**$10,977**

[3] The total average cost of gas and electric appliances assumes that a household has all three gas appliances and upgrades them all. Assumptions for each technology type is as follows:

- The cost of a space heater covers one split system and therefore, in practice these costs may be higher.
- Water heat pump prices are also expected to decrease because of learning curves, economies of scale and technological improvements.

For cooktops, the cost is indicative of an average induction stove. Purchasing an electric ceramic stove will drive up operating costs but will decrease the capital appliance cost significantly.

Note that these cost estimates are conservative in some ways. Material additional costs can be incurred, including wiring upgrades and building works (e.g. plastering, pipework). These space heating costs also reflect only the cost for electrifying one room. Whereas the cost of installing whole-of-home ducted reverse cycle air-conditioning to replace ducted gas are typically over $12,000.

In addition, multi-unit and complex buildings are treated the same as privately owned rental properties, assuming an average cost for transitioning gas appliances to electric ones. In practice the actual costs for upgrading apartments are likely to be different from those in free standing homes. In some cases, they may be significantly lower and in other complex buildings they may be higher, depending on the technology sets that are chosen. The ACT Government is currently undertaking work to better understand the cost-optimal pathways to electrify complex buildings. In the absence of more accurate data, the average costs for free-standing ones are the best available alternative for estimating the order of magnitude funding requirements per household.

There is also potential to pair lower cost water heating and cooking electrification technology options with investment on solar PV to deliver higher total benefits (see Section 1.5).

Lastly, appliance costs could be reduced through the bulk procurement of appliances by the ACT Government. Due to the large number of appliances that would be purchased by the ACT Government, there would likely be an opportunity to negotiate the price of the individual units. This would involve implementing a bulk procurement process modelled on the South Australian rebate swap for solar program (Switch for Solar). A tender process would be required to select suppliers that would form a panel. To qualify and remain eligible for Government subsidies, panel suppliers would need to agree to pre-determined prices and follow quality and safety standards. It is likely that a price reduction of approximately 10-20% could be achieved through a bulk procurement contract, however, this would need to be tested. The bulk procurement by the ACT Government could therefore be a streamlined way to secure material discounts for installed appliances.

Lower income households will be disproportionately impacted if not electrified

As shown in Figure 1 below, gas appliances cost more to run than electric appliances. On average, an ACT home using gas appliances will spend $450 more on energy consumption each year when compared to an electrified home. If a home is fully electrified and uses solar, it saves a further $510 in energy consumption bills (or $960 less than when using gas appliances). There will be additional savings from fully electrifying a home due to avoiding the gas standing fee – see discussion in Section 1.4.

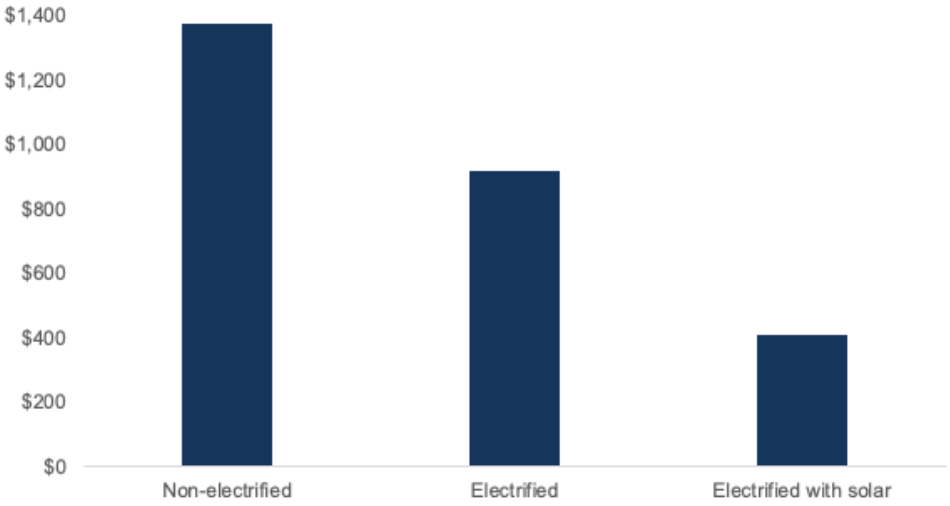


Figure 1: Average annual energy bill for ACT homes (non-electrified, electrified and electrified with solar)[4]

As shown in Figure 2 below, lower income households spend a higher proportion of their income on energy bills – spending up to 8% more on energy when compared with the average ACT home.

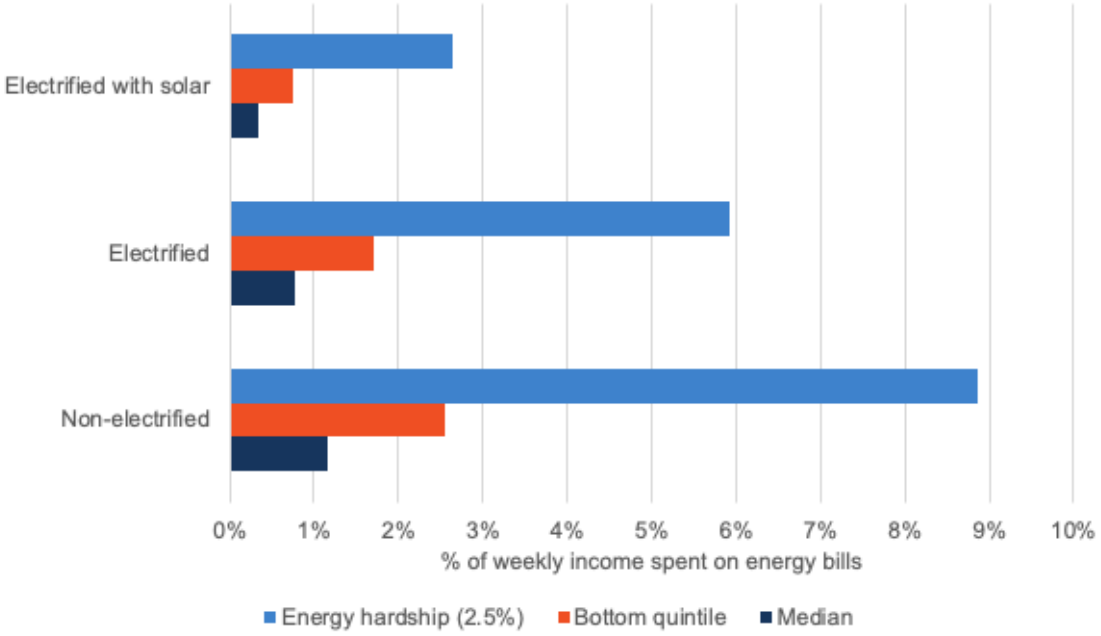


Figure 2: Percentage of weekly income spent on energy bills for the median ACT household, bottom 20% and lowest 2.5% living in non-electrified homes, electrified homes, or electrified homes with solar[5]

Figure 2 above shows that electrifying lower income households will decrease the proportion of disposable income spent on energy bills weekly by up to 3%. Therefore, a decrease in energy

[4] Source: 2021 Residential Baseline Study for Australia and NZ for 2000 - 2040 (RBS 2021); Electricity price forecast (c/kWh) (Excel file "CCEEW Retail electricity prices from NCC DRIS 5 Sept 22.xlxb"; and Solar Choice - Energy production from solar panels Canberra

[5] Source: ABS Australian National Accounts: State Accounts, Key National Accounts aggregates by state and territory, ACT data: Table 19 (from Data download)

bills for lower income households will result in saving a greater proportion of disposable income.

1.2 Identifying households facing electrification barriers is challenging

In the ACT there are a combined 186,963 dwellings[6]. For private dwellings in the ACT (i.e., dwellings that are not social or public housing) 67% are owner occupied and 25% are rented. However, in the bottom 20% of households of the ACT population who earn the lowest household income – the proportion of owner occupied to rented dwellings is 54% and 20% respectively. There is a large increase in the number of people who are living in social or public housing. The analysis and modelling for this report uses the number of gas accounts (131,000) instead of the total number of private dwellings (186,963) and excluded all social and public and other housing.

Energy hardship isn't restricted to households on lower incomes

The ongoing Energy Equity Work Program (EEWP) led by the Group of Energy Efficiency Researchers (GEER) Australia has found that energy hardship affects various groups in different ways. This makes it difficult to identify people in, or vulnerable to, energy hardship.

Jurisdictions, including the ACT, have developed this multi-year EEWP to address the risk of vulnerable households being left behind in the energy transition. The GEER team draws from Swinburn University, CSIRO, Common Capital, and Queensland University of Technology. The work program is conducting detailed primary research to help state, territory and Australian policy makers better understand, measure, address and prevent energy hardship.

Crucially, the EEWP has found that hardship is neither limited to lower income earners or a binary state. It varies by both severity and duration. Challenging life circumstances can also cause and compound the impact of energy costs and the barriers to overcome them. These include serious personal/family health conditions, domestic violence, and mental health crises.

The current national data set is poor, which means it is also difficult to quantify the problem. The current definitions and mechanisms used considerably underestimate the extent of hardship. Work is currently underway to develop new and different approaches.

Common program eligibility criteria can inadvertently exclude those in need

Many initiatives that provide support to lower income households and households vulnerable to, or experiencing, energy hardship use the Australian concession card system for their eligibility criteria. One reason is due to the administrative simplicity involved with being able to quickly and efficiently identify households in need and in supplying the necessary information and evidence. Concession cards can therefore significantly reduce the administrative burden on governments, utility providers and households.

Concession cards are used as a proxy for need, although it is generally thought to be quite a poor proxy. This is because it may exclude people who do not qualify for a concession card, but

[6] Including social and public housing

who need support to avoid falling into hardship. It also may exclude households in invisible hardship who are deploying coping strategies such as under-consuming energy or reducing their spending on other essential items (e.g. food) to ensure they can continue to pay their energy bills.

In the ACT, concession cardholders are eligible for the ACT utilities concession which provides a fixed rate contribution to their energy costs. The types of concession cards that are eligible for this payment are:

- Pensioner Concession Card
- Health Care Card
- Veteran Gold Card Holders
- Low Income Health Card
- ACT Services Access Card

All but one of these concession cards are administered by the Commonwealth and the jurisdictions do not have access to the data identifying card holders. This makes it difficult to quantify how many ACT households fall into this category.

The HESP provides rebates for eligible homeowners to help with the upfront costs of installing energy-efficient products. Households must be holders of one of the first three of concession card types listed above to qualify. However, they must also own and occupy the home in which the installation will occur.

This eligibility criteria excludes all low-income rental households in the ACT. Rental households have additional barriers to accessing energy efficiency due to split incentives between landlords and tenants. Landlords are unlikely to voluntarily electrify their rental properties without incentives as they do not receive the energy bill benefits that would result from the upgrade. Excluding low-income rental households from electrification support is likely to increase inequity.

Again, without access to Commonwealth data, it is difficult to quantify how many ACT households currently hold a concession card and are therefore eligible under the current HESP criteria.

In the order of 25,000 ACT private households will require material assistance to transition off gas by 2045 and reduce energy hardship

There are various ways of characterising “lower income households”, and therefore various ways of grouping the target population for this report. Four methods were tested to determine an appropriate target cohort of households – with the number varying slightly depending on the method used. Differences are mostly the result of small differences in the dataset underpinning each method. In any case, each method shows that a figure of around 25,000 homes will need support for electrification.

Two of the methods use the number of gas accounts in the ACT. The first method adds the number of privately owned and privately rented detached/semi-detached households earning a household weekly income between $0 - $1,500. This equates to 21,900 gas accounts. The second method takes the total number of gas accounts for homeowners and renters (including

complex/multi-unit buildings) and excludes all public renters. This number is 125,058 and is divided by five to give the bottom 20% gas account cohort of 25,012.

A third method was used to conduct a sensitivity check on the number of gas accounts in the bottom 20% of income earners. This method uses ABS data for the number of dwellings in the ACT in 2021 (187,156 dwellings). The bottom 20% of households with the lowest income is therefore 37,431 households. Using a calculated average of gas ownership across the ACT population of approximately 70% [5], the number of gas accounts in the bottom 20% is therefore 26,202.

A fourth more conservative approach to estimate this cohort is using the Australian Council of Social Service (ACOSS) definition of poverty [6]. The ACOSS definition of poverty includes households whose income is equal to, or less than, 50% of the median income (minus housing costs). In the ACT, 50% of the weekly median income is $1,186 [3]. After deducting average housing costs in Australia of $317 [7], this leaves $869.50. This translates to around 22,025 homes, of which, on average, 70% or 15,418 have gas accounts.

For the purposes of the quantitative analysis in this report, we have used the second approach i.e., the bottom 20% of gas accounts (excluding public renters) – which includes 25,012 homes. Until the national EEWP is able to provide a more precise estimate of those in and vulnerable to energy hardship, our GEER partners have advised that the bottom 20% is a suitable estimate for the order of magnitude of people likely needing material assistance.

In addition, multi-unit and complex buildings are treated the same as privately owned rental properties, assuming an average cost for transitioning gas appliances to electric ones. In practice the actual costs for upgrading apartments are likely to be different from those in free standing homes. In some cases, they may be significantly lower and in other complex buildings they may be higher, depending on the technology sets that are chosen. The ACT government is currently undertaking work to better understand the costs optimal pathways to electrify complex building. In the absence of more accurate data, the average costs for free-standing ones are the best available alternative for estimating the order of magnitude funding requirements per household.

Households in the bottom 20% of income earners

It is very likely that lower-income households will not have electrified yet, therefore, we find that taking the bottom fifth of these gas accounts is a good proxy for the number of households with gas accounts in the bottom 20%.

This cohort of households is the largest cohort analysed. The proportion of renters (private, social, public, and other) and owner occupiers is shown in the table below.

Table 3: Proportion of ACT households in the bottom 20% of income earners by household type, compared to the total addressable market[7]

Household type	Percentage of households in the bottom 20% of income earners	Percentage of total ACT households
Owned	54%	67%
Rented (private)	20%	25%
Rented (public)	19%	5%
Rented (social)	2%	1%
Other	5%	2%

1.3 Households that electrify experience significant net bill savings

Electrification benefits vary based on the type of appliance that is upgraded

As discussed in Section 1.1 electric appliances are cheaper to run than gas appliances. Figure 3 below shows the cost breakdown of energy bills by appliance type for electric versus gas appliances. The average household will save $735 a year in energy bills if they electrify all three appliances. This includes a saving of the gas connection fee which is no longer charged to a home once it is fully electrified.

[7] Australian Bureau of Statistics - 2021 Census - selected dwelling characteristics: Tenure and Landlord Type by HIND Total Household Income (weekly) by SA4 (EN). Accessed via ABS Table builder: Dwelling records for ACT tenure by income.

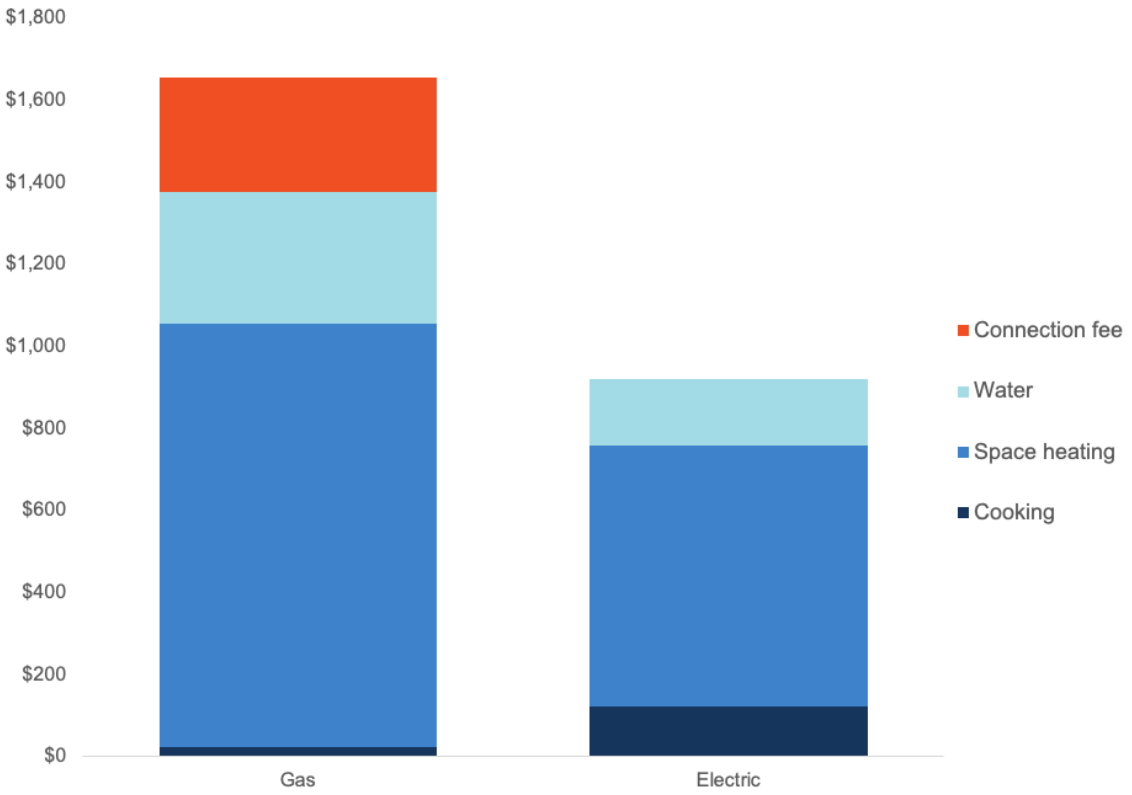


Figure 3: Breakdown of annual energy cost by appliance (gas versus electric)[8]

For a fully electrified household, installing a solar PV system will result in a further reduction in energy bills. This is because the solar PV system will reduce the household demand for energy consumption from the grid. On average, households in the ACT consume 40% of their solar PV electricity generation [8]. The other 60% is exported back to the grid where the household can receive a feed-in tariff of 7c/kWh – further reducing electricity bills. Note, these figures are based on a broad average of 40% self-consumption, however in practice that is likely to vary by household depending on behaviour. For example:

- An analysis of international residential solar PV self-consumption found that households on average consume 49% of their solar PV generation [9].
- A study comparing the adoption of solar in Australian households in and out of hardship found that households in hardship consume 36% of their solar PV generation, compared with 26% in other households [10].
- A study on the impact of residential batteries on solar PV consumption and export in ACT households found that self-consumption in ACT households is approximately 34% [11].

Complete electrification has additional energy bill saving benefits

Households connected to the gas network must pay gas standing fees. Gas standing fees represent the cost of maintaining the gas network and are shared across all the network participants (the number of gas connections). The average home in the ACT pays 77c/day for this connection, on top of their consumption rate [12]. This equates to $281.05 a year. These standing fees are forecasted to increase as the number of households connected to the gas

[8] Source: 2021 Residential Baseline Study for Australia and NZ for 2000 - 2040 (RBS 2021); and Electricity price forecast (c/kWh) (Excel file "CCEEW Retail electricity prices from NCC DRIS 5 Sept 22.xlxb"

network decreases. Complete household electrification therefore has additional energy bill savings because the household can disconnect from the gas network entirely and will not be subject to increasing gas standing fees.

Because lower income households will struggle financially to electrify, they are likely to be the last group left connected to the network. In this case, they will be left to bear the brunt of high gas standing fees. This will contribute to their already disproportionately high expenditure on energy bills, relative to their income.

The Business as usual (BAU) scenario for this analysis assumes that ACT households are electrifying at an average rate of 1.5% a year. In addition, the BAU scenario assumes that the ACT Government will pay for the upgrade costs of the remaining unelectrified homes in the final 4 years leading up to 2045 (ahead of the termination of fossil fuel gas consumption in the ACT). This equates to 95,271 homes across the total ACT population in between 2041 - 2045. It is unlikely that the households that have transitioned before this year will be from the vulnerable households cohort.

As shown in Figure 4 below, the gas network standing fee per household under the BAU scenario, will increase from $281.05 per year, to $363.39 per year by 2040 and $1,498.15 per year by 2045. Because the households remaining on the gas network will likely be lower income households who cannot afford the electrification upgrade costs – supporting them to electrify early is vital to avoid highly perverse outcomes.

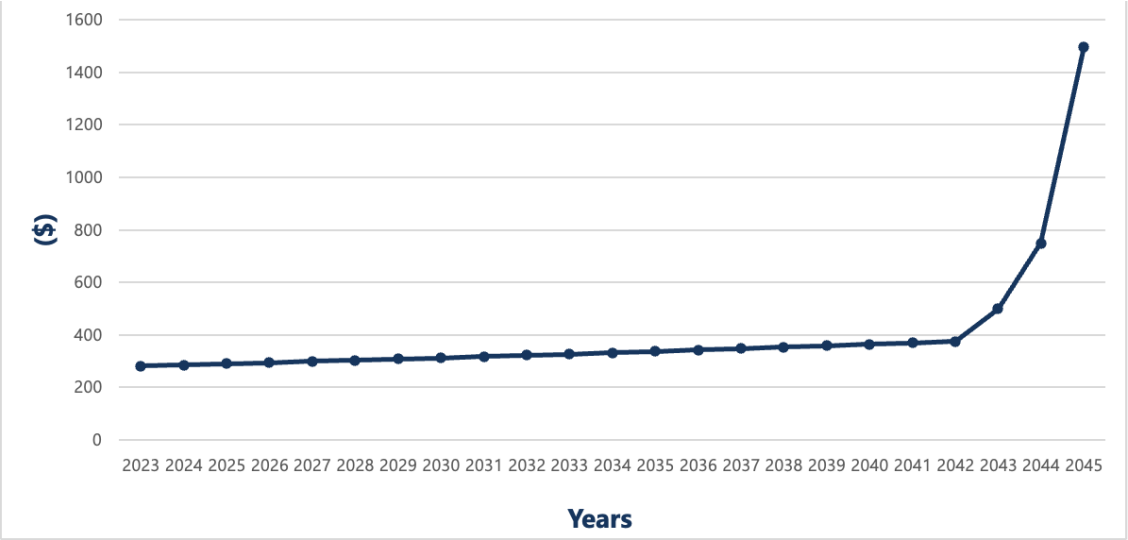


Figure 4: Annual gas network standing fee under the BAU scenario[9]

The costs and benefits of electrification discussed in Section 1.4 below, assume the above rates of BAU electrification and avoided network standing fee benefits.

However, it is possible that a consumer-led electrification may occur at faster rates than the standard integrated energy plan and impact assessment tool assumptions. In practice the adoption of new technologies typically follows an “s-curve”. Adoption gradually rises, then

[9] Source: ABS data on number of gas accounts; daily gas supply charge under a Direct Saver 2023/24 contract with ActewAGL

steeply accelerates at an inflection point when a crucial mass of the population all moves at once before flattening out as laggards slowly transition, until they have no option not to.

Figure 5 bellow illustrates the pace and scale on gas standing cost increases for customers left on the network if the ACT gas transition follows an archetypal s-curve and government action is not taken to limit the recovery of claimed network costs across a shrinking customer base. In this scenario, the 2030 standing fee would be approximately $405, rising rapidly to $2,610 in 2035 and upwards of $3,700 a year by 2041. Those households who face barriers to electrification and vulnerability to energy hardship would be even more exposed should this occur. Factors like this tend to create feedback loops in technology transitions, which accelerate behaviour change and result in s-curve shaped adoption rates.

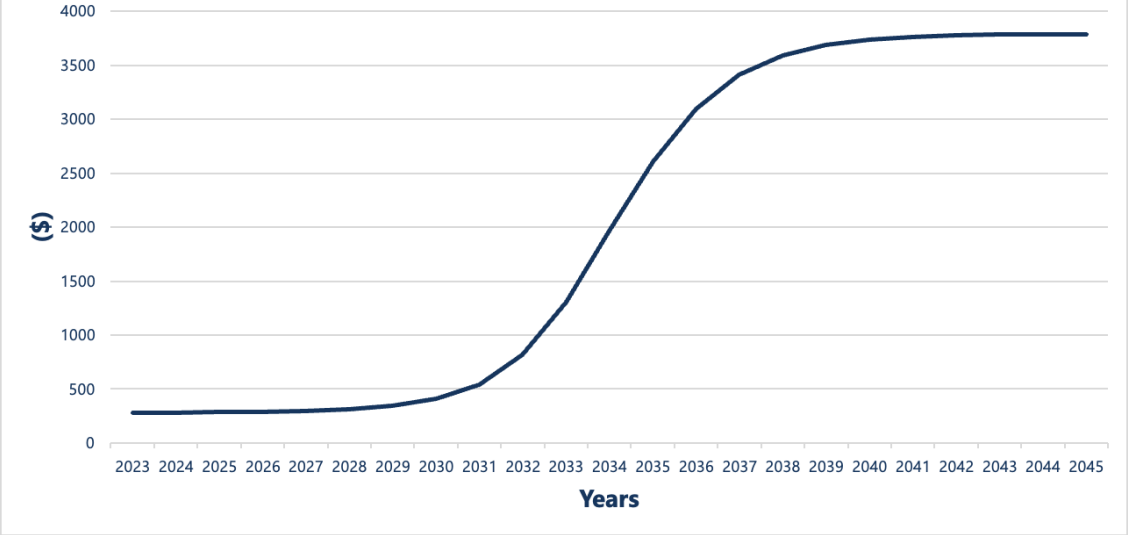


Figure 5: Annual gas network standing fee under the consumer-led electrification BAU scenario[10]

The scale of the potential impacts illustrated above warrants investigation outside of this project of policy options to protect all ACT customers and avoid electrification supply chain bottle necks. One example option could include a staged and planned write-down of gas network asset values once lifetime or a fair risk adjusted value has been recovered.

1.4 ACT-wide economy costs and benefits vary significantly depending on the mix of timing and appliances

We have modelled two scenarios which include a mix of cohorts, timing, and appliance type. We compared these scenarios to the BAU scenario outlined above (households are electrified at an average rate of 1.5% a year). The scenarios modelled include:

[10] Source: ABS data on number of gas accounts; daily gas supply charge under a Direct Saver 2023/24 contract with ActewAGL

- Scenario 1: Electrification now – A quarter of the group analysed is electrified over the next 4 years (2024-2028).
- Scenario 2: Electrification at end-of-life - Appliances are upgraded to electric appliances at the end of each gas appliance's life[11].

Each scenario has varying levels of costs and benefits. Our analysis shows that full electrification of lower income households (including adding solar PV) in the ACT has a net benefit. Therefore, when scaling up the number of households that are electrified, the net benefits also increase.

If all other associated public and private costs and benefits are also considered, all three options deliver similar benefit: cost ratios of just over 2:1. However the total net societal benefit decrease the longer upgrades are delayed. This is because the benefits of delayed capital costs of upgrades, remain lower than benefits of energy bill savings which are foregone due to the delay. This is shown the different net societal benefits over four different scenarios below.

Table 4: Net societal benefit of electrifying the bottom 20% (of income earners) of ACT gas connected homes (all figures in this table are the Net Present Value (NPV))

	Electrification now (2024-2028)	**Electrification now + solar (2024-2028)**	**End-of-life electrification (2024-2036)**	**End-of-life + solar (2024-2036)**
Total Net Societal benefit	**$193.7 million**	**$344.0 million**	**$134.6 million**	**$77.9 million**
Capital cost	$221.1 million	$394.3 million	$184.2 million	$328.5 million
Energy bill savings	$347.8 million	$475.5 million	$251.8 million	$339.4 million

This analysis shows that at a 5% discount rate, there are greater benefits under Scenario 1 than under Scenario 2. A discount rate is used to calculate the Net Present Value (NPV) which represents the time value of money – a finance principle – i.e. money is worth more now than in the future. The sooner households are electrified, the greater the cumulative bill savings (i.e., 22 years of savings). Because of how discount rates are applied under current modelling conventions, the longer one delays spending, the lower the capital cost of replacing appliances will be (in the net present value). Costs will therefore be lowest if they are upgraded at the end of the appliance's life, instead of being replaced early.

The total capital cost of electrifying the bottom 20% of gas customers under Scenario 1 would be around $221.1 million but deliver these customers a net present value of $347.8 million in bill savings to 2045. Alternatively, these capital costs could be substantially reduced under Scenario 2 to $184.2 million. This is because only the incremental difference between electric

[11] We have assumed a 12-year lifetime of each appliance.

and gas appliance costs would be required and costs could be spread over around 12 years. However, this slower timeline results in lower bill savings of $251.8 million.

Policies to support households to electrify need to balance total benefits with the budget constraints of providing material and scalable assistance. Scenario 2 allows the ACT Government to support more households, but spreads costs over a greater number of years in a long-term electrification program. This would require policy measures that can unlock $15 million per year over 12 years, or $26.6 million including solar, compared with a $221.1 or $394.3 million for a four-year early electrification program. Notably these costs do not need to be fully met by government or any single policy. Different cohorts will require different levels of assistance, ranging from full subsidisation, partial rebates, to subsidised debt, to budget neutral debt. Government costs can be prioritised to those in greatest need and split across a mix of budget, budget neutral, off budget and regulatory mechanisms. For an end-of-life electrification program targeting the bottom 20%, the NPV of equipment costs would be around $328.5 million and bill savings of $339.4 million.

The analysis of costs and benefits under each scenario has been conducted in accordance with the current ACT whole-of-Government business case framework. However, emerging best practice is to consider a distributional analysis of each dollar benefit [13]. Consequently, the distributional analysis could change the total net benefit. This business case might benefit from further analysis in line with this emerging best practice.

1.5 Lower-cost electrical appliances and solar PV could improve costs and benefits

Within the figures in Section 1.4 above, there is also scope to optimise the benefits based on changing the technology mix. Figure *6* below shows the upfront capital and lifetime operating expenses for each appliance and fuel type[12].

[12] The analysis done for figure 5 is additional to the analysis done for the modelling of this report. It should be treated as a sensitivity analysis around different upfront capital and lifetime operating costs. Some of these numbers will therefore differ from those used in the primary modelling for this report.

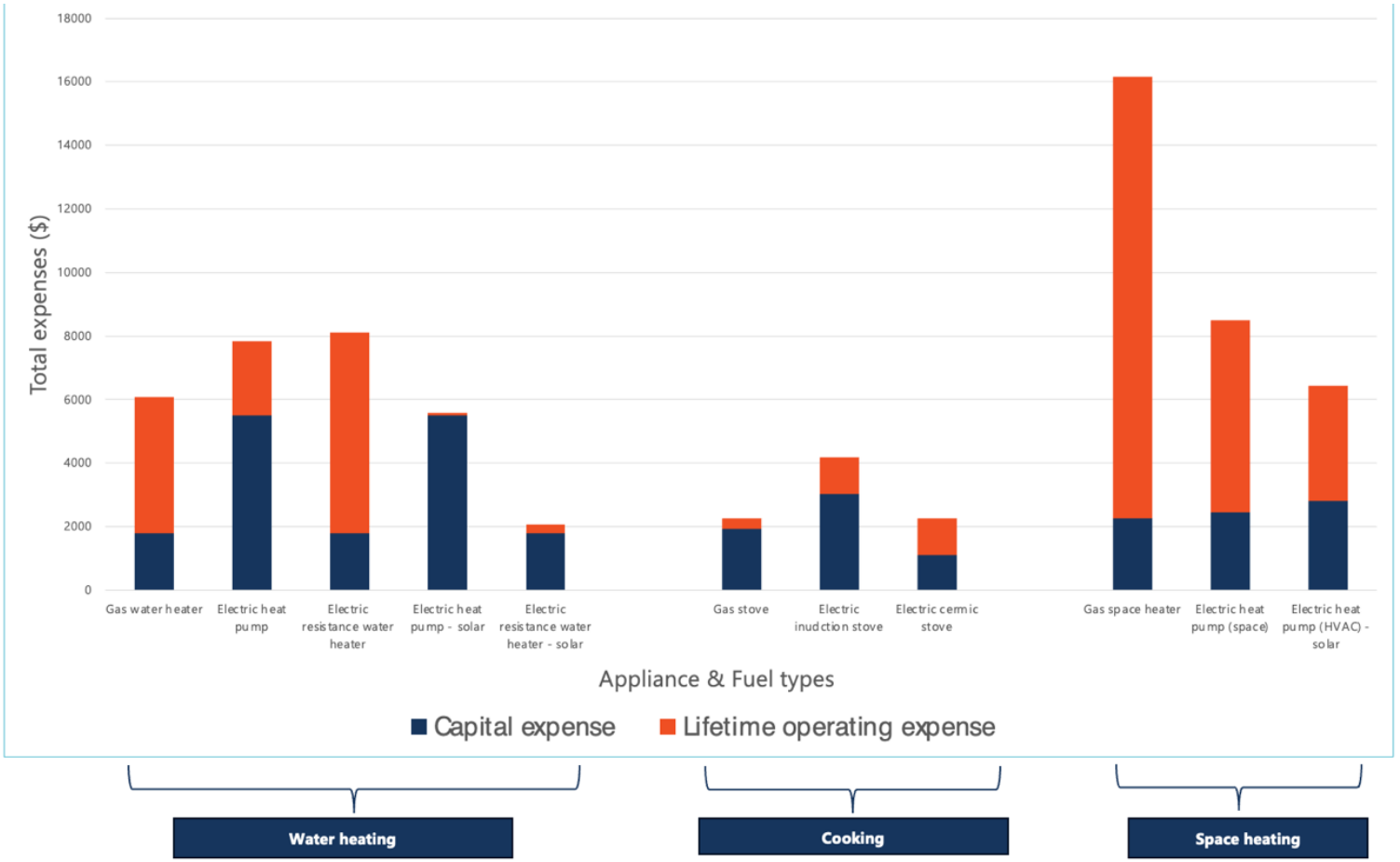


Figure 6: Lifetime cost of ownership (capital and lifetime operating expenses) by appliance and fuel types[13]

[13] Source: 2021 Residential Baseline Study for Australia and NZ for 2000 - 2040 (RBS 2021); Electricity price forecast (c/kWh) (Excel file "CCEEW Retail electricity prices from NCC DRIS 5 Sept 22.xlxb"; Solar Choice - Energy production from solar panels Canberra; Plan - Canberra is electrifying; Choice: What to know before you buy a gas cooktop; Everyday climate choices: A guide to hot water and heat pumps - ACT Government

Figure *6* shows the comparative lifetime cost of ownership (capital cost and typical lifetime running costs accounting for fuel prices) for a range of heating, cooking and space heating options. For each activity the left hand-side shows the total lifetime cost of the dominant gas technology, followed by the high-efficiency electrification option, followed by the lower cost electrification option for water heating and cooking. For water and space heating, the figure also illustrates the costs of electrification options with solar PV. (Note, low-cost electric resistance space heating options are not shown as their running costs are prohibitively high and cannot be considered to provide equivalent levels of service). We have assumed a 5% discount rate for these calculations, in line with the central modelling done for this report.

For water heating, if a home does not have solar PV, a gas water heater will have the lowest total lifetime expenses. However, when solar is included in the technology mix, an electric resistance water heater and a heat pump will both have higher lifetime savings than the gas water heater. The electric resistance water heater will have the highest savings of the two. For cooking appliances, the highest lifetime savings is from an electric ceramic stove or a gas stove. However, should a household fully electrify or cook during times where solar PV is available, than the electric stove will have additional savings when compared to the gas stove. For space heating, the highest lifetime savings will be for an electric heat pump water heater using solar, followed by an electric heat pump water heater without solar[14][15]. Overall, a household will receive the highest savings from complete electrification and using solar PV.

Table 5 and Figure 7 below illustrate the breakdown of capital and operating expenses for an average household for different technology and fuels mixes. The lowest total lifetime expense is $16,707 for a fully electrified household that uses solar PV and benefits from the feed-in tariffs for exported energy. We have assumed a feed-in tariff of 7c/kWh and the lifetime for appliances to be 12 years. It should also be noted that we attributed the whole cost of solar PV to the 12-year operating lifetime. However, solar panels generally have lifetimes of 25-30 years. This means that for the next upgrade of electric appliances, the cost of solar panels will not be incurred. As discussed in Section 1.3 above, there will be further savings from complete electrification beyond those illustrated below, because a household will also avoid the gas annual connection fees.

[14] Capital costs for electric heat pumps for space heating is for a single ducted system. The cost of upgrading an entire household will likely be larger than what is presented.
[15] An electric heat pump system allows both cooling and heating functions whereas a gas space heater only provides heating capabilities. Therefore, strictly speaking, this change of appliances is an upgrade rather than a direct like-for-like swap.

Table 5: Breakdown of capital and lifetime operating expenses for different appliance, technology & fuel types (AUD$, net present value terms using a 5% discount rate)[16]

Technology mix	Capital upgrade expense	Lifetime operating expense	Total expenses
Gas whole of home	$5,977	$18,527	$24,504
Electric whole of home	$9,050	$9,547	$18,597
Electric whole of home + solar	$14,370	$5,059	$19,429
Electric whole of home + solar + feed-in tariffs	$14,370	$2,337	$16,707

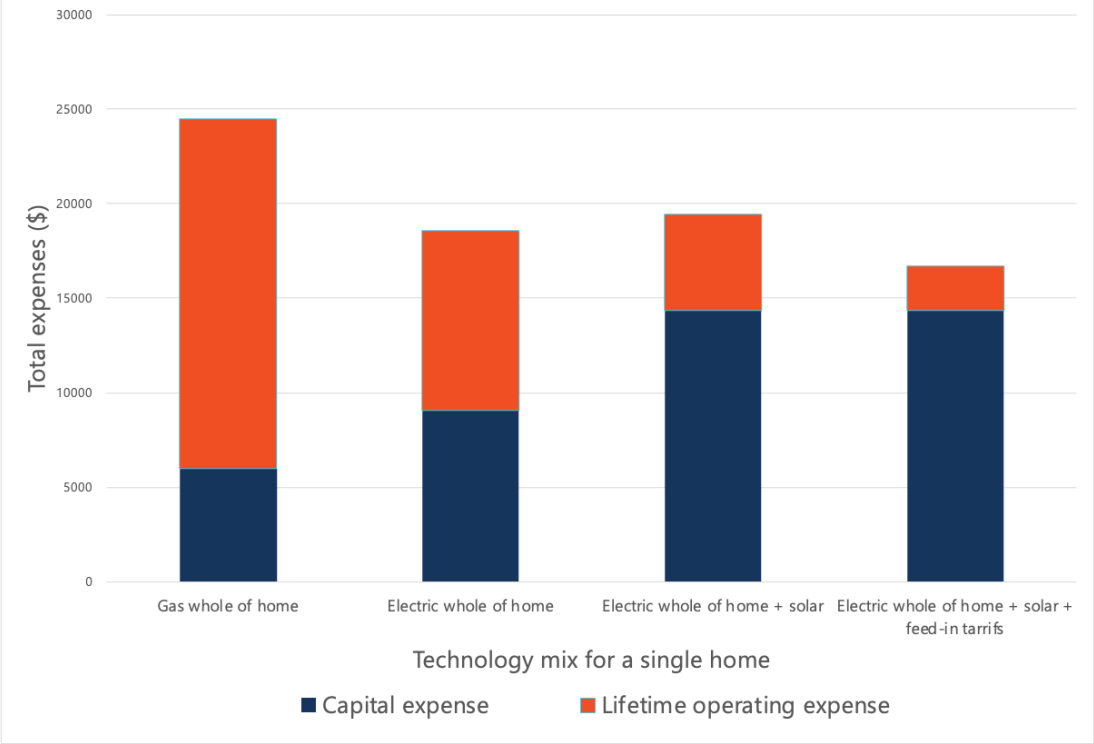
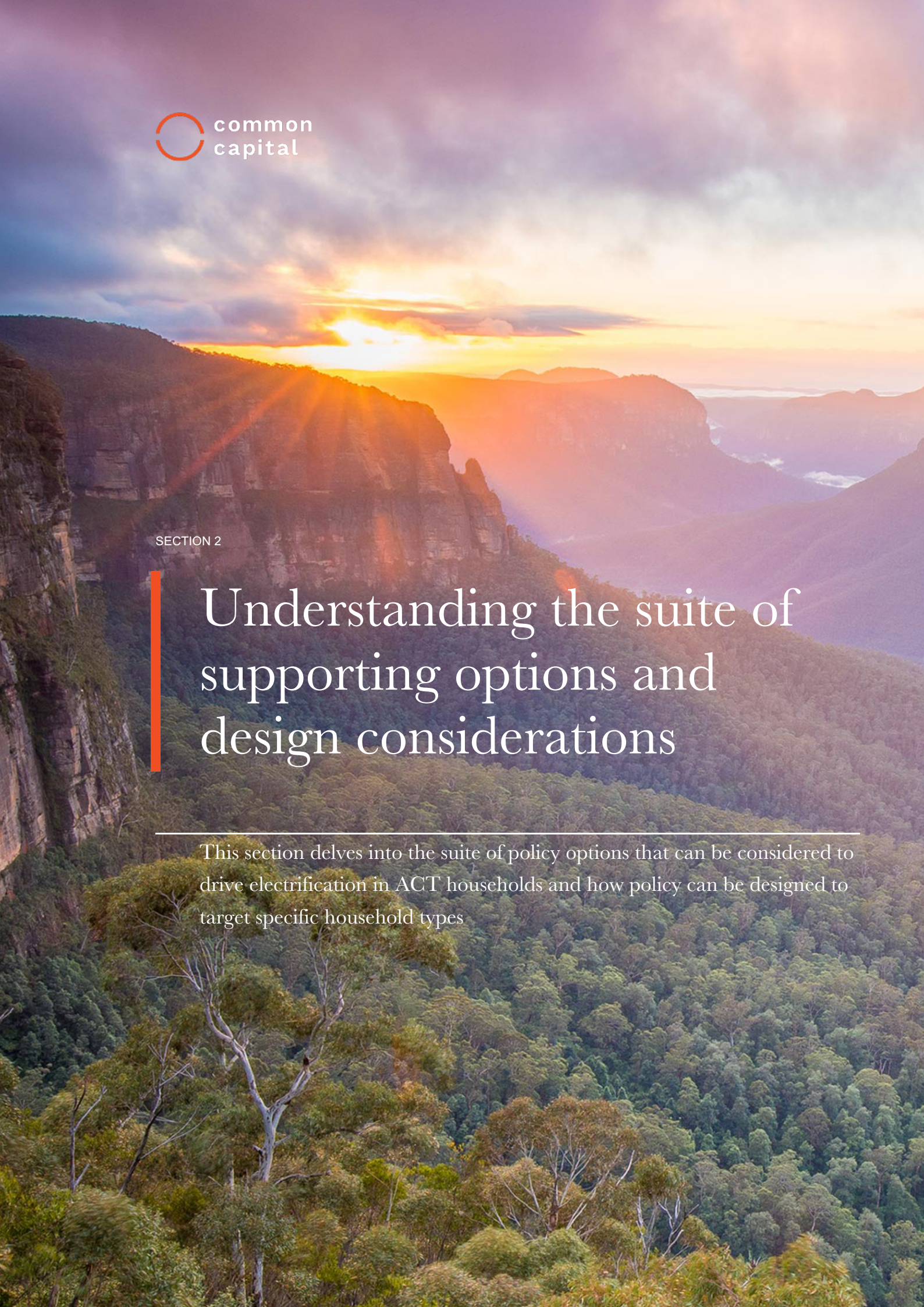


Figure 7: Average household capital and lifetime operating expenses for different fuel and appliances[14]

[16] Source: 2021 Residential Baseline Study for Australia and NZ for 2000 - 2040 (RBS 2021); Electricity price forecast (c/kWh) (Excel file "CCEEW Retail electricity prices from NCC DRIS 5 Sept 22.xlxb"; Solar Choice - Energy production from solar panels Canberra; Plan - Canberra is electrifying; Choice: What to know before you buy a gas cooktop; Everyday climate choices: A guide to hot water and heat pumps - ACT Government

Figure 7 above shows that while capital costs are highest when solar PV is installed, the large savings in energy bills more than compensates for these costs. Fully electrified homes with solar have the lowest total expenses.



common capital

SECTION 2

Understanding the suite of supporting options and design considerations

This section delves into the suite of policy options that can be considered to drive electrification in ACT households and how policy can be designed to target specific household types

The full upfront costs of electrification costs estimated in Section 1 do not need to be fully met by government or any single policy. Different cohorts will require different levels of assistance, ranging from full subsidisation, partial rebates, to subsidised debt, to budget neutral debt. Government costs can be prioritised to those in greatest need and split across a mix of budget, budget neutral, off budget and regulatory mechanisms. This section identifies and considers complementary options for a complementary suite of policy measures to support as many households as possible in different cohorts to electrify while managing budget impacts. It considers the design and delivery considerations to ensure effective resources allocation reaches those in greatest need.

2.1 Complementary policy options to drive electrification in target households

Section 1 identified end-of-life replacement as the cost optimal way to support electrification. This would require unlocking $15 million per year for the 20% of households earning the lowest income (25,012 gas accounts) in the ACT. A suite of complementary policy options will be required to ensure all households in the ACT can electrify by 2045, with varying levels of support provided.

"With current cost of living pressures, at least the bottom two to three quintiles [40-60% of households] in the ACT are likely to require close-to-full support to electrify. This can be spread across multiple policies."

There are several complementary policy options that could be adopted to spread this cost and minimise the impact on the ACT budget, these include:

- **Policy Option 1:** Zero-interest loan for rental properties through improving SHS accessibility
- **Policy Option 2:** Low interest loan for electrification upgrades in rental properties
- **Policy Option 3:** Implement a gas network decommissioning bond
- **Policy Option 4:** New 100% point-of-sale rebate for a new program or reformed HESP
- **Policy Option 5:** Lower income energy rebate swap for full electrification
- **Policy Option 6:** Expansion of the Minimum Energy Efficiency Standards for Rental Homes
- **Policy Option 7:** Expand EEIS support for electrifying lower income households

Different options can be more or less suitable for different cohorts of target households and will impact the uptake that can be achieved. Each option will also have different budget implications and benefits and challenges that will need to be further explored. A preliminary analysis of each of these options has been provided in the tables below.

	Policy Option 1: Zero-interest loan for rental properties through improving SHS accessibility
Description	A zero-interest loan is currently on offer through the Sustainable Household Scheme (SHS). Under this scheme, each eligible household can receive up to $15,000 in interest free loans. This loan can be used to cover the full or partial costs of a mix of upgrades related to either increased onsite solar PV or electrification of gas appliances or electric vehicles (EVs). This option provides a partial subsidy for electrification upgrades, with the remainder of the cost covered by the landlord. The scheme does not currently exclude target households, however, we have heard in interviews that it is less suitable for these households for a number of reasons, including: • Due to the requirements under the Responsible Lending Criteria, debt is often not appropriate for this cohort. • Some households in this cohort have accessibility issues with the application process. • Some of the households in this cohort have a general distrust and scepticism of loans due to previous experiences. • Excludes renters, which make up the majority of target households, as they do not own their home and therefore cannot access the loan.
Lower income household cohorts	This option is likely to be of most value to target rental properties as it reduces the barriers for their landlords to electrify the property. It is likely to be of less value to the many income owner occupiers in the bottom 20% cohort with low disposable income due to responsible lending considerations.
Eligibility	This option would require an expansion of the SHS eligibility criteria to allow $15,000 per dwelling, rather than per person. Currently, the SHS is inadvertently incentivising landlords to prioritise their own properties over their tenants. *"Landlords don't want to upgrade their rental homes to be better than their own homes."*
Budget implications	The Government is able to recover approximately 70% of program funding provided (depending on the government bond rate).
Key benefits	• Lower cost to the Government than direct subsidies. • Assists target rental households.

Key considerations	• Whilst this option provides an incentive, there is no guarantee landlords will want to take out a loan to electrify their investment properties as some view these upgrades as unnecessary (especially if the appliances are not broken). This option is best paired with complementary measures, like Policy Option 3 (gas network decommissioning bond) and Policy Option 6 (minimum rental standards).

	Policy Option 2: Low interest loan for electrification upgrades in rental properties
Description	A low interest loan could be implemented alongside, or instead of, the SHS zero interest loan. The loan offering, parameters and eligibility criteria could be the same as the SHS loan, only the Loanee must pay a small amount of interest. The interest rate would be set below the publicly available interest borrowing rate. This option provides a partial subsidy for electrification upgrades, with the remainder of the cost and interest on the loan, covered by the landlord. As above, loans are less suitable for the target households but can be a useful tool to incentivise those who are willing and able to take out a loan, to do so.
Lower income household cohorts	As with the zero-interest loan, this option is likely to be of the most value to the target rental properties as it reduces the barriers for their landlords to electrify the property. It is likely to be of even less value to lower income owner occupiers than the zero-interest loan as there is an additional cost barrier and has the potential to trap households in a cycle of debt. This is because even though the interest rate is lower than the publicly available rate, it may still be too high for these households who as a result may only be able to afford to pay off the interest rather than the balance of the loan.
Eligibility	SHS eligibility criteria could be adopted.
Budget implications	This option is budget neutral as the interest rate is set at the Government's cost of capital.
Key benefits	• Lower cost to the Government than direct subsidies. • Assists target rental households.
Key considerations	• As discussed under Policy Option 1, landlords may not want to take out a loan to electrify their investment properties. Landlords are likely to be less

	inclined to take out a loan if they have to pay interest on it (even though the interest rate is lower than the market rate). Again, this option is best paired with complementary measures, like Policy Option 3 (gas network decommissioning bond) and Policy Option 6 (minimum rental standards).

	Policy Option 3: Implement a gas network decommissioning bond
Description	To drive the level of electrification required, disincentives for gas-to-gas replacements may be necessary. This option would involve households paying a bond if they choose to replace a gas appliance with a new gas appliance. This option provides a disincentive for those who are not taking advantage of the incentives being delivered by the ACT to electrify appliances. This option also provides a revenue stream as the money collected from this bond could go into a fund that can be used to offset the cost of electrification in target households. Note, this mechanism has not been tested or implemented in any jurisdiction in Australia.
Lower income household cohorts	This option is likely to be of the most value to the target rental properties as it makes it more likely that their landlords will electrify appliances if they break. It is likely to be of less value to lower income owner occupiers as it does not remove any of their barriers to electrification.
Eligibility	N/A
Budget implications	This option would provide additional revenue for the Government; that can be used to offset the cost of electrification in target households.
Key benefits	• Assists target rental households. • Provides additional revenue that can be used to support other households to electrify. • Creates a disincentive which can be more persuasive than incentives in some scenarios. • This is a soft transitional measure compared with a regulatory ban on the installation of replacement gas appliances.
Key considerations	• This measure would accelerate the consumer-led adoption of electric appliances so careful consideration should be given to the timing of implementation to ensure the majority of vulnerable households have/can transition off gas.

	• Consideration would need to be given to an exemption framework to ensure this mechanism does not have unintended consequences for distributional impacts. • Legislative amendments would be required to allow Access Canberra to enforce this mechanism.

	Policy Option 4: New 100% point-of-sale rebate for a new program or reformed HESP
Description	Due to lower income households' limited disposable income and availability of funds, the current structure of the HESP is not appropriate for this target group. Some target households simply do not have any disposable income that can be allocated to partially funding electrification upgrades. These households are in the most vulnerable portion of society and therefore, require the cost of electrification upgrades to be fully covered. The rebate also needs to be applied at the point-of-sale and paid directly to the installer so that there are no upfront costs required of target households. This is a key part of the rebate design as out-of-pocket costs (that are later reimbursed) often make rebates prohibitive for the target households.
Lower income household cohorts	This option is likely to benefit the most vulnerable portion of target households (lowest 2.5%-7.5% and households with chronic health conditions) in the ACT who could not afford these upgrades and would gain the most from the associated energy bill savings (electrified homes save an average of $735 a year in energy bills). Only owner occupiers would have access to these rebates, with other mechanisms needed to support renters.
Eligibility	Lower income owner occupiers should be eligible under this policy option. Eligible households could be identified using an income test for non-concession cardholders. This could be used to include households that may be ineligible for concession cards but still require support due to other factors/barriers. The income test should account for the number of household occupants (instead of an income threshold). More details on designing effective eligibility criteria can be found in Section 2.2 (under Principle 4). Households with chronic health conditions and/or disabilities should be prioritised.
Budget implications	Direct cost to budget

Key benefits	• The Government can be certain that these properties will be permanently disconnected from gas. Even if the occupant of the house changes, future occupants will benefit from the electrification upgrades. • This option will likely transition lower income households off gas sooner than under a BAU scenario, which will prevent these households from being disproportionately impacted by rising gas network charges. • Households will be permanently disconnected from gas and therefore benefit from energy bill savings and avoid the increasing annual gas standing fee.
Key considerations	• This option requires high upfront costs from the Government (approximately $11,000 per household (not including solar)). • It can be difficult to identify the target households most in need of 100% subsidies. Community partners (e.g. Care Financial, St. Vincents, ActewAGL) can be leveraged to help identify those most in need.

	Policy Option 5: Lower income energy rebate swap for full electrification
Description	Target households receiving an energy rebate can opt to swap their annual rebate (for a fixed number of years) in exchange for electrification upgrades that enable the household to disconnect from gas. Households that participate in the rebate swap should be required to permanently disconnect from gas to ensure that future residents (who may also be target households) will retain the benefits of electrification. Measurement and verification of the energy savings in individual households should be conducted to prove program benefits. Annual energy bill savings should exceed the annual rebate amount to ensure households are not placed in a worse position. In addition, interviewees raised concerns around the vulnerability of these households and the need for consumer protection practices to ensure households are not being pressured to lock themselves in. *"Need serious consumer protection in place…wouldn't want them to be in a worse position after the 10 years or five years, where they're foregoing the concession just because they've had bad advice from a supplier".* A similar program previously existed in South Australia and currently exists in NSW, however, these programs involve residents swapping their rebates for solar systems (that deliver energy savings). The key challenge involved with the rebate swap is if the household moves before the rebate swap period is served. If this household moves into an unelectrified home, they are then worse off as they will have higher energy bills and no annual bill support payments. To mitigate this risk, interviewees strongly supported the need for

	these mechanisms to provide the recipient with flexibility in the amount of upfront funding and subsequently the number of years in which they will forego their annual energy rebate. For example, in NSW, households must agree not to receive their annual rebate for 10 years, in exchange for a solar PV system [14]. Flexibility will be particularly important when offering rebate swaps for electrification upgrades. This is because some houses may already be partially electrified and only require support to upgrade one or two appliances. The NSW program has also experienced a low uptake of the rebate swap opportunity. They explained that they have challenges with program awareness, resulting from a lack of marketing budget to help source eligible households. However, widespread marketing efforts are likely not needed – effective targeting of eligible households through partnering with organisations is likely to be a more efficient use of funding and result in greater uptake. A key feature of poor practice in current programs is to not support a large number of households in need to avoid benefiting a small number of households who may not need support. It is theoretically possible that some households who are eligible now may not maintain that eligibility for the full length of the rebate swap term. Analysis should be done to understand if this is a material risk through understanding the change over time. Based on the materiality assessment, the program funding criteria and budget can be designed to find other ways to mitigate the risk of anticipated savings being unrealised.
Lower income household cohorts	This will benefit target owner occupiers who are currently receiving energy bill rebates. This option is likely to benefit the most vulnerable portion of target households in the ACT who could not afford these upgrades and would gain the most from the associated energy bill savings (electrified homes save an average of $735 a year in energy bills).
Eligibility	Only owner occupiers should be eligible for this program. It should be relatively easy to identify eligible households as they are already receiving the rebate. Eligible households that are not receiving the energy rebate could be more difficult to identify, however, community partners who have established communication channels with this cohort could be leveraged.
Budget implications	The cost of electrifying a household using a rebate swap would determine how many years that household must forego their annual rebate for. Therefore, whilst there are higher upfront costs to the Government, ultimately, the costs will amount to be the same (just over a longer period). This option would likely have a higher cost to benefit ratio due to the future bill savings that would otherwise remain unrealised.

Key benefits	• There is no net additional cost to the Government, but rather a shift in the timing of these payments with a front loading of the annual rebate cost. • This option not only provides relief support (in helping to pay energy bills) but addresses the cause of the energy bills to help prevent hardship. Instead of helping households pay off their energy bills, the Government spends the same amount of money to reduce household energy bills – removing or reducing the future need for government support for household energy bills (both for the current residents and future residents). • Households will be permanently disconnected from gas.
Key considerations	• Rather than the costs being split over several years, the total rebate costs are required upfront to pay for the electrification upgrades. • If the resident moves to an unelectrified property, they have potentially lost both their electrification benefits and their annual rebate, requiring further assistance to electrify the new property and/or pay for the unelectrified property's higher energy bills. • As per the South Australian and NSW program designs, a rebate swap program should ensure that there is careful screening to ensure the expected savings from the upgrades undertaken significantly exceed the rebate being foregone. In addition, an initial pilot program should involve intensive M&V to validate and refine program settings before it is scaled and continue with ongoing M&V to quantify savings.

	Policy Option 6: Expansion of the Minimum Energy Efficiency Standards for Rental Homes
Description	This option would involve expanding the existing minimum energy efficiency standards for rental properties to cover the electrification of appliances. Currently, the standards ensure that any rental property with no ceiling insulation or existing ceiling insulation below the minimum requirements, will need to upgrade the ceiling insulation. A key risk with this option is the potential to impact the rental prices in the ACT. Electrification upgrades can be expensive and landlords may attempt to recover costs through increased rents. However, small rent increases will not impact target households, as long as these increases do not exceed the bill savings delivered through electrification. In addition, once all households are electrified, there will be no additional rental value from electrified appliances.

Lower income household cohorts	This option is likely to only impact target rental properties. Owner occupiers will need to access support from other policy mechanisms to electrify their homes.
Eligibility	This option would require a new regulation under the *Residential Tenancies Act 1997* that requires all residential rental properties in the ACT to be electrified and disconnected from gas.
Budget implications	There is no cost to Government under this option – landlords pay the full cost to electrify their investment properties. This option could be paired with complementary policy options that provide support to landlords to do so, recognising the potentially high costs associated with electrification.
Key benefits	• Assists target rental households. • No cost to the Government as all costs would be borne by landlords. • A significant proportion of all properties in the ACT will be fully electrified by a set date. • There will be significant bill savings delivered to rental households, with no upfront costs.
Key considerations	• Given the potential high costs associated with electrification, not all landlords will have the capacity to pay for these upgrades. • This option may be politically challenging to execute given the potentially high costs for landlords. • Potential for significant rental market impacts that leave target rental households worse off, including rental prices being raised above potential bill savings. • Apartment buildings can face challenges that standalone houses do not, for example potentially greater limitations on space or Strata restrictions. Apartment buildings will therefore likely require different electrification options. Consider separately designing precise obligation requirements and staging to align with the different needs of different building types.

	Policy Option 7: Expand EEIS support for electrifying target households
Description	The Energy Efficiency Improvement Scheme (EEIS) is an energy efficiency obligation scheme that imposes a requirement on electricity retailers in the ACT to deliver energy savings. Currently, 40% of the savings from activities delivered by Tier 1 retailers under the EEIS must be delivered to priority households in the ACT. This option involves increasing these targets to drive

	energy retailers to source and provide discounts for upgrades in priority/target households.
Lower income household cohorts	Upgrades are partially discounted by retailers under the EEIS, however some of the upgrade cost must be met by the household. This is therefore not a suitable option for target households as upfront costs can be prohibitive. However, if energy retailers are struggling to source a sufficient number of priority households, they may increase the subsidies, making the offer more attractive for target households.
Eligibility	Add an income test for non-concession cardholders to include households that may be ineligible for concession cards but still require support due to other factors/barriers. The income test should account for the number of household occupants (instead of an income threshold).
Budget implications	Funding for this option is considered to be off budget as it is indirectly funded by the current EEIS legislation (costs are spread across all energy customers in the ACT).
Key benefits	• Energy retailers will be more active in identifying target households to electrify as they cannot meet their obligation without delivering energy savings to these households. • May assist target rental households if subsidies are increased.
Key considerations	• Consideration needs to be given to the EEIS redesign to ensure there are exemptions or caps to ensure the distributional equity of the EEIS' pass-through costs. • EEIS priority group targets need to be designed to ensure lower income households and apartments have appropriate access to direct benefits. • The electrification barriers faced by apartments provide challenges to the uptake of upgrades under the EEIS, therefore the scheme needs to be repositioned to drive a higher concentration of benefits to those most in need, whilst also carefully managing the distribution of scheme cost pass throughs to avoid distributional inequity. • There is a risk that higher retailer contributions (i.e. through higher discounts to incentivise priority households to upgrade) may result in higher electricity prices as retailers seek to recover the increase to their costs.

Energy concessions could unlock a significant source of revenue

In interviews we heard there are very high numbers of ACT households on energy concessions with solar PV who received substantial negative energy bills as a result.

"There's actually money being pumped into a good number of accounts where there's actually no payable balance."

For confidentiality reasons we were unable to obtain the exact number of households with negative energy bills. However, one interview believed the Government could and should consider obtaining this information from energy retailers in the ACT[17].

"If you were looking at trying to unlock some capital, solar accounts [energy concession accounts] would be the place to look for it."

Reducing energy concession payments to a proportion of total energy bills could be an option to avoid concession payments subsidising negative energy bills. The reduced energy concession payments could then be used as an additional source of revenue that could be redirected to households in need of electrification support.

2.2 Best practice policy design to help target households

Addressing the barriers to electrification faced by target households is a significant challenge for many reasons, including the number of households that will likely need financial support to electrify (as discussed in Section 1). However, best practice policy design will ensure that all households in need are supported to electrify and that each household is upgraded to a minimum quality allowing permanent disconnection from gas. This will support program uptake by households in the target population.

Stakeholders interviewed for this project broadly agreed that for ACT policy to be effective at supporting targeted households in the process of electrifying, programs need to be appropriately targeted, have nuanced eligibility criteria and administrative simplicity, provide sufficient and material support delivered through appropriate channels and mechanisms, and are scalable so they can help everyone in need.

The Better Practice Guide Towards Energy Equity written by GEER Australia, has identified seven better practice principles for designing effective energy hardship policy. These principles, and the core concepts underpinning these principles, were discussed in length by stakeholders interviewed for this project. The seven principles and interview findings are outlined below.

Principle 1: Clearly define the driver or state of energy hardship you are trying to address and develop a policy/program that will have a material impact.

Generally, interviewees had not (and were unable to) quantify the size of the ACT population in need of support to electrify. All interviewees expressed challenges with effectively identifying and targeting households in need. As discussed in Section 1.2, there are currently different ways in which target households who may need support are being identified e.g. 20% of

[17] This information can be requested under the *Electricity Feed-In (Renewable Energy Premium) Act 2008.*

households earning the lowest income in the ACT, households with concession cards etc. Understanding the key attributes of households in need is important to be able to craft an eligibility criterion that includes all vulnerable households (and excludes those who are not).

Defining the target population is important to enable households in need to be identified (i.e. both owner occupiers and renters) and provided with appropriately tailored support that allows these households to prioritise their upgrades and permanently disconnect from gas.

- **Government programs have historically been reluctant to include renters in their electrification programs.** This is due to concerns that landlords will increase rents as a result of a perceived increase in value from electrification upgrades and/or renters losing electrification benefits if they move house. These concerns could be mitigated by implementing mechanisms that prevent landlords raising rents for a period of time following the subsidised upgrades. If the Government is providing direct funding (e.g. grants, low interest loans etc.) or indirect funding (e.g. through EEO schemes), the funding criteria should include conditions that can be explicitly tied to limiting rental increases. In addition, renters losing electrification benefits if they move is challenging, however, it is likely another lower income renter would move in and therefore the benefit is not lost. Also, once all households are electrified this will no longer be an issue. Therefore, whilst there are challenges to supporting rental households to electrify, these households should not be excluded.
- **Prioritising the order of electrifying appliances may help to transition target households sooner.** Some interviews believed the order in which gas appliances are upgraded can impact energy and bill savings. For example, upgrading gas water heating and space heating/cooling appliances can deliver material savings without fully disconnecting a property from gas. In contrast, upgrading a gas stove to an electric stove without fully disconnecting a property from gas does not deliver the same level of savings. However, given the long lifetimes of stoves (often up to 20 years) – not upgrading stoves when they fail could mean locking a household into gas for an extended period.
- **Permanently disconnecting a property from gas is important to ensure electrification benefits are sustained.** There are currently three options to disconnect gas when a household is electrified. These options vary in their level of permanence and cost. These include:
    - Notifying the energy retailer that the household wishes to close their gas account – a disconnection fee is usually charged by the retailer, usually the cost for a final meter reading (~approximately $15). The gas meter remains and subsequently any future resident can reconnect gas appliances.
    - Disconnection of supply by wadding or locking the meter – involves implementing temporary measures to disconnect the gas supply, however the meter remains in place (~approximately $100-$150 [15]). The meter is able to be reconnected to gas appliances in the future.
    - Complete meter removal – the only permanent solution that ensures no future gas appliances can be connected (~approximately $800).

All households that receive Government support to electrify should be required to permanently disconnect from gas. However, with current costs at approximately $800, this would significantly increase the funding required to support target households to electrify (and consequently impact a program's scalability). Given the high cost of a meter removal, a low-cost permanent solution needs to be developed to make it easier for households to permanently disconnect from gas.

All interviewees agreed that the ACT Government has strong community partners that should be leveraged to identify and target households. It was explained that these partners have existing channels and infrastructure through which households in need are identified, and they have an understanding of how to provide the required support.

"How do you pick out the people that really need assistance? The community sector, they deal with them everyday."

"You'd have an identification system and you'd have the people that are scoped to assist them at the other end."

Principle 2: Ensure your policy/program is designed for scalability.

As discussed in Section 1.1, the electrification of households can be complex and expensive. To ensure adequate support for all target households in the ACT, programs need to have funding and delivery models that can provide support at the scale required to electrify all households in the ACT.

Currently, support in the ACT is either low-cost and low impact for many households (e.g., energy assessments, budgeting services, draught proofing etc.), or high-cost and high impact but for a small number of households (e.g., complete electrification for households with chronic health conditions). Some programs in the ACT are providing a relatively high level of financial support to a large number of households to upgrade an appliance, however it is either not enough to upgrade all appliances (and the household therefore remains connected to the gas network) or it requires high upfront costs that cannot be met by the target households. Programs need to provide adequate financial support using an appropriate financing mechanism.

"Electrification is quite complex…all the NGOs we spoke to are like rebates, are just not going to be enough for these people that need more support."

We heard in interviews that a higher level of support is needed for all target households to enable them to permanently disconnect from gas. To provide this level of individual financial support at the scale outlined in Section 1 will require a suite of policy tools tailored to the targeted group (discussed in Section 2.2).

Principle 3: Assess costs and benefits at a whole-of-government level.

Programs that assist target households to electrify and permanently disconnect from the gas network provide significant non-energy related benefits e.g. improves indoor air quality which can provide considerable health benefits. This will reduce future health system costs and should be included in the assessment of program costs and benefits. Assessing costs and benefits at a whole-of-government level may also provide an opportunity for cross-portfolio funding, which may help to expand the scale and impact of the program.

We note that this is more of a backend strategic consideration for the ACT Government and interviewees did not comment on this process.

Principle 4: Improve accessibility by reducing friction and burden for the households you are trying to help.

Interviewees considered accessibility to support to be one of the most important components of the program design. If accessibility barriers are not minimised, programs may be excluding households in need. Interviewees explained that many of the target households face additional barriers, beyond financial.

"It needs to be a very simple process…most vulnerable consumers will require assistance in some ways to do it"

"Some of them don't have the technology to be able to even access [support]. Some of them don't even have an e-mail address, there was one case where someone made someone an e-mail address at a library so they could apply for the interest-free loan…but it was a huge amount of work."

There are several factors that can impact the accessibility of a program. These include nuanced eligibility criteria without administrative complexity, tailored funding mechanisms, and awareness within the targeted cohort.

Eligibility criteria – As discussed in Section 1.2, eligibility criteria that quickly and effectively identifies households in need, remains a challenge. Interviewees conceded that the eligibility criteria used for existing programs lacked nuance and may be inadvertently excluding households within the targeted population.

"Programs that try to help often end up stacking eligibility criteria, like concession cards and home ownership, and inadvertently exclude large numbers of people we are trying to help."

"All of our clients are vulnerable in one way or another…but these groups don't fall into tick boxes that are neat and tidy."

"We need broad eligibility, it's not just concession card holders."

"I had a client who didn't qualify for a concession card by $13…and she's missing out on the utilities hardship fund of $750."

However, they also noted the need for a streamlined eligibility assessment process so as not to add complexity that delays support.

"Finding that balance between having a reasonable eligibility criteria that is fair, but also actually still reaching the people we need to. And it's also balancing that against administrative burden of actually trying to work it out in the first place."

It was determined that eligibility for a program that assists lower income households to electrify should be a function of household income and the number of people in the household. This data currently exists, albeit in different data sources, and consequently would require a work program to combine these sources to identify and verify eligible households. **Evidentiary requirements** – While a nuanced eligibility criteria is imperative to ensure targeted households can access support, the evidentiary requirements can significantly reduce accessibility. To avoid including households that are not in need of support, programs often require evidence that can add administrative complexity. This can lead to unintentionally excluding eligible households. Interviewees suggested working with community partners to provide a concierge service to minimise accessibility barriers. In addition, household privacy should be prioritised as a perceived lack of privacy may deter some households from seeking help.

"I know a few people actually who went to apply for a loan and then decided not to because they had to give Brighte access to their bank account to read their bank account. So they decided not to do that because they felt that was an invasion of their privacy."

"Avoid unnecessarily invading people's personal privacy…be reasonable on what you are asking from people for them to prove their vulnerability."

Funding mechanism – The funding mechanism used can affect accessibility in target cohorts. Different mechanisms suit different cohorts and should be chosen based on the targeted group's needs and capacity to pay. Different funding mechanism options include loans, rebates, grants etc. The mechanism chosen, as well as the design of that mechanism will either increase or decrease accessibility barriers. For example, a rebate may be a suitable mechanism for low-income households, but not if the rebate requires the household to pay upfront costs that are later reimbursed.

Awareness – Interviewees noted a key barrier to accessibility for many of the existing programs was awareness. Many programs aiming to support the electrification of low-income households, both in the ACT and NSW, struggle to get uptake from targeted households. We heard that promotion of the programs should be budgeted for. However, to avoid large marketing expenditure requirements, promotional efforts should be acutely targeted.

Promotional efforts can be effectively targeted by using partners and partner channels to reach households that are likely to be eligible. For example, partners that generally have a good understanding of who their lower income households are, include ActewAGL, banks, and community organisations.

Consumer choice – Provide a level of flexibility and choice when it comes to deciding which appliances and products to upgrade to. Consumer choice is necessary to avoid adding friction and more barriers to demand. For example, replacing a ducted heating/cooling system with an individual split system in the living room may not be appropriate for someone with a chronic health condition who needs to heat the entire house. It is also important to provide choice to allow for nuance in individual circumstances. For example, instead of offering an induction stove to everyone, which can have additional costs e.g. new pots and pans, offer a ceramic stove with the option to upgrade to an induction stove.

Removing accessibility barriers does not guarantee that target households will participate in ACT programs. All aspects of program design will need to be tailored to target households. Consider additional market research into the framing, technologies, funding mechanisms and evidentiary requirements that resonate with target households.

Principle 5: Use inclusive framing in all of your policy/program communications.

Poorly chosen language risks stigmatising the targeted population or raising feelings of shame, guilt and/or embarrassment. This may deter targeted households from seeking support. This can be particularly true of those who are reluctant to access support or who are facing vulnerability to, but are not in, direct hardship.

"Some people think 'this is for poor people, not for me' [when thinking about support from St. Vincents]"

Interviewees did not raise any issues with the ACT's framing in general. Previous research indicates that the ACT actively considers framing – the Home Energy Support Program was originally named the Solar for Low-Income Households program. This was changed after finding that the language of the original name risked excluding people who would benefit from the program [16].

Principle 6: Be aware of your strategic context.

Electrification in the target households is a complex problem that likely needs to be addressed by a suite of complementary policies and programs. Understanding which part of the problem each program is best placed to solve allows for effective policy design that complements broader strategic policy goals and existing policies and programs. Not aligning programs with broader strategic goals around energy hardship, electrification, and existing policies and programs, risks efforts becoming fragmented or duplicated.

Principle 7: Incorporate your evaluation approach into the design of your policy/program.

Identifying the key indicators of success as early as possible in the policy design or reform process, will enable an effective evaluation plan, data monitoring and collection plan to be developed. This will help specify how each indicator will be assessed and what data will be required. Ensure measurement and verification processes are in place from the beginning and continuously collect data that proves the impacts of the program. If an evaluation approach is not designed early, there is a risk of not being able to credibly evaluate the success of the program, which may lead to its dissolution. Real-time data collection also allows for real-time monitoring of outcomes, enabling an iterative approach to policy implementation.

Applying these seven principles to reform existing or design new policy will support more effective policy for electrifying target households. However, given the significant cost of electrifying target households, where the funding will come from is an important consideration to ensure scalability. The funding source needs to be balanced with the appropriateness of the funding mechanism which should be based on the target group's needs and capacity to pay (as discussed in Section 2.1 above.

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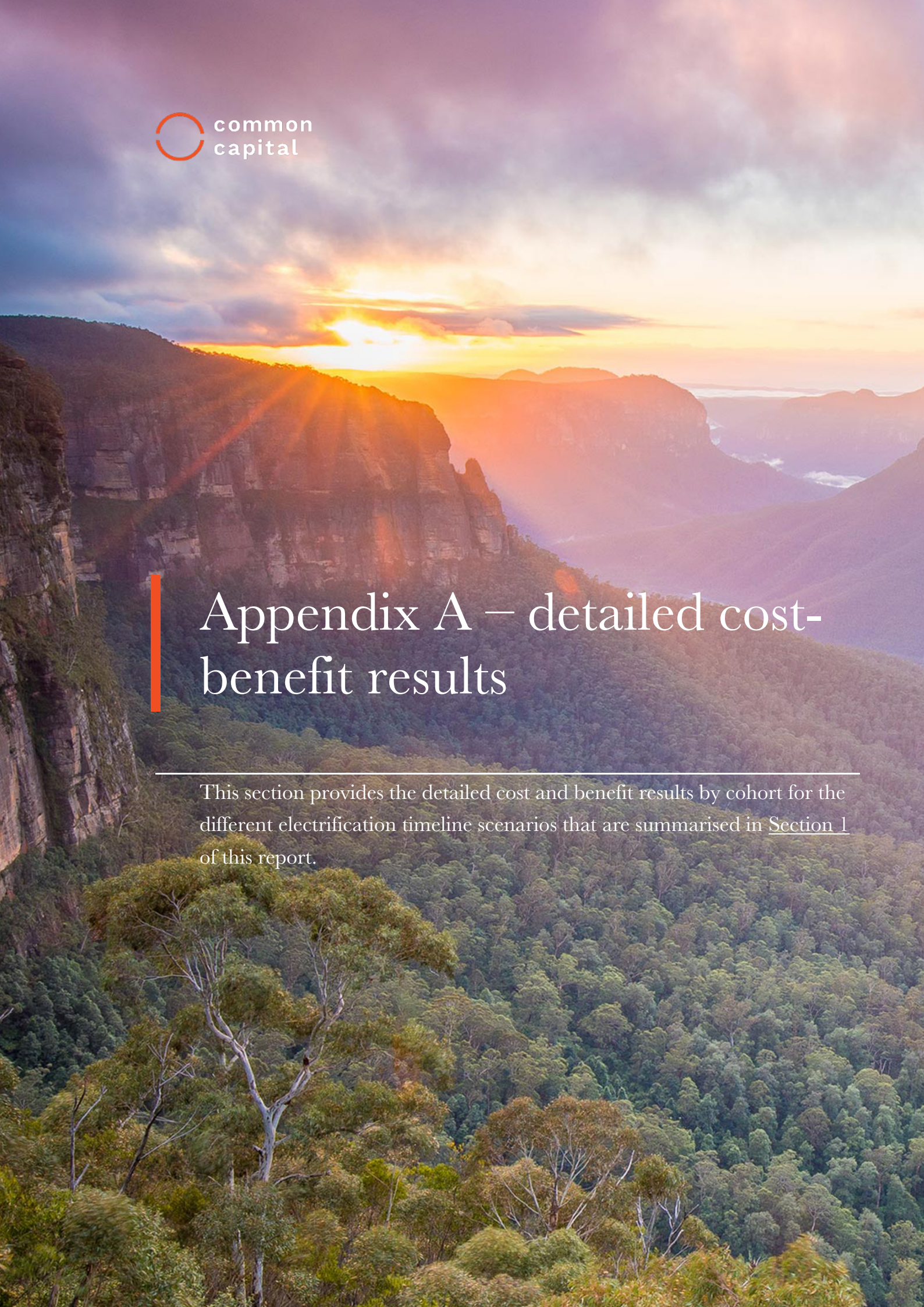

Appendix A – detailed cost-benefit results

This section provides the detailed cost and benefit results by cohort for the different electrification timeline scenarios that are summarised in Section 1 of this report.

Table 6: Costs and benefits for bottom 20% income cohort to upgrade now with solar (AUD$, net present value terms)

Economic impact component	BAU	Scenario	Scenario relative to BAU
Capital cost of initial mass electrification	$67,073,915	$394,284,203	$327,210,288
Total BAU end-of-life replacement and baseline electrification costs	$159,801,480	$123,130,768	-$36,670,712
Household energy bills	$666,576,985	$191,103,145	$475,473,840
Net participant benefit	-	-	$512,144,552
Societal net benefit	-	-	$344,034,704
Societal benefit to cost ratio	-	-	1.6
Cost of carbon emissions (@ $50 per tonne)	$21,142,786	$4,318,370	$16,824,416

Table 7: Costs and benefits for bottom 20% income cohort to upgrade now without solar (AUD$, net present value terms)

Economic impact component	BAU	Scenario	Scenario relative to BAU
Capital cost of initial mass electrification (NPV)	$67,073,915	$221,125,169	$154,051,254
Total BAU end-of-life replacement and baseline electrification costs (NPV)	$159,801,480	$123,130,768	-$36,670,712
Household energy bills	$666,576,985	$318,794,415	$347,782,570
Net participant benefit	-	-	$384,453,281
Societal net benefit	-	-	$193,731,316
Societal benefit to cost ratio	-	-	3.0
Cost of carbon emissions (@ $50 per tonne)	$21,142,786	$4,318,370	$16,824,416

Table 8: Costs and benefits for bottom 20% income cohort to upgrade at end of life with solar (AUD$, net present value terms)

Economic impact component	BAU	Scenario	Scenario relative to BAU
Capital cost of initial mass electrification (NPV)	$67,073,915	$328,509,953	$261,436,039
Total BAU end-of-life replacement and baseline electrification costs (NPV)	$159,801,480	$96,144,899	-$63,656,580
Household energy bills	$666,576,985	$327,222,912	$339,354,073
Net participant benefit	-	-	$403,010,653
Societal net benefit	-	-	$77,918,034
Societal benefit to cost ratio	-	-	1.7
Cost of carbon emissions (@ $50 per tonne)	$21,142,786	$9,944,319	$11,198,467

Table 9: Costs and benefits for bottom 20% income cohort to upgrade at end of life without solar (AUD$, net present value terms)

Economic impact component	BAU	Scenario	Scenario relative to BAU
Capital cost of initial mass electrification (NPV)	$67,073,915	$184,237,203	$117,163,289
Total BAU end-of-life replacement and baseline electrification costs (NPV)	$159,801,480	$96,144,899	-$63,656,580
Household energy bills	$666,576,985	$414,819,207	$251,757,778
Net participant benefit	-	-	$315,414,359
Societal net benefit	-	-	$134,594,490
Societal benefit to cost ratio	-	-	4.7
Cost of carbon emissions (@ $50 per tonne)	$21,142,786	$9,944,319	$11,198,467

Table 10: Costs and benefits for lowest 2.5 percentile cohort to upgrade now with solar (AUD$, net present value terms)

Economic impact component	BAU	Scenario	Scenario relative to BAU
Capital cost of initial mass electrification (NPV)	$8,384,239	$49,285,525	$40,901,286
Total BAU end-of-life replacement and baseline electrification costs (NPV)	$20,003,068	$15,391,346	-$4,611,722
Household energy bills	$83,322,123	$23,887,893	$59,434,230
Net participant benefit	-	-	$64,045,952
Societal net benefit	-	-	$18,532,944
Societal benefit to cost ratio	-	-	1.6
Cost of carbon emissions (@ $50 per tonne)	$2,642,848	$539,796	$2,103,052

Table 11: Costs and benefits for lowest 2.5 percentile cohort to upgrade now without solar (AUD$, net present value terms)

Economic impact component	BAU	Scenario	Scenario relative to BAU
Capital cost of initial mass electrification (NPV)	$8,384,239	$27,640,646	$19,256,407
Total BAU end-of-life replacement and baseline electrification costs (NPV)	$20,003,068	$15,391,346	$1,166,380
Household energy bills	$83,322,123	$39,849,302	$43,472,821
Net participant benefit	-	-	$48,084,544
Societal net benefit	-	-	$24,216,414
Societal benefit to cost ratio	-	-	3.0
Cost of carbon emissions (@ $50 per tonne)	$2,642,848	$539,796	$2,103,052

Table 12: Costs and benefits for lowest 2.5 percentile cohort to upgrade at end of life with solar (AUD$, net present value terms)

Economic impact component	BAU	Scenario	Scenario relative to BAU
Capital cost of initial mass electrification (NPV)	$8,384,239	$41,063,744	$32,679,505
Total BAU end-of-life replacement and baseline electrification costs (NPV)	$20,003,068	$12,018,112	-$7,984,956
Household energy bills	$83,322,123	$40,902,864	$42,419,259
Net participant benefit	-	-	$50,404,215
Societal net benefit	-	-	$9,739,754
Societal benefit to cost ratio	-	-	1.7
Cost of carbon emissions (@ $50 per tonne)	$2,642,848	$1,243,040	$1,399,808

Table 13: Costs and benefits for lowest 2.5 percentile cohort to upgrade at end of life without solar (AUD$, net present value terms)

Economic impact component	BAU	Scenario	Scenario relative to BAU
Capital cost of initial mass electrification (NPV)	$8,384,239	$23,029,650	$14,645,411
Total BAU end-of-life replacement and baseline electrification costs (NPV)	$20,003,068	$12,018,112	-$7,984,956
Household energy bills	$83,322,123	$51,852,401	$31,469,722
Net participant benefit	-	-	$39,454,678
Net public benefit	-	-	$16,045,219
Total net benefit	-	-	$16,824,311
Societal benefit to cost ratio	-	-	4.7
Cost of carbon emissions (@ $50 per tonne)	$2,642,848	$1,243,040	$1,399,808

End-of-life scenario costs and benefits, compared with BAU

As shown in Figure 8 below, under the End-of-life scenario the energy bill costs are lower than experienced under the BAU scenario, however the appliance replacement costs are higher. In addition, the sum of both costs under the End-of-life scenario are smaller than under BAU. We can also see that the increase in energy bill costs is greater than the increase in appliance replacement costs, under BAU (represented by a steeper curve). This is compared with Figure 9 which shows the net benefit of the End-of-life scenario compared to BAU – in this graph we can see that the increase in appliance replacement costs is almost completely offset by the energy bill savings.

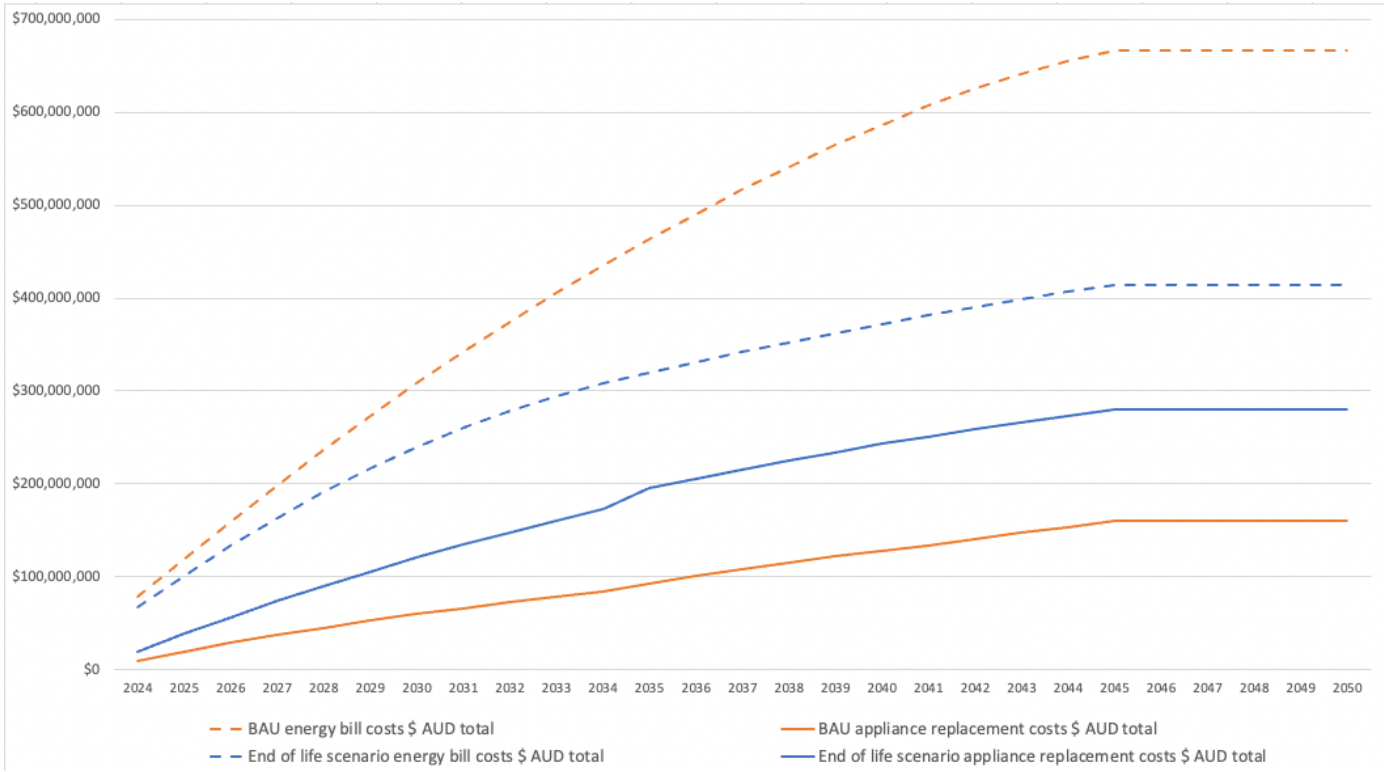

Figure 8: Total costs (energy bill and appliance replacement) under BAU and the End-of-life scenario

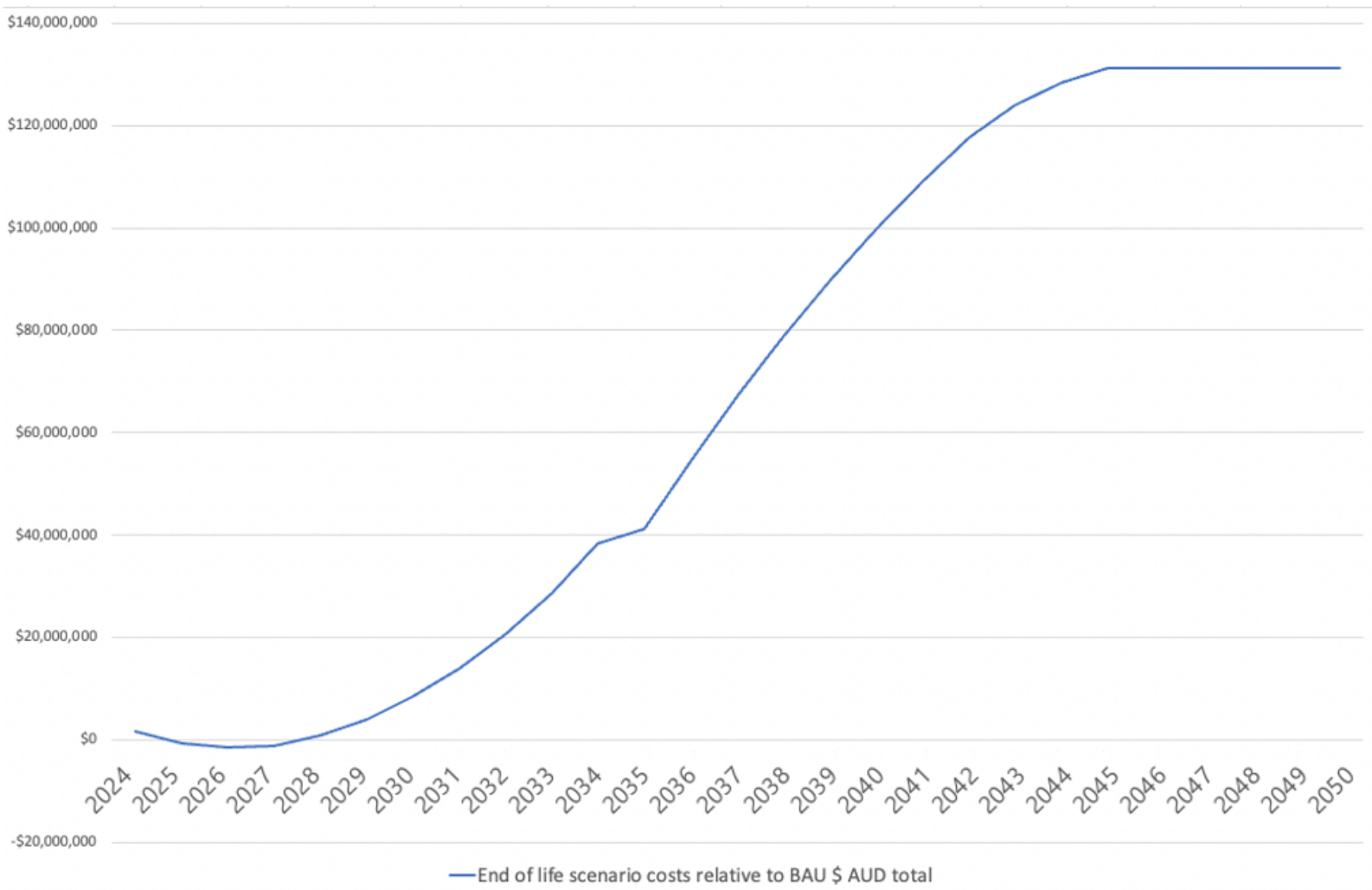

Figure 9: Net benefit (bill and CAPEX savings) of the End-of-life scenario, relative to BAU

Upgrade now scenario costs and benefits compared with BAU

As shown in Figure 10 below, energy bill costs are lower than the appliance costs under the Upgrade now scenario. Under the BAU scenario, energy bill costs are much higher than the appliance replacement costs. Like the End-of-life scenario, the energy bill costs are overall lower and the appliance costs are higher under the Upgrade now scenario, compared with the BAU scenario. Figure 11 shows that whilst there is an initial negative net benefit under the Upgrade now scenario, there is a positive net benefit after 2030. Under the End-of-life scenario, net benefits peak at approximately $130 million in 2045, this is compared to the Upgrade now scenario which peaks at approximately $160 million in 2045.

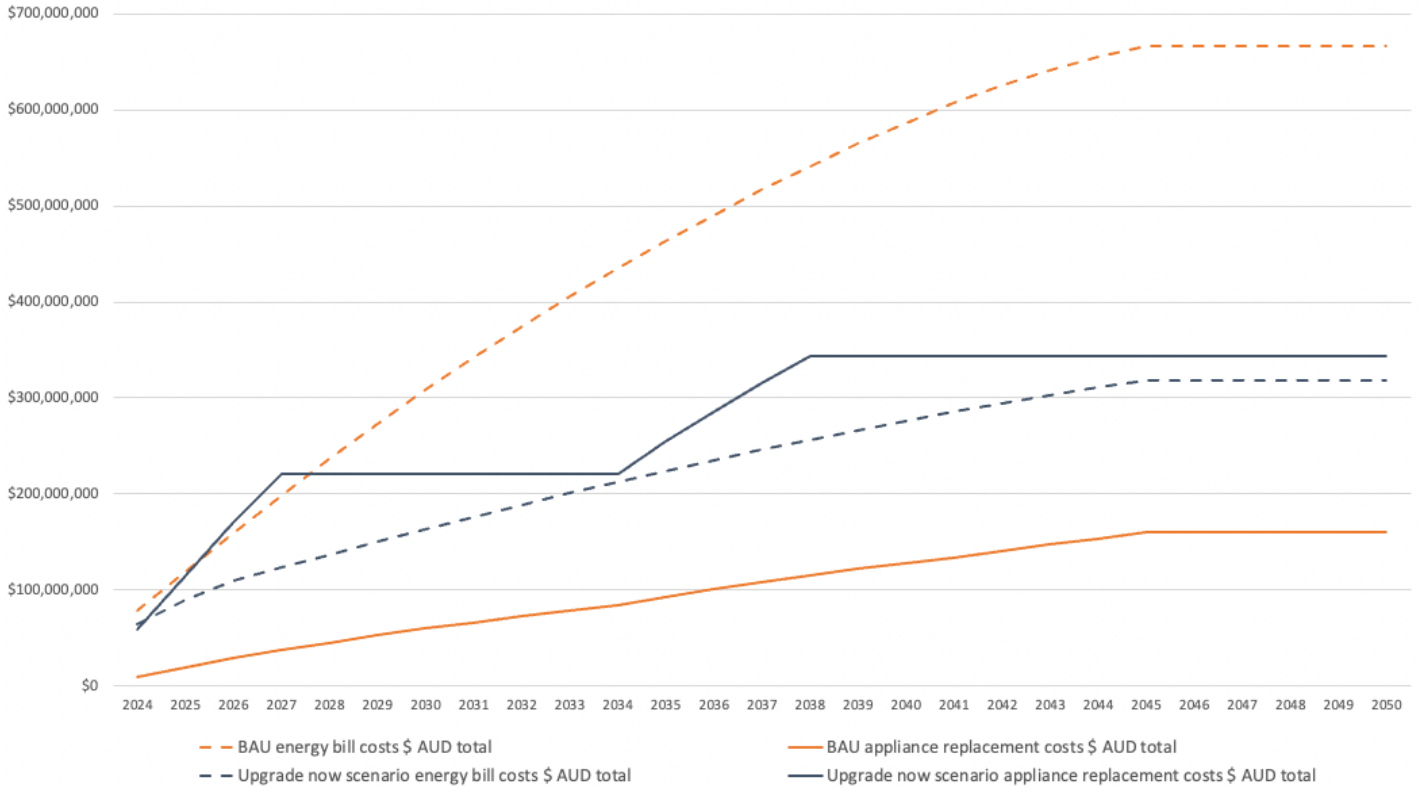

Figure 10: Total costs (energy bill and appliance replacement) under BAU and the Upgrade Now scenario

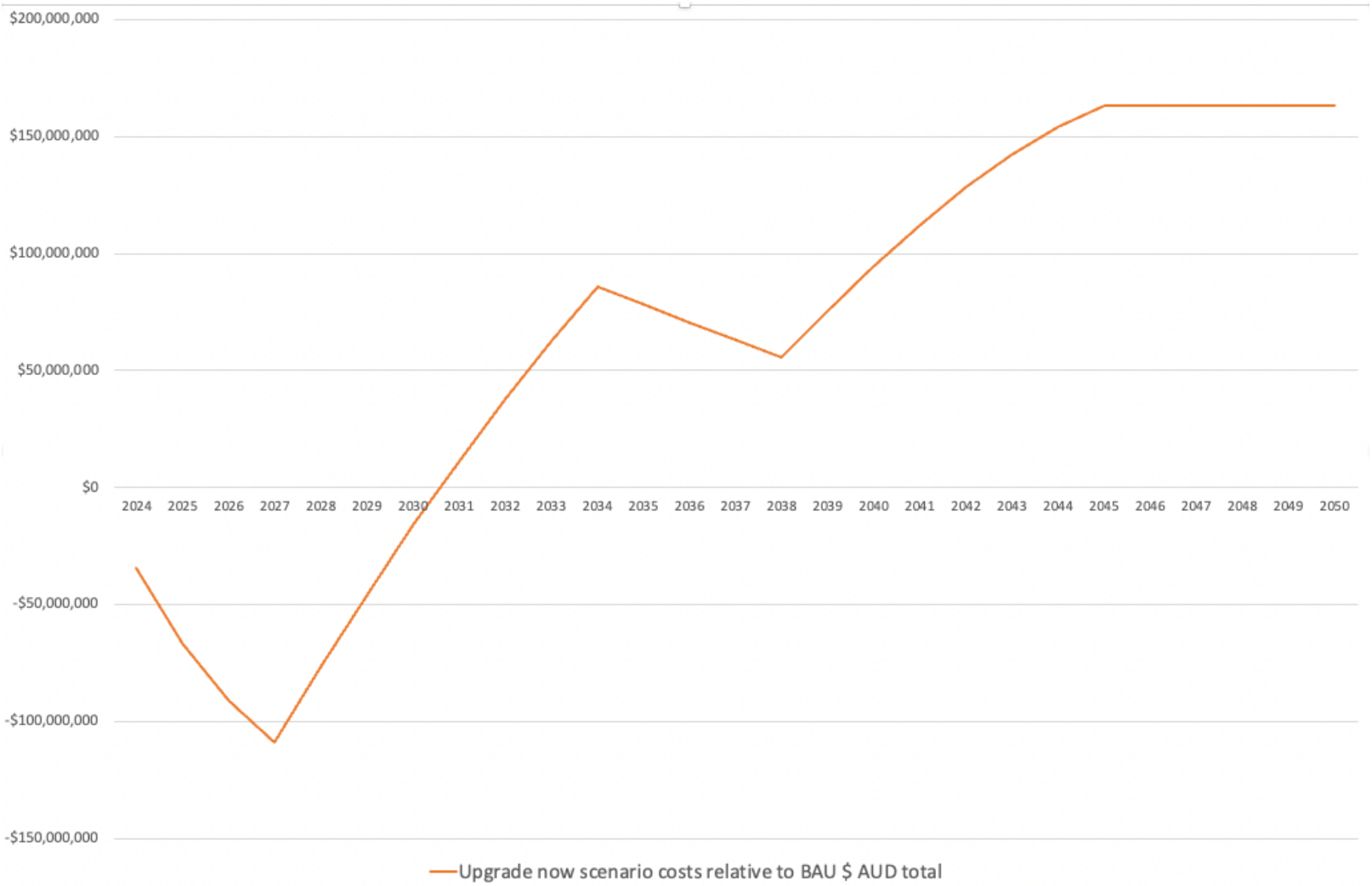

Figure 11: Net benefit (bill and CAPEX savings) of the Upgrade now scenario, relative to BAU

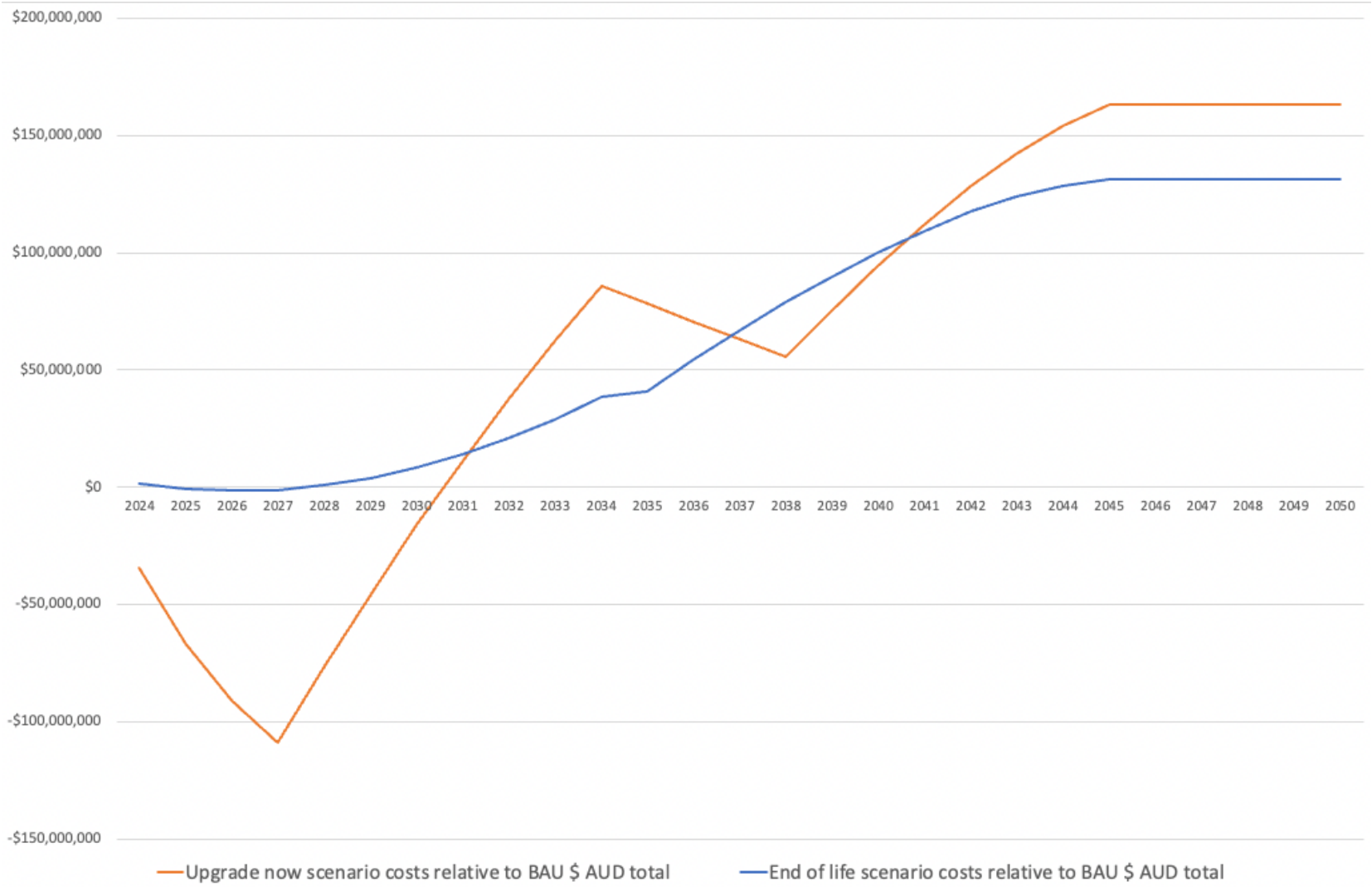

Figure 12: Net benefit (bill and CAPEX savings) of both scenarios (End of life and Upgrade Now) relative to BAU

common capital

Appendix B: data sources and modelling assumptions

This section outlines the detailed data sources and modelling assumptions used in this project.

Cross-sectional data

Table 14: Electricity typical use in residential dwellings in 2021

End use appliance	Unit	Data	Source	Reference	Assumption/ rationale	Notes
Hot water	kWh/ dwelling	597.3	2021 Residential Baseline Study for Australia and NZ for 2000 - 2040 (RBS 2021)	2021 RBS_OutputTablesV1.9.2-AU. Found at: https://www.energyrating.gov.au/industry-information/publications/report-2021-residential-baseline-study-australia-and-new-zealand-2000-2040	Total cooking consumption in ACT is quoted as 0.42 PJ. We have converted to kWh using a standard conversion factor of 2.778e+8, and then divided that by the total number of dwelling stock numbers in the ACT.	Note that unlike for commercial and SME sectors, figures are given as total averages per home (not per sqr m).
Space heating	kWh/ dwelling	2,330.4	2021 Residential Baseline Study for Australia and NZ for 2000 - 2040 (RBS 2021)	2021 RBS_OutputTablesV1.9.2-AU. Found at: https://www.energyrating.gov.au/industry-information/publications/report-2021-residential-baseline-study-australia-and-new-zealand-2000-2040	Total cooking consumption in ACT is quoted as 1.56 PJ. We have converted to kWh using a standard conversion factor of 2.778e+8, and then divided that by the total number of dwelling stock numbers in the ACT.	Note that unlike for commercial and SME sectors, figures are given as total averages per home (not per sqr m).
Cooking	kWh/ dwelling	448.0	2021 Residential Baseline Study for Australia and NZ for 2000 - 2040 (RBS 2021)	2021 RBS_OutputTablesV1.9.2-AU. Found at: https://www.energyrating.gov.au/industry-information/publications/report-2021-residential-baseline-study-australia-and-new-zealand-2000-2040	Total cooking consumption in ACT is quoted as 0.28 PJ. We have converted to kWh using a standard conversion factor of 2.778e+8, and then divided that by the total number of dwelling stock numbers in the ACT.	Note that unlike for commercial and SME sectors, figures are given as total averages per home (not per sqr m).

End use appliance	Unit	Data	Source	Reference	Assumption/ rationale	Notes
Per total building	MWh/ dwelling	6.0230	2021 Residential Baseline Study for Australia and NZ for 2000 - 2040 (RBS 2021)	2021 RBS_OutputTablesV1.9.2-AU. Found at: https://www.energyrating.gov.au/industry-information/publications/report-2021-residential-baseline-study-australia-and-new-zealand-2000-2040	Dwelling numbers are from RBS data for ACT total occupied and unoccupied dwellings in 2023. We have divided total sector electricity consumption by total number of dwellings to get per building total. Dwelling number = 186005.86	This methodology will result in the average consumption per household

Table 15: Gas typical use in residential dwellings in 2021

End use appliance	Unit	Data	Source	Reference	Assumption/ rationale	Notes
Hot water	MJ/ dwelling	6,743	2021 Residential Baseline Study for Australia and NZ for 2000 - 2040 (RBS 2021)	2021 RBS_OutputTablesV1.9.2-AU. https://www.energyrating.gov.au/industry-information/publications/report-2021-residential-baseline-study-australia-and-new-zealand-2000-2040	Total hot water consumption in ACT is quoted as 1.25 PJ. We have converted to MJ using a standard conversion factor of 1e+9, and then divided that by the total number of dwelling stock numbers ACT.	Note that unlike for commercial and SME sectors, figures are given as total averages per home (not per sqr m).

End use appliance	Unit	Data	Source	Reference	Assumption/ rationale	Notes
Space heating	MJ/ dwelling	21,850	2021 Residential Baseline Study for Australia and NZ for 2000 - 2040 (RBS 2021)	2021 RBS_OutputTablesV1.9.2-AU. https://www.energyrating.gov.au/industry-information/publications/report-2021-residential-baseline-study-australia-and-new-zealand-2000-2040	Total space heating consumption in ACT is quoted as 4.06 PJ. We have converted to MJ using a standard conversion factor of 1e+9, and then divded that by the total number of dwelling stock numbers ACT.	Note that unlike for commercial and SME sectors, figures are given as total averages per home (not per sqr m).
Cooking	MJ/ dwelling	522	2021 Residential Baseline Study for Australia and NZ for 2000 - 2040 (RBS 2021)	2021 RBS_OutputTablesV1.9.2-AU. https://www.energyrating.gov.au/industry-information/publications/report-2021-residential-baseline-study-australia-and-new-zealand-2000-2040	Total cooking consumption in Act is quoted as 0.097 PJ. We have converted to MJ using a standard conversion factor of 1e+9, and then divided that by the total number of dwelling stock numbers ACT.	Note that unlike for commercial and SME sectors, figures are given as total averages per home (not per sqr m).
Per total building	MJ/ dwelling	29,224	2021 Residential Baseline Study for Australia and NZ for 2000 - 2040 (RBS 2021)	2021 RBS_OutputTablesV1.9.2-AU. https://www.energyrating.gov.au/industry-information/publications/report-2021-residential-baseline-study-australia-and-new-zealand-2000-2040	Dwelling numbers are from RBS data for ACT total occupied and unoccupied dwelling in 2023. We have divided total sector gas consumption by total number of dwellings to get per building total gas consumption. Dwelling number = 186005.86	This methodology will result in the average consumption per household
Total residential sector	MJ	5,435,755,952	2021 Residential Baseline Study for Australia and NZ for	2021 RBS_OutputTablesV1.9.2-AU. https://www.energyrating.gov.au/industry-information/publications/report-	Figure from ACT 2023, natural gas. Figure quoted as 5.44 PJ. We have converted to MJ using a standard conversion factor of 1e+9	

End use appliance	Unit	Data	Source	Reference	Assumption/ rationale	Notes
			2000 - 2040 (RBS 2021)	2021-residential-baseline-study-australia-and-new-zealand-2000-2040		

Table 16: ACT economy characteristics

Characteristic	Unit	Data	Year	Update frequency	Source	Reference
Household Expenditure - weekly (ACT)	$ AUD/ household	$1,670	2015-2016	6-yearly	Cost Benefits Assumptions Guide - ACT	ABS Household Expenditure Survey, Australia: Summary of Results

Characteristic	Unit	Data	Year	Update frequency	Source	Reference
Gross household disposable income per capita, in nominal terms (ACT)	$ AUD	$96,350	2020-2021	annually	Cost Benefits Assumptions Guide - ACT	ABS Australian National Accounts: State Accounts Key National Accounts aggregates by state and territory ACT data: Table 19 (from Data download)
Full-Time Adult Average Weekly Ordinary Time Earnings (AWOTE) (ACT)	$ AUD	$1,910.30	May-2021	bi-annually	Cost Benefits Assumptions Guide - ACT	ABS Average Weekly Earnings, Australia, Table 12H

Table 17: ACT employment data

Characteristic	Unit	Data	Year	Update frequency	Source	Reference
Employed persons	#Number	221,023	Oct-2021	monthly	Cost Benefits Assumptions Guide - ACT	ABS Labour Force, Australia ACT data: Table 11 and Table 11a

Characteristic	Unit	Data	Year	Update frequency	Source	Reference
Unemployed persons	#Number	15,514	Nov-2021	monthly	Cost Benefits Assumptions Guide - ACT	ABS Labour Force, Australia ACT data: Table 11 and Table 11a
Unemployment rate	%	6.6%	Dec-2021	monthly	Cost Benefits Assumptions Guide - ACT	ABS Labour Force, Australia ACT data: Table 11 and Table 11a
Office vacancy rates (Canberra)	%	7.7%	Jul-2021	6 monthly	Cost Benefits Assumptions Guide - ACT	August 2021: ACT Office Market Report 2021
Retail Trade (ACT)		$646,000,000	Oct-2022	monthly	Cost Benefits Assumptions Guide - ACT	ABS Retail Trade, Australia
Wage Price Index (Annual Growth) (ACT)	%	2.7%	Sept-2021 - sept-2022	quarterly	Cost Benefits Assumptions Guide - ACT	ABS Wage Price Index, Australia; Calculated based on data in Table 2b.

Table 18: Capital cost of residential appliance replacement ($AUD)

Appliance	Cost	Source	Reference	Assumption/rationale
Cooking - electric	$3,027	Plan - Canberra is electrifying, ACT Government	https://energy.act.gov.au/plan/	This is an average cost of replacement + the installation price (of $277). Figure for a 4-person household
Cooking - gas	$1,927	Choice: What to know before you buy a gas cooktop	https://www.choice.com.au/home-and-living/kitchen/cooktops/buying-guides/gas-cooktops	This is an average cost of replacement + the installation price (of $277).
Space heating/ cooling - electric	$2,450	Plan - Canberra is electrifying, ACT Government	https://energy.act.gov.au/plan/	This is an average cost of replacement + the installation price (of $550). Figure for a 4-person household
Space heating/ cooling - gas	$2,250	Choice: How to buy the best gas heater	https://www.choice.com.au/home-and-living/heating/gas-heaters/buying-guides/gas-heaters	This is an average cost of replacement + the installation price (of $550).
Water heating - electric	$1,800	Everyday climate choices: A guide to hot water and heat pumps - ACT Government	https://www.climatechoices.act.gov.au/policy-programs/sustainable-household-scheme/buyers-guides/singing-in-the-shower-a-guide-to-hot-water-heat-pumps	Exact numbers as shown in source.

Appliance	Cost	Source	Reference	Assumption/rationale
Water heating - heat pump	$5,500	Everyday climate choices: A guide to hot water and heat pumps - ACT Government	https://www.climatechoices.act.gov.au/policy-programs/sustainable-household-scheme/buyers-guides/singing-in-the-shower-a-guide-to-hot-water-heat-pumps	Exact numbers as shown in source
Water heating - gas	$1,800	Everyday climate choices: A guide to hot water and heat pumps - ACT Government	https://www.climatechoices.act.gov.au/policy-programs/sustainable-household-scheme/buyers-guides/singing-in-the-shower-a-guide-to-hot-water-heat-pumps	Exact numbers as shown in source

Table 19: Solar PV data

Solar datapoint	Unit	Data	Source	Reference	Assumption/rationale
Average number of solar panels per house	Number	15	Solar Choice - Energy production from solar panels Canberra	https://www.solarchoice.net.au/blog/solar-power-canberra-act/#:~:text=The%20amount%20of%20solar%20panels,depending%20on%20their%20watt%20rating.	Assumption: Panels are free of shading and oriented North at 30 degrees. Solar panel system efficiency is 75% (which is a conservative assumption).

Solar datapoint	Unit	Data	Source	Reference	Assumption/rationale
Average solar PV system output (annual)	kWh	6,570	Solar Choice - Energy production from solar panels Canberra	https://www.solarchoice.net.au/blog/solar-power-canberra-act/#:~:text=The%20amount%20of%20solar%20panels,depending%20on%20their%20watt%20rating.	Assumption: Panels are free of shading and oriented North at 30 degrees. Solar panel system efficiency is 75% (which is a conservative assumption).
Average system size of home solar PV	kW	5	Solar Choice - Energy production from solar panels Canberra	https://www.solarchoice.net.au/blog/solar-power-canberra-act/#:~:text=The%20amount%20of%20solar%20panels,depending%20on%20their%20watt%20rating.	Assumption: Panels are free of shading and oriented North at 30 degrees. Solar panel system efficiency is 75% (which is a conservative assumption).
Average cost of home Solar PV system	$	4,970	Solar Choice - how much do Solar Panels cost? (October 2023)	https://www.solarchoice.net.au/solar-panels/solar-power-system-prices/	Price is for ACT and a 5kW system.
Feed-in tariff price	c/kWh	7	Solar Choice - Indicative Returns for solar panels Canberra - Last updated July 2023	https://www.solarchoice.net.au/blog/solar-power-canberra-act/#:~:text=The%20amount%20of%20solar%20panels,depending%20on%20their%20watt%20rating.	
Average household consumption	%	40	Solar Choice - Indicative Returns for solar panels Canberra - Last updated July 2024	https://www.solarchoice.net.au/blog/solar-power-canberra-act/#:~:text=The%20amount%20of%20solar%20panels,depending%20on%20their%20watt%20rating.	

Solar datapoint	Unit	Data	Source	Reference	Assumption/rationale
Average returns from feed-in tariff (annual)	$	990	Solar Choice - Indicative Returns for solar panels Canberra - Last updated July 2025	https://www.solarchoice.net.au/blog/solar-power-canberra-act/#:~:text=The%20amount%20of%20solar%20panels,depending%20on%20their%20watt%20rating.	Assumes a 7c/kwh tariff (which has been trending downwards)

Table 20: ACT Housing tenure data

Solar datapoint	Data	Source
Owned outright	45,167	2021 census data: TENLLD Tenure and Landlord Type by STATE (EN) Australian Capital Territory
Owned with a mortgage	68,028	2021 census data: TENLLD Tenure and Landlord Type by STATE (EN) Australian Capital Territory
Rented: Real estate agent	29,035	2021 census data: TENLLD Tenure and Landlord Type by STATE (EN) Australian Capital Territory
Rented: State or territory housing authority	8,655	2021 census data: TENLLD Tenure and Landlord Type by STATE (EN) Australian Capital Territory

Solar datapoint	Data	Source
Rented: Person not in same household	10,793	2021 census data: TENLLD Tenure and Landlord Type by STATE (EN) Australian Capital Territory
Rented: Community housing provider	1,027	2021 census data: TENLLD Tenure and Landlord Type by STATE (EN) Australian Capital Territory
Rented: Other landlord type	2,848	2021 census data: TENLLD Tenure and Landlord Type by STATE (EN) Australian Capital Territory
Rented: Landlord type not stated	213	2021 census data: TENLLD Tenure and Landlord Type by STATE (EN) Australian Capital Territory
Tenure type not stated	6,414	2021 census data: TENLLD Tenure and Landlord Type by STATE (EN) Australian Capital Territory
Other tenure type	2,790	2021 census data: TENLLD Tenure and Landlord Type by STATE (EN) Australian Capital Territory
Tenure type not applicable	12,183	2021 census data: TENLLD Tenure and Landlord Type by STATE (EN) Australian Capital Territory
Total	**187,153**	2021 census data: TENLLD Tenure and Landlord Type by STATE (EN) Australian Capital Territory
Owned total	113195	
Rented total	52571	

Solar datapoint	Data	Source
Other / not reported total	21387	

Time series data

Table 21: Electricity price forecast (c/kWh) (Excel file "CCEEW Retail electricity prices from NCC DRIS 5 Sept 22.xlxb" given in the DCCEEW data.)[18]

Year	Electricity price forecast
2023	27.31
2024	24.62
2025	24.31
2026	24.1
2027	25.54
2028	24.34
2029	25.67
2030	25.67
2031	27.75
2032	28.66
2033	28.78
2034	29.14
2036	30.14

[18] Energy prices are volatile and particularly so as at September 2023. As result, we find that attempting to model them beyond the next year may lead to perverse outcomes. We suggest that energy price forecasts be updated at the time of creation for each business case as these forecasts will likely change. For today's prices, check energy retailers comparisons websites. For short-term prices check AEMO or AER (next 3 years). For medium term check the wholesale energy price forecast for NSW or ACT (5 years). For long-term prices, use this report or use trend lines to predict these prices based on the difference between retail and whole sale prices today versus those in 5 year's time.

Year	Electricity price forecast
2037	30.62
2038	31.11
2039	31.59
2040	32.08
2041	32.56
2042	32.56
2043	32.56
2044	32.56
2045	32.56
2046	32.56
2047	32.56
2048	32.56
2049	32.56
2050	32.56

Table 22: Gas price forecast (c/MJ) (Source: DPIE - fuel price forecasts and network LRMCs[19])[20]

2023	7.16
2024	8.17
2025	8.85
2026	9.41
2027	9.82
2028	10.03
2029	10.26
2030	10.5
2031	10.75
2032	10.98
2033	11.18
2034	11.35
2036	11.5
2037	11.61

[19] DPIE source uses: Policy calculation using Aurora commodity price forecast (DOC20/452165) from 2019
[20] We have used figures from the DPIE report referenced. Then, we have converted the DPIE figures quoted in GJ to MJ using the standard conversion rate of 3.6.

2038	11.68
2039	11.74
2040	11.8
2041	11.86
2042	11.89
2043	-
2044	-
2045	-
2046	-
2047	-
2048	-
2049	-
2050	-

Table 23: ACT residential appliance stock by end use (Source: Residential Baseline Study for Australia and New Zealand, 2000- 2040 (2021)[21]

Year	Cooking	Space heating/cooling	Water heating
2023	452,780	713,063	180,426
2024	461,517	719,857	184,491

[21] 2021 RBS_OutputTablesV1.9.2-AU.xls. Found at: https://www.energyrating.gov.au/industry-information/publications/report-2021-residential-baseline-study-australia-and-new-zealand-2000-2040

Year	Cooking	Space heating/cooling	Water heating
2025	470,255	726,468	188,499
2026	478,902	732,652	192,432
2027	487,303	738,302	196,316
2028	495,662	743,627	200,110
2029	503,922	748,617	203,824
2030	512,055	753,884	207,416
2031	520,099	759,459	210,888
2032	528,027	765,226	214,220
2033	535,868	771,118	217,431
2034	543,623	777,190	220,566
2036	551,304	783,278	223,642
2037	558,936	789,652	226,678
2038	566,527	796,311	229,685
2039	574,085	803,163	232,690
2040	581,625	810,104	235,697
2041	-	-	-
2042	-	-	-
2043	-	-	-

Year	Cooking	Space heating/cooling	Water heating
2044	-	-	-
2045	-	-	-
2046	-	-	-
2047	-	-	-
2048	-	-	-
2049	-	-	-
2050	-	-	-

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SECTION 4

Appendix C – total number of gas accounts in the ACT

Who is Vulnerable – Who Can We Reach in IEP1?

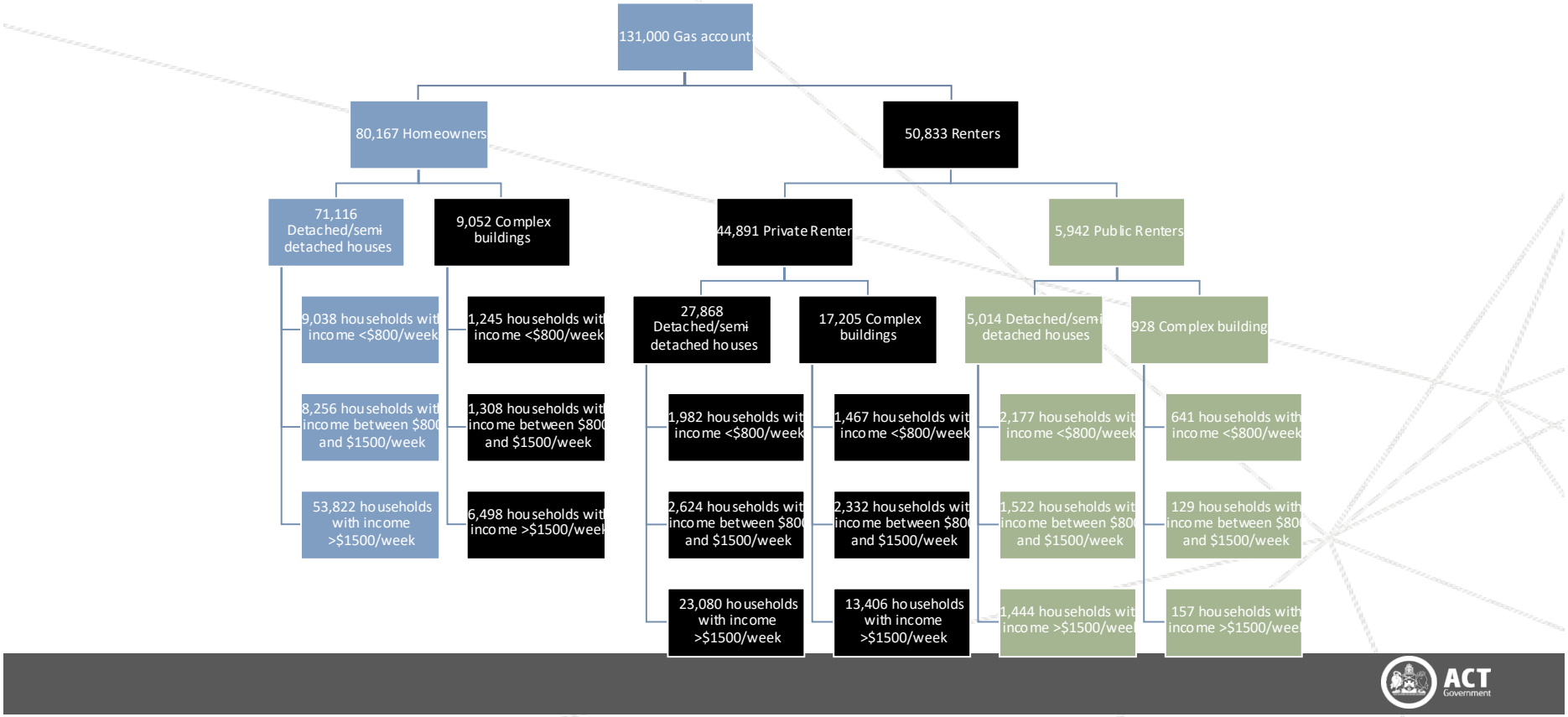
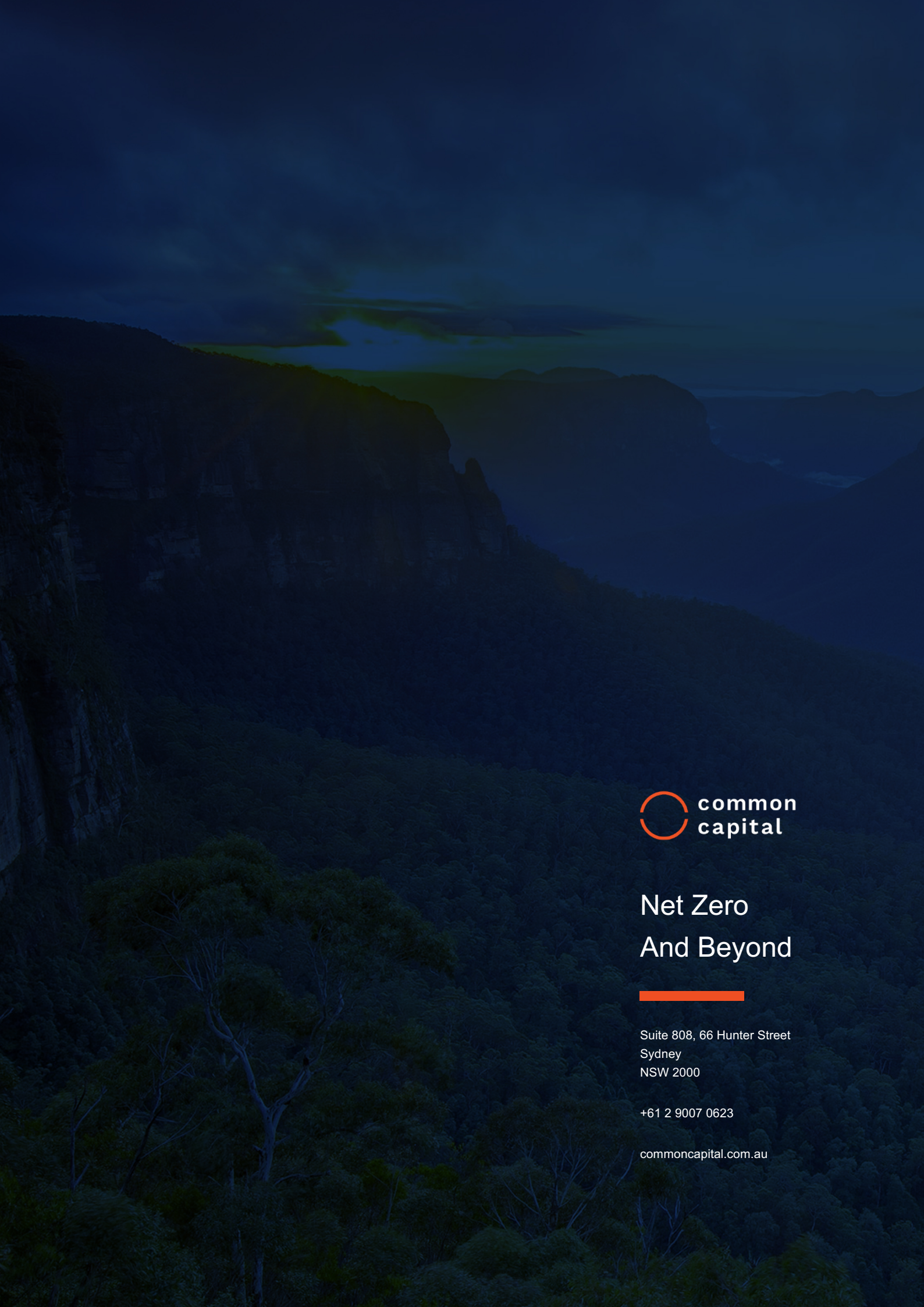


Figure 13: Total number of gas accounts in the ACT, split by occupancy type and income (based on ABS data)



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