NO NEW GAS CONNECTIONS

REGULATORY IMPACT ASSESSMENT

[Department Name: ENVIRONMENT, PLANNING AND SUSTAINABLE DEVELOPMENT DIRECTORATE]

[October 2023]

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1 Executive Summary

The Climate Change Strategy 2019-2045 includes an action to develop a plan for achieving zero emissions from gas use by 2045. As part of this plan, the ACT Government is planning to prohibit new gas connections in prescribed circumstances by introducing regulation. This approach aims to address the current challenge where over 80% of new homes and buildings are connecting to the gas network. By taking action now, the government seeks to avoid exacerbating the issue with new gas connections and ensure a smoother transition as existing homes and buildings gradually reduce their gas consumption. This proactive approach helps prevent potential future complications and builds a more sustainable energy landscape.

The ACT Government needs to decide on an implementation strategy which defines the timeline, transitional arrangements, and the territory zones subject to the proposed regulation. As an input to this decision the Government wants to understand the impact of different implementation options on the economy, consumers, workforce and other stakeholders.

Baringa Partners were engaged to conduct a high-level qualitative and quantitative analysis of the impact that the proposed regulation could have on a range of ACT consumers and stakeholders, and the Territory's emission reduction targets. The analysis was completed over approximately 3 weeks, with limitations in the data as outlined in section 5.1 and 5.2.

The quantitative analysis assesses the costs and benefits of implementing this policy to the consumers by projecting expected gas connections and assessing their lifetime costs through publicly available capital and operating cost data. The quantified results focus solely on total cost of ownership for consumers, and we have not quantified other beneficial impacts such as a cost of avoided emissions or economic benefits as part of the base case results due to time and data availability. However, we explore these aspects in sections 5.2.2 and 5.2.3 respectively. We have focused on connections to 2030, given better data certainty through this period. We do, however, note that additional benefits would be likely realised post 2030, as detailed in section 5.1.1. We include a detailed review of different implementation timelines, and transitionary periods as well as implementation in different Territory zones, making up the implementation options.

Five options for zonal implementation of this policy were considered. Each option considers prohibition of new gas connections in different combination of land use zones. Each land use zone, in turn, has a mixture of customer types (residential, small-medium business, large customer and contract customers). The number of connections within each option is dependent upon the zones covered and the type and number of new connections within those zones (see Figure 1).

The options considered are:

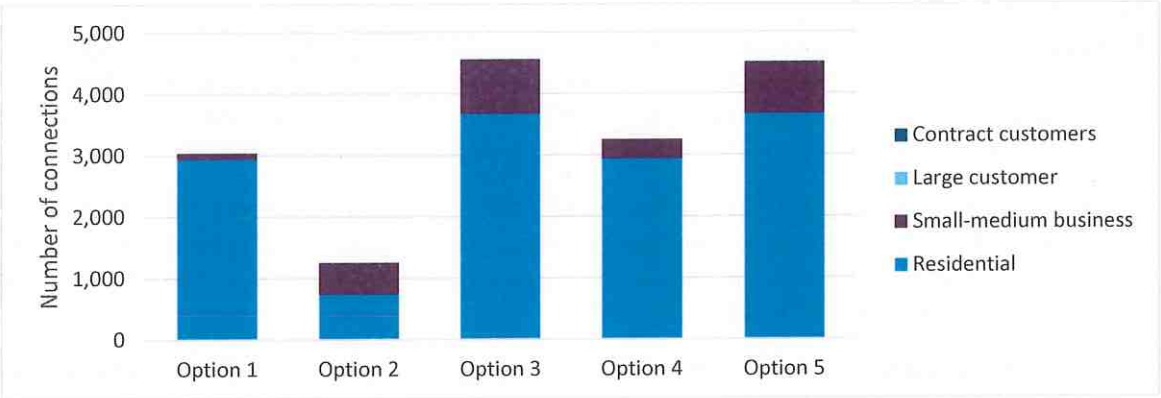
- Option 1: Residential zones only,
- Option 2: Commercial zones only,
- Option 3: All land zones except industrial,
- Option 4: Residential and community facility zones (combined),
- Option 5: residential, commercial and community facility zones (combined)

The ACT Government is not currently considering applying the regulation to Industrial zones. This means that new businesses which are reliant on gas could continue to be developed in these areas. In

addition, an exemption framework will be developed to allow businesses that have no feasible electric options to seek to connect to the gas network if an existing connection is not available to them.

Residential connections make up the vast majority of connections impacted by the regulation, with a minority of small-medium business connections. The number of large customers is very low, but large customers are present in options 2, 3, and 5. The contract customers (industrial or large government customers) as excluded from the quantitative analysis as they would require bespoke solution to electrification and their network connection requests need to be evaluated case by case and are expected to be very limited in number.

Figure 1 The cumulative number of connections impacted by the proposed regulation for each option



Our analysis show that all-electric pathway yields positive net benefits for an average customer in each customer segment compared to a dual-fuel pathway, when considering costs and benefits over a 15-year investment timeframe (see Figure 2). Therefore, the implementation option with the highest coverage of number and type of connections yields highest benefits. This demonstrates that, as well as the broader benefits of decarbonisation which have not been quantified here, this policy is likely to offer savings to consumers over a 15-year horizon. These numbers would increase further with consideration of potential connections post 2030, or inclusion of a carbon cost.

Figure 2 Present value of net benefits across options (under base case assumptions)

For each of the options, we have also considered the sensitivity of results to key assumptions around implementation and the economics of the solutions. We have varied regulation implementation by

postponing the implementation to latest possible date and allowing for 6 months transition-in arrangement. Our analysis showed that these alternatives have minor impact on the net benefits to be achieved under each option. However, the results are highly sensitive to upfront costs and upgrade cost. These costs are significantly influenced by site-specific factors such as the customer needs (e.g., space heating, water heating, cooking), size of the installed system, technology (e.g., heat pumps, induction, electric cookers, and heaters, etc.) of the equipment and building type. Given the timelines of this study, site-specific variables have not been modelled. Depending on these variables, upfront and upgrade costs could vary significantly, potentially doubling the assumed median costs. While increasing upfront cost diminishes the net benefits, higher upgrade cost (as in avoided costs) improves the economic viability for the options.

The qualitative analysis assesses the non-quantified risks and impacts of the proposed regulation on ACT consumers and stakeholders. This assessment concluded that the likelihood of this regulation causing an increase in electricity costs is low, mainly due to the relatively small additional electricity load (around 7 GWh/yr) when compared to the overall electricity demand in ACT (2,772 GWh/yr demand in 2022[1]). However, it would contribute to increasing gas costs to consumers.

The regulation was also found likely to contribute to accelerated investment required in the electricity grid as demand in existing areas increases further. The supply chain for key electrification products such as heat pumps is under increasing global strain, and by accelerating uptake, there is some risk that supply chains may limit the uptake in the ACT.

The gas workforce is likely to reduce faster than otherwise with the introduction of this regulation, and targeted efforts on upskilling will be required to ensure there is sufficient workforce to enable electrification and continue grid stability.

Industrial consumers are set to experience the effects of regulation as they face the prospect of elevated gas prices along with potential future electrification costs. While the quantitative analysis indicates that transitioning to an all-electric pathway for new connections is financially viable over a 15-year period, certain businesses might adopt a shorter-term investment perspective and transfer electrification costs to consumers. In the long-term though we would expect the societal benefits of decarbonisation, and the lower running costs of these businesses to offset any cost increases.

The prohibition of new commercial and business connections could potentially supress competition, creating disparities in access to gas-reliant businesses in certain areas of the Territory. This might lead to situations where certain areas, either exempt from the regulation or with a pre-existing high density of gas-dependent businesses, enjoy access to such services, while newly developed areas may not have the same privileges. The exemptions framework could seek to prevent this effect. Residential consumers are likely to see largely favourable impacts, with improved health, simpler billing and more efficient homes that will not require future electrification costs.

[1] GHD Advisory & Acil Allen (April 2022), Economic and Technical Modelling of the ACT Electricity Network Strategic Report. EPSDD.

2 Background

In order to prevent serious global consequences of climate change, such as increased bushfires, floods and extreme heat events, Australia has signed the Paris Agreement aiming to limit the increase in temperature to well below 2 degrees above pre-industrial levels. Australia's nationally determined contribution commits to reducing greenhouse gas emissions by 43% below 2005 levels by 2030[2].

The ACT government has set ambitious emissions reduction targets, supporting Australia's decarbonisation efforts, aiming to achieve net zero emissions by 2045 across all emissions in the territory. This target has been legislated and independently reviewed under *the Climate Change and Greenhouse Gas Reduction Act 2010* (CCGGR Act).

To achieve this, the government has interim targets in place to progressively reduce emissions (relative to 1989-90 levels) by:

- 40% by 2020 (this target has been met)
- 50 to 60% by 2025
- 65 to 75% by 2030 and
- 90 to 95% by 2040.

The ACT's first interim target was met primarily through shifting its electricity supply to 100% renewables. This was achieved through investing and contracting with renewable energy projects within the ACT and NSW and linking their electricity supply with local demand. Before this, electricity use was the single largest source of emissions in the territory.

As transitioning the electricity supply to renewables has now been achieved, efforts have moved to focus on the other key sources of emissions: natural gas, transport, industrial processes, waste and agriculture. These sources are all more challenging to transition, requiring longer periods to transition away from current emissions-intensive processes. Directed effort is required for all these sources over the next 20 years in order for the net zero target to be achievable.

Natural gas is the second largest remaining source of emissions in the ACT, accounting for 22.5% of emissions from its combustion and a further 3.2% from fugitives (e.g., leakage) in the network in the 2021-22 financial year. Over half of natural gas use in the Territory is residential, relying on natural gas for space heating, water heating and cooking, with 30% attributed to business and 19% to industrial connections[3]. Reducing emissions from natural gas is a difficult process, as electrifying existing connections requires upfront costs and the benefits are unclear to homeowners, and some industrial processes do not have effective fuel switching options.

The Parliamentary and Governing Agreement of the 10th Legislative Assembly (PAGA) includes commitments to legislate to prevent new natural gas connections in prescribed circumstances. The

[2] Parliament of Australia (September 2022), Climate Change Bill 2022

[3] ACT Government (2023), Regulating for the prevention of new fossil fuel gas network connections Issues Paper

Climate Change Strategy 2019-2045 includes an action to develop a plan for achieving zero emissions from gas use by 2045.

In August 2022, the ACT Government announced that the decarbonisation of fossil fuel gas use in the Territory would be through electrification. The government released a discussion paper on its pathway to electrification and tabled the Climate Change and Greenhouse Gas Reduction (Natural Gas Transition) Amendment Bill 2022 in the Legislative Assembly. This bill would make amendments to the CCGGR Act, allowing the government to regulate connections to the gas distribution network and prohibit new gas connections in certain areas. The government held public consultations on the proposed regulation from March to April 2023 and the bill passed the ACT Legislative Assembly in June 2023.

The government is also proposing to amend the Territory Plan[4] to prevent fossil fuel gas connections from being made to new residential subdivisions. This would mean that all new residential subdivisions, including the creation of unit plans (apartments), in the ACT would not be able to make gas connections. The government is still finalising amendments to the Territory Plan. At the time of this analysis, it is expected that the changes would be implemented in late 2023.

Baringa Engagement

Baringa Partners were engaged to perform quantitative and qualitative analysis of the impact of the regulation over a condensed four-week time period. The quantitative analysis is based on the total cost of ownership for consumers over the economic lifetime of appliances. The results compared a projection where consumers can connect to the gas network compared to the regulation being in place, assessing both economic and emissions impact. The qualitative analysis discusses the impacts to consumers, businesses, industry, the energy system, the community, and the overall economy of the Territory as well as potential workforce and supply chain considerations.

[4] The *Territory Plan* is a statutory document that guides planning and development in the ACT, made under the *Planning and Development Act 2007*

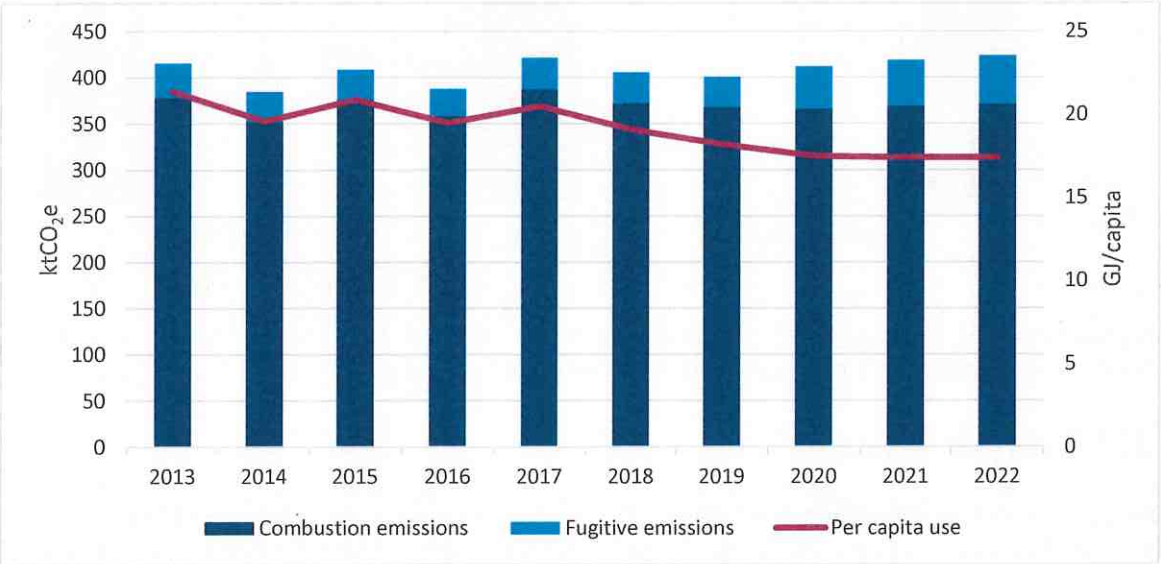
3 The problem

3.1 The problem and the magnitude

This section of the Regulatory Impact Assessment discusses the evidence supporting the need for action. The ACT has committed to reducing emissions to net zero by 2045 along with interim targets including reducing emissions by 50-60% by 2025 relative to 1989-90 levels. In 2022 emissions were 47% lower than 1990 levels, but remaining emissions are unlikely to reduce organically and require government intervention.

Emissions from natural gas are the second largest source of emissions remaining in the ACT and are not decreasing year-on-year despite incentives to reduce consumption and switch to all-electric homes[5]. Figure 3 shows the annual emissions from natural gas from FY 2013 to FY 2022, as well as the average consumption per capita which is declining year on year consistently. The reductions in consumption per capita tell a positive story in improving efficiency, but this reduction is offset by an increase in total consumption.

Figure 3 ACT natural gas emissions and per capita use by financial year[6]

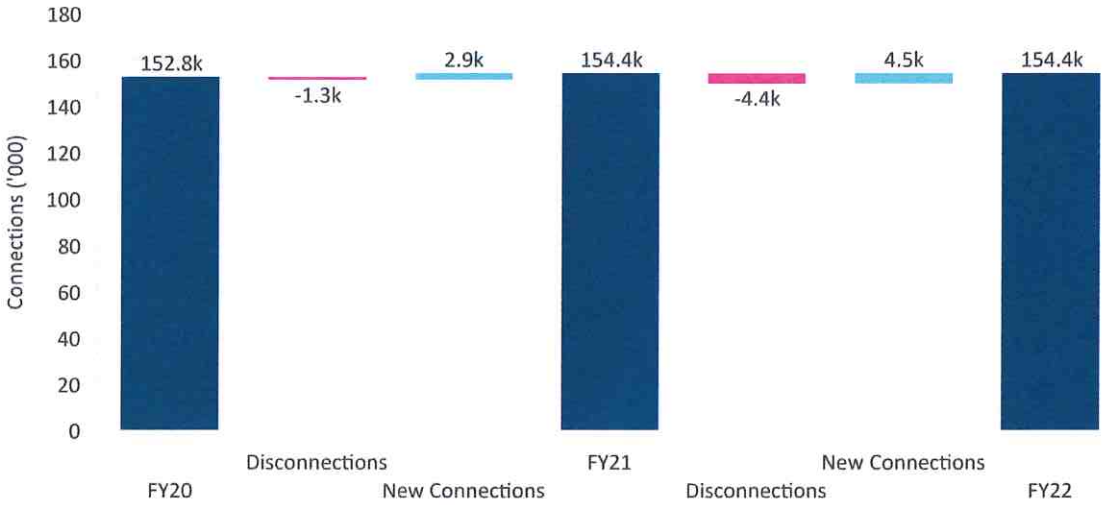


[5] Zero Emissions Suburbs Policy, Sustainable Household Scheme, Home Energy Support: Rebates for Homeowners

[6] Point Advisory (November 2022) ACT Greenhouse Gas Inventory for 2021-22, Environment, Planning and Sustainable Development Directorate, ACT Government.

While existing homes and businesses are seeing some reduction in gas usage through switching to electric alternatives, 80% of new homes[7] are still connecting to the gas network. The higher upfront costs of electric options can result in property purchasers, developers, architects, and builders favouring low-upfront-cost gas alternatives, particularly where they would not be liable for any costs to retrofit electric options in the future. Figure 4 shows the total number of residential gas connections reported to the Australian Energy Regulator by Evoenergy, along with the annual volume of connections connecting and disconnecting from the network[8]. This data includes connections in Queanbeyan (NSW) as Evoenergy are the distributor for this region. The annual disconnections from FY 2020 to FY 2022 are exceed by new connections, leading to an increase in total connections.

Figure 4 Residential connections from Evoenergy



Allowing new natural gas connections negates the efforts of the ACT to reduce emissions and may create a significantly more expensive and challenging transition problem.

3.2 Market failure

Despite incentives and public awareness efforts from the ACT government resulting in a reduction in natural gas consumption per capita, the market is not reducing total natural gas usage, as continued new connections negate reductions. Approximately 80% of newly built low density and single residential homes are still connecting to the gas network, offsetting the emissions reductions achieved by existing customers switching existing gas appliances to electric ones[9] . Public information

[7] ACT Government (2023), Regulating for the prevention of new fossil fuel gas network connections Issues Paper

[8] AER (November 2022), Evoenergy Gas pipeline information - RIN responses

[9] ibid

on the lifetime savings from all electric homes compared to gas fuelled is readily available, but the market is not responding to this information, especially in new build properties.

Several key aspects suggest that regulatory intervention may be required. These problems are predominantly due to a miss-match of decision-making timeframes and economic lifetime of the gas or electric assets and indicate that government intervention may improve overall well-being.

These include:

1. Building all electric homes generally has higher upfront costs than gas reliant, with savings not seen for the first few years. Developers may elect to build out the cheapest option without considering lifetime costs. Lower ongoing costs can be difficult for consumers to understand as they are unlikely to have reliable information on long-term energy and gas costs.
2. Developers that are planning to rent or sell their property are not incentivised to spend higher upfront costs for lifetime savings as they will not enjoy the benefits of lower energy bills and avoided future transition costs.
3. Developers do not have reliable information or fail to factor in the environmental and health benefits of all electric homes in comparison to gas.
4. Uncertainty around the pace of rising gas costs as Canberra reduces its reliance on gas and the transition costs at the end of life of their gas assets to electrify, causes these to be under-accounted-for in economic decision making. In some cases, these costs can be much higher than simply building all electric, especially for larger connections.

4 Rationale and objectives of the proposed regulation

Current regulatory framework and proposed changes allows some new gas connections.

The issues paper[10] gives a thorough overview of the existing rules regulating gas connections in the ACT.

The National Energy Customer Framework within the National Energy Laws requires that gas distributors offer a connection service to all customers. This connection is provided for free if it is determined that the distributor will recover the costs of the connection over the expected lifetime of the asset.

In order to overcome this obligation, the ACT government is creating its own laws to prohibit new connections in some circumstances.

The Territory Plan is a statutory planning document that guides planning and development within the ACT. Before 2020 this required that all new greenfield developments required gas infrastructure to enable gas connections. In September 2020, this was varied to allow greenfield developments to be gas-free, in line with the ACT climate ambition. Since that time, the Suburban Land Agency has stopped including gas network infrastructure in ACT Government land releases. This has effectively prevented new land releases from having gas connected but does not circumvent the national law requirements for Evoenergy to offer gas connection services if requested.

Further variation on the Territory Plan is in the process, with consultation complete to vary the plan to prevent fossil fuel gas mains connections from being made to new residential subdivisions (including new unit plans), in both greenfield and redevelopment areas. These changes are expected to commence in late 2023. This analysis assumes that the Territory Plan changes are in place at the time the regulation commences.

What is the objective of the proposed regulation considered in this report?

The purpose of the regulation is to prevent new gas connections in commercial and residential zones. The proposed regulation will address the key gaps in the current framework that allow new gas connections where there is a feasible electric alternative. This is particularly the case for residential customers but also will capture commercial connections, who will be able to seek an exemption if gas is necessary for their business.

Key areas that the regulation will address:

- Infill developments that are not subdividing (new buildings, renovations, knockdown rebuilds)
- Existing buildings that do not have an existing gas connection, from seeking a gas connection.

[10] ACT Government (2023), Regulating for the prevention of new fossil fuel gas network connections Issues Paper

- Greenfield suburban developments where the estate development has commenced (subdivision completed) but development approval and building approvals have not been issued.

These key areas will no longer be able to connect to the gas network if they are located in the land use zones this regulation will apply to.

Importantly, this regulation can restrict connections for businesses and commercial users. This is currently unrestricted and needs to be addressed for the ACT to achieve its emission targets and reduce the use of fossil fuels in this sector.

How will the impact of the proposed regulation be measured?

It is proposed that the impact of this regulation would be measured by two primary methods:

1. Total number of new fossil fuel gas network connections each year; and

2. Reduction in Territory emissions from natural gas combustion as reported in the ACT Greenhouse Gas Inventory Report

It is important to note that the impact of this regulation is measured on an incremental basis. Specifically, we are considering the potential cost and impact of implementing the additional prohibition of gas connections as outlined above, rather than the impact of other related proposed changes to the Territory Plan outlined above. This significantly reduces the number of residential properties impacted.

5 Impact Assessment

5.1 Modelled implementation options

The ACT Government has a range of options for implementing the regulation within specific territorial zones. They have actively engaged with stakeholders to gather feedback regarding the implementation strategies. Feedback received from stakeholders indicates that aligning the regulation rollout with territory land zones would be an effective approach.

Currently, there are 23 different zones, which are grouped into seven main categories:

- Residential,
- Commercial,
- Industrial,
- Community facilities,
- Parks and recreation,
- Transportation and services, and
- Non-urban zones.

To address the diverse features of these zones, the ACT Government has created five distinct options for implementing this regulation, each involving a single or a combination of different zones. Our assessment will yield results for each of these options, providing a comprehensive overview of their respective impacts.

Table 1 Different territory zones covered by the implementation options

	Option 1	Option 2	Option 3	Option 4	Option 5
Residential zones	√		√	√	√
Commercial zones		√	√		√
Community facility zones			√	√	√
Industrial zones					
Parks and recreation zones			√		
Transport and services zones			√		
Non-urban zones			√		

These zones could encompass a range of customer segments, which are defined by the electricity and gas network operators or retailers. The main segments are: Residential, Small and Medium Business, and Commercial and Industrial. These segments are primarily distinguished by their total energy consumption. While it is theoretically possible to precisely assign each customer to the appropriate territory zone based on their geographical location, such an endeavour would demand substantial effort and time, resources that were not available for this project. Consequently, the ACT

Government, in collaboration with relevant stakeholders, has provided an estimate for the distribution of customers across these zones.

The ACT Government has not proposed including industrial zones in any options, as discussed in the Issues Paper[11]. This approach acknowledges that some businesses require gas for effective operation and allowing these to connect in industrial zones without requiring an exemption allows for condensed zones of gas reliant businesses which can be addressed through bespoke options in the future. This approach was broadly supported by the community through feedback to the Issues Paper. For these reasons, no analysis was requested by the ACT Government on industrial zones. In addition, it should be noted that the regulation will apply to new connections only. Businesses which require gas to operate economically can consider locating in existing properties with gas connections, although we note that in time the available pool of properties of this nature will decline.

Table 2 The breakdown of customer numbers in each segment across territory zones

	Residentials	Small and medium businesses	Large commercials	Contract customer
Residential zones	80%	10%	-	-
Commercial zones	20%	50%	40%	100%
Community facility zones	-	21%	-	-
Industrial zones	-	15%	60%	-
Parks and recreation zones	-	2%	-	-
Transport and services zones	-	2%	-	-
Non-urban zones	-	-	-	-
Total	100%	100%	100%	100%

To assess the impact of the proposed regulation, we estimated the connection numbers within each customer segment and subsequently assigned these customers to their respective territory zones and options. Our basis for estimating the number of connections relied on historical connection data[12] and customer numbers[13] provided by the ACT government. The three-year period was selected to capture the stable connections growth rate exhibited over that period. We made the assumption that recent connection trends would persist over the next six years and approximately 2,500 - 3,000 new buildings would connect to the gas network annually if no prohibition were in

[11] ACT Government (2023), Regulating for the prevention of new fossil fuel gas network connections Issues Paper

[12] Supplied by ACT Government

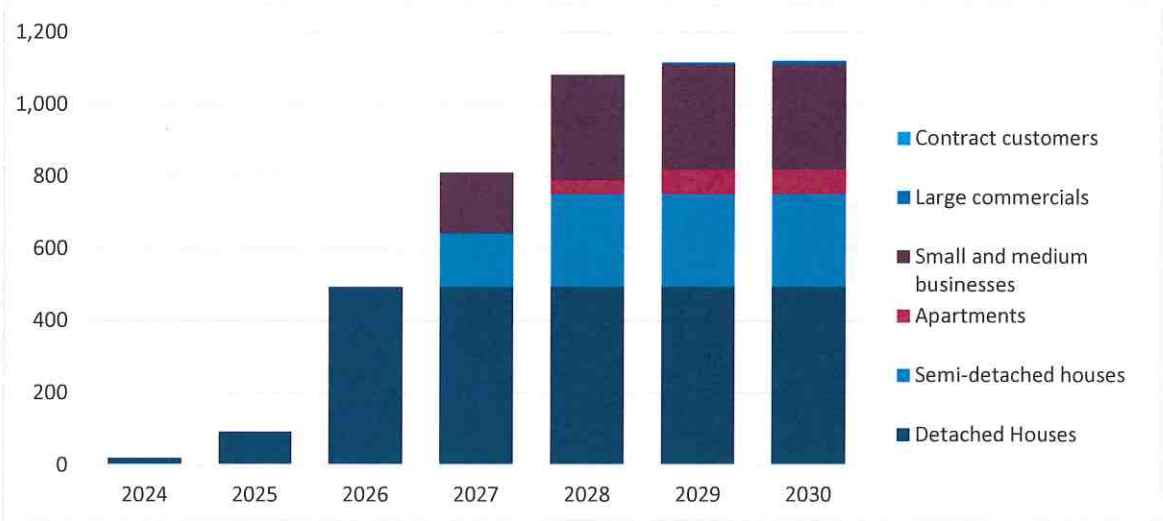
[13] Supplied by ACT Government

place. While this approach simplifies the analysis, it was deemed the most suitable methodology given the constraints of time and available data.

There will inevitably be a time gap between the commencement of the proposed regulation and the actual connection and occupancy of the buildings. Gas network connections are anticipated to persist over the next two years due to existing plans that include gas, that will fall outside of the reach of the regulation. Currently, roughly 80% of all new homes are opting for gas connections, and many businesses and industrial customers also rely on gas[14]. This trend is expected to persist until the existing stock of building and development approvals is exhausted. The premises that are being planned now will be subject to the proposed regulation and will not have the 'choice' to connect to gas network.

The analysis compares the cost of all electric pathway to a counterfactual dual-fuel pathway for those premises. Figure 5 shows the number of estimated new gas connections by premise type under the earliest commencement date scenario without any transitional arrangements. Our analysis excludes the contract customers (industrial or large government customers using more than 10 TJ per year) due to low growth potential and bespoke solution requirements. Although there is a large number of apartment connections recorded in recent years, only a small portion (5%) of these connections are considered in our analysis due to other regulations covering this segment[15]. Expansion of apartments coverage would require different sets of inputs and assumptions as these dwellings have different energy usage characteristics and require different solutions than detached houses.

Figure 5 Estimated number of new connections per annum impacted by the proposed regulation



[14] ACT Government (2023), Regulating for the prevention of new fossil fuel gas network connections Issues Paper

[15] Amendments to the *Territory Plan* will prevent fossil fuel gas connections from being made to new residential subdivisions.

It is important to note that other proposed changes in the Territory Plan could also affect the same customer segments and building types. Customers within these categories would naturally transition to all-electric connections. We have assumed that the proposed changes will go ahead as announced, therefore these dwelling types (i.e., new subdivisions both greenfield and infill, greenfield semi-detached houses, majority of infill apartments) have been excluded from our analysis to show net incremental impact of the proposed regulation. We estimate that less than half of the estimated business-as-usual connections would be affected by this regulation.

According to the draft rollout plan, this regulation is scheduled to take effect between October and May 2024, with potential transitional arrangements to support customers who have applied for Development or Building Approvals for their development, some of which may involve planned gas connections. The ACT Government seeks to comprehensively understand the repercussions of varying the regulation implementation date and the transitional arrangements.

Three alternative implementation dates (30/11/2023, 31/12/2023, and 1/5/2024) and four potential transition-in scenarios (0, 1, 3, 6 months) are under examination in our analysis. To understand the impact, we have run sensitivities for the latest implementation date (1/5/2024) and the longest transition-in period (6 months). The primary impact of these dates lies in the number of connections that may be initiated during this period to secure a gas connection, subsequently influencing the number of connections subject to the proposed regulation's effects. If these connections proceed as planned, the regulation will have no impact on them or their associated customers. These customers will then connect to the network and commence gas usage within a timeframe ranging from a few months to several years, contingent on the nature and complexity of their building projects.

5.1.1 Treatment of connections after 2030

Aligned with the ACT Government's target of achieving net-zero emissions by 2045, it's anticipated that economic rationale would discourage new gas network connections beyond 2030. This is because any asset installed after this point would require retrofitting before reaching the end of its useful life to comply with these emissions targets. Given the substantial cost this entails for owners, it is expected that the prevailing behaviour will shift away from connecting gas assets to the network. For this reason, our analysis focuses on the connection between now and 2030 (inclusive). The analysis does not estimate the number of connections in this category as there is significant uncertainty of the volume of consumers who would continue to install gas appliances regardless, as well as a lack of certainty that recent historical patterns of new connections remain a relevant benchmark.

However, any connections not made after 2030 as a direct result of the regulation would lead to additional economic benefits to the Territory in this analysis, and each connection would have a larger economic saving as the economic lifetime of the gas appliance is shortened. To provide an illustration of this, Table 3 below shows the difference between the savings for a residential customer installing electric alternatives if the lifetime of the gas boiler is 15 years (the base case), 10 years, or 5 years. The savings increase given the high retrofit costs are spread over a smaller number of useful years for the gas equipment.

Table 3 Net benefits sensitivity on economic lifetime of dual-fuel residential property

	15yr	10yrs	5yrs
NPV savings ($)	$1.7k	$3.1k	$6.3k

As an illustration of potential additional value, residential properties which create new gas connections but have to replace appliances after 10 years instead of the expected 15 years, result in net economic losses for each consumer 85% higher. If this is reduced to 5 years this becomes 274% higher.

5.2 Quantitative assessment

5.2.1 Assessment approach

Our analysis focuses on comparing the total cost of ownership for major energy-consuming processes such as space heating, water heating and cooking (only relevant for residential connections), running on gas versus electricity. This cost assessment covers two key components:

- **Upfront costs:** This includes the initial expenses associated with the purchase and installation of the appliances (either gas or electric)
- **Running costs:** These costs consist of energy expenses (either gas or electricity) incurred over an estimated asset life of 15-year period. We have omitted maintenance costs from our assessment. These costs tend to be more relevant to large commercial connections, and obtaining comprehensive data on those remains a challenge.

In the case of gas-connected customers, the total cost of ownership factors in additional elements:

- **Gas connection cost:** The cost of connection to the gas network,
- **Gas disconnection cost:** Considered at the end of the 15-year period,
- **Upgrade cost:** These will be necessary for any gas connection as it has been assumed that the gas assets need to be replaced with electric assets at the end of its life to enable the net zero emission target of ACT Government. This upgrade cost only includes the building upgrades necessary for removing gas assets and allowing for electric appliance instalment, not the electrical appliance and installation costs. This is because customers will require a new electrical appliance at the end of the asset life in either case.

The electricity connection costs are not included in the electricity comparison case as connection to the electricity network is required in both cases.

We have calculated the total cost of ownership in Net Present Value for each individual connection and then scaled these costs in accordance with the estimated customer/building numbers connecting over the next six years, aligning with each respective option. Our analysis draws upon a variety of sources to gather the necessary inputs:

- **Upfront cost:** The cost implications on households are extensively studied for Victoria[16] and ACT[17]. We referred to these studies to estimate the range of upfront cost for gas and electric appliances.
- **Energy usage:** Gas usage is based on the average gas consumption per customer segment as reported by Evoenergy, which is further split into heating and non-heating categories as per earlier studies[18]. Electricity usage is estimated based on the equivalent output requirement in each category with adjustment on appliance efficiency.
- **Energy cost:** Baringa periodically publishes independent projections of wholesale energy prices. We have used these projections to estimate electricity and gas retail rates. This estimate assumes no significant real price shifts in other components of the retail pricing structure. It's worth noting that with fewer customers opting for gas connections, there could be an upward pressure on gas network tariffs, ultimately leading to an overall rise in retail tariffs. On the electricity front, the impact is complex and has not been quantified in this high-level analysis. Although this prohibition won't alter the number of connections to the electricity network, there might be necessary investments in network augmentation that could push up network costs.

The following section provides the results for total cost of ownership analysis as expressed in the present value of differences between running on electric versus gas appliances. A positive result means that electrical appliances provide net savings to the customers considered under the relevant option.

The base case assumes:

- Regulation is in place by 31/11/2023
- No transition-in arrangements (0 months)
- Median estimate of the upfront costs and upgrade costs
- Assessment period of 15 years in line with the asset life

Illustrating the Investment and Cashflows for Residential Customers

Figure 6 provides a breakdown of the investment and cashflows for a typical residential customer considering the all-electric pathway against dual-fuel pathway. The initial upfront cost represents the additional expense incurred when purchasing and installing electric appliances (i.e., space heating, water heating, and cooking appliances). The ongoing positive cashflows consist of energy bill savings (i.e., the difference between expected electricity bills and gas bills).

Had the customer chosen the dual-fuel pathway, they would have faced upgrading costs for their electric infrastructure (wiring, plumbing, etc.) to accommodate new electric appliances. By opting for

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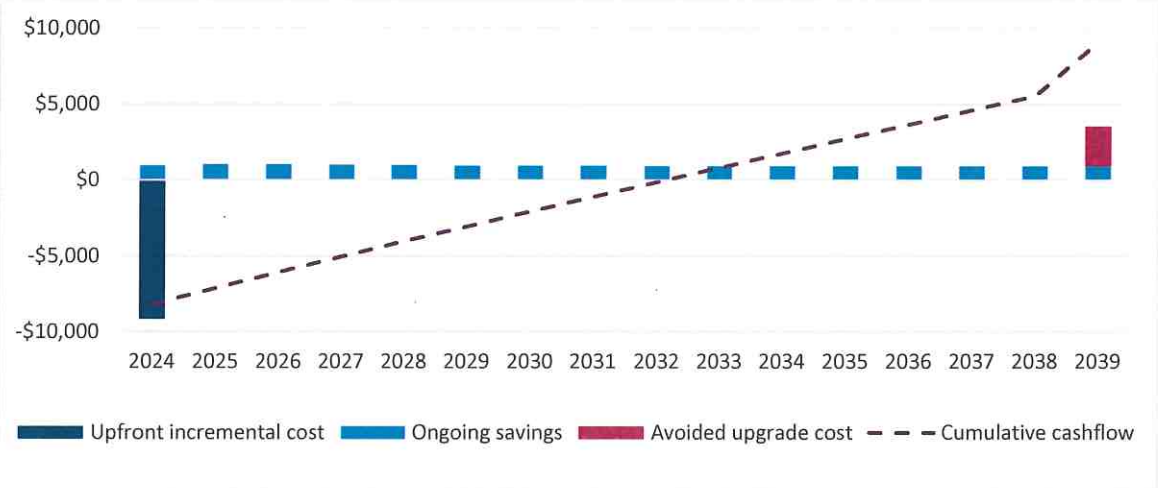
[16] GHD Advisory (April 2022), All-Electric New Homes Cost Assessment. Department of Environment, Land, Water and Planning

[17] GHD Advisory (March 2022) Survey of large gas consuming assets. Condition and Concept Report. Environment, Planning and Sustainable Development Directorate

[18] GHD Advisory & Acil Allen (April 2022), Economic and Technical Modelling of the ACT Electricity Network Strategic Report. EPSDD.

an all-electric setup, the customer avoids these expenses, leading to additional savings. In this case, the total savings outweigh the incremental cost, demonstrating that going all-electric creates net benefits for the customer. While some customers may make their decision based on simple payback period (e.g., Figure 6 shows that a typical residential property would break even after 7 years), others (e.g., businesses) would assess Net Present Value (NPV) of the discounted cashflows.

Figure 6 Cashflows for a typical residential customer opting all-electric pathway



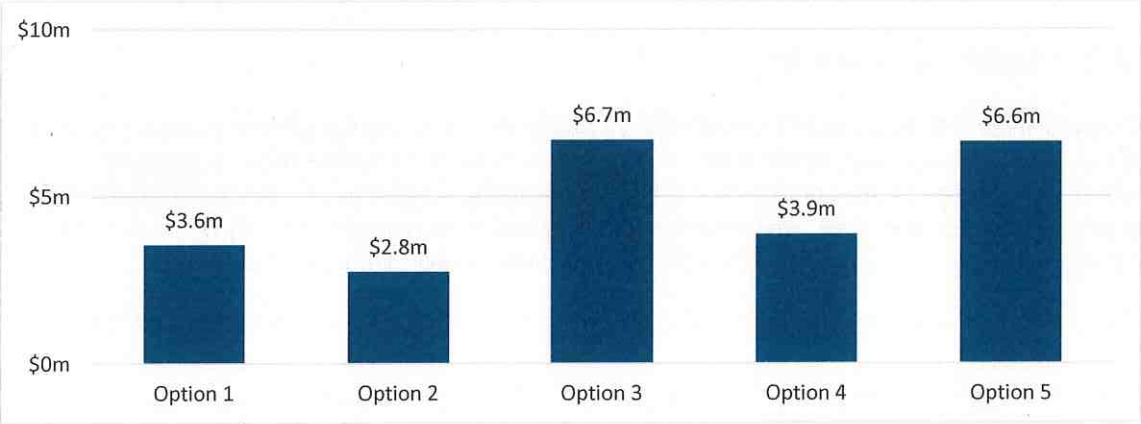
The key factors in this analysis are:

- **Upfront costs:** These can vary significantly based on the type, size, and the output required from the appliance used (heating requirement, hot water usage, etc.). Some technologies are more mature, and appliances can be purchased at competitive cost while others would require premium for new and immature technology. Building fit-outs and the labour required also depends on the installed appliance.
- **Upgrade costs:** End of life costs of gas assets before paying for replacement electric appliances. Costs include disconnection and abolishment fee of gas connection, the upgrade cost of the electricity infrastructure at the dwelling (additional plumbing and rewiring, upgrading power supply) to facilitate electrification at the end of 15 years. These depend on building type and the original infrastructure built. Building standards may also evolve over time, leading to additional costs.
- **Energy consumption savings (gas versus electricity):** Energy consumption depends on the efficiency. For instance, a heat pump is highly efficient compared to single electric radiators in each room.
- **Energy retail rates:** The rates at which energy bills are calculated significantly influence savings and there are several alternatives to choose from. The choice of a different combination of retail plans (electricity versus gas) has the potential to substantially influence ongoing savings and, consequently, the economic outcomes of the analysis.
- **The assessment period:** While our analysis aligns with a 15-year asset life, it's important to note that customers may have varying perspectives on expected returns and when they would like to reach the breakeven point of investments versus savings. Their desired payback of an investment to be attractive is likely to vary based on their specific customer segment.

Our analysis demonstrates that all-electric pathway yields net positive benefits (i.e., bill savings and avoided upgrade costs are higher than costs) for an average customer in each segment compared to a dual-fuel pathway. Positive values from the analysis reflect net economic benefits for the Territory. This means that implementing this regulation results in economic benefits, as well as resulting in emissions reductions.

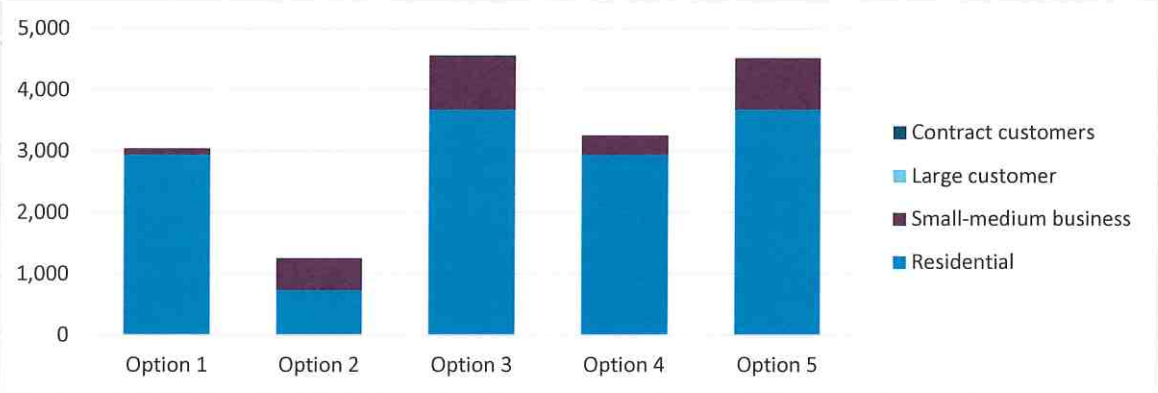
The analysis highlights the significant role of avoided upgrade costs in making the all-electric pathway economically advantageous. While typical residential customers achieve net benefits even without considering the upgrade costs, business must factor in future upgrade expenses in their decisions as the bill savings alone may not be sufficient to offset upfront costs. The implementation option with the highest coverage of number and type of connections yields highest benefits (see Figure 7).

Figure 7 Present value of net benefits across different implementation options



The number of connections within each option is dependent upon the covered zones and the respective type and number of new connections within those zones (see Figure 8). Option 3 and 5 covers largest number of connections. They also include very small number of large customers. The contract customers (industrial or large government customers) are excluded from this quantitative analysis as they would require bespoke solution to electrification and their network connection requests need to be evaluated on a case-by-case basis.

Figure 8 The cumulative number of connections impacted by the regulation for each option



5.2.2 Sensitivity of results

As previously mentioned, the ACT Government is currently evaluating various alternatives concerning the rollout of the regulation to select territory zones, commencement date of the regulation, transition-in arrangements, and the final date of connection. In order to inform the decision making, we have reassessed the results under different sets of inputs and assumptions for which the ACT Government sought feedback from the stakeholders. Within each option, we have varied:

- Regulation implementation by postponing the implementation date from 31/11/2023 to 1/5/2024.
- Transition-in arrangement from 0 to 6 months. This assumes that after regulation commencement, developers have a period of 6 month to continue to submit development or building approvals for homes with gas connection which are approved.
- A 'final date' for new gas connections to be made, for land use zones subject to the proposed Regulation, of 3, 4 or 5 years from regulation commencement.

Implementation timing

This analysis considers different timing options for the implementation of the regulation to assess the potential adverse impacts to developers of the near-term implementation possibility. The ACT Government recognise that development processes can be long and costly, so the intention is that developers who have already finalised design of the building but not yet submitted the relevant approvals do not have to undertake complex re-work as a result of implementing this policy. The intent is then to balance the emissions reductions and economic and community benefits with keeping the adverse impacts on developers low.

Given the near-term implementation timeline of the regulation, there have been two methods identified to mitigate the impacts on developers:

- Delay implementation,
- Implement, but allow a transitional period where well-developed projects can still continue to connect to gas.

Implementing with an additional transitional period to allow for applications to be submitted provides policy certainty (i.e., the policy is implemented) while also minimising re-work of fully completed designs.

With delays to the implementation of the legislation, or an extended transition period, there is a potential risk that developers accelerate development processes to submit a much higher volume of applications than historical average rates, resulting in a reduced benefit (in terms of emission reduction or cost benefits). This behaviour is hard to meaningfully predict and therefore has not been included within the quantitative results.

Final date for gas connection for projects with development approval

The ACT Government is also considering a final connection date for applications which successfully submit application before the regulation comes into place. This would reduce the risk of a long tail of developments with development /building approvals with gas connection and ensure they are finalised in a timely manner. A final date for connections will also provide certainty and visibility into the expected number of dual-fuel connections and emission levels within the period to 2045. A final connection date that considers existing building or development approvals also provides clarity and security to the developers enabling them to execute on submitted plans without additional rework and cost.

The duration of time from development approval or building approval to network connection (which is typically very close to the occupancy date) can range significantly based on building type. For the core analysis, representative assumptions have been agreed with the ACT Government of:

- Average residential – 18 months,
- Average small to medium business – 36 months,
- Average large commercial – 60 months.

This means that options of last connection dates of 3, 4 or 5 years would mainly impact the larger more complex commercial businesses, as the residential and most of the small to medium business developments would have sufficient time to connect to the gas network even under the earliest final connection date of 3 years from the regulation date. A 5-year final date for connection would align with s211 of the *Planning Act 2023*, which requires developments to be completed within a 5-year period, unless an extension of the approval is granted.

Table 4 Sensitivity on final connection date

	Final Connection Date		
	5 years (base)	4 years	3 years
Option 1	$3.6m	$3.6m	$3.6m
Option 2	$2.8m	$3.1m	$3.9m
Option 3	$6.7m	$7.0m	$7.8m
Option 4	$3.9m	$3.9m	$3.9m
Option 5	$6.6m	$6.9m	$7.8m

Table 4 shows the impact of a shorter final connection timing on the net benefits of the regulation to the Territory. Because of the representative assumptions used for the quantitative methodology on connection times, implementing these changes results in impacting the number of large commercial

connections, with a low impact for small and medium business connections. Options 1 and 4 are not impacted materially, as they do not include large commercial businesses, and only have a small volume of small business connections included. Options 2, 3 and 5 are the most impacted, increasing the net benefits by approximately one million for 3 year restriction in comparison to the base case.

While the quantitative analysis compares the direct capital and operational costs of electric and gas pathways, which demonstrates a net benefit increase, there are other aspects that, once quantified, may potentially diminish these net benefits. This is especially pertinent for projects that received development approval prior to the Regulation commencement and would need to go through rework. These include:

- Sunk costs and rework of the design of those developments to make them all-electric,
- Resubmission of Development and Building Approvals for new designs,
- Potential loss of yield or floor space for units, due to electric infrastructure typically taking up more space,
- Potential impact on the economic viability of the developments, due to network infrastructure upgrade costs,
- Potential impact on contracts for sale based on approved Development Application's.

Shorter timelines accelerate the electrification in the territory but would increase the risk of expensive rework requirements, exacerbate supply chains constraints and workforce limitations. There is also some risk that implementing with these timeline constraints could unfairly disadvantage specific sites which are particularly difficult or require long development timeframes.

It is important that the Government considers the potential economic impact on the developments (both approved and in the process of getting approval) and the emission reduction achievable when selecting a final connection date.

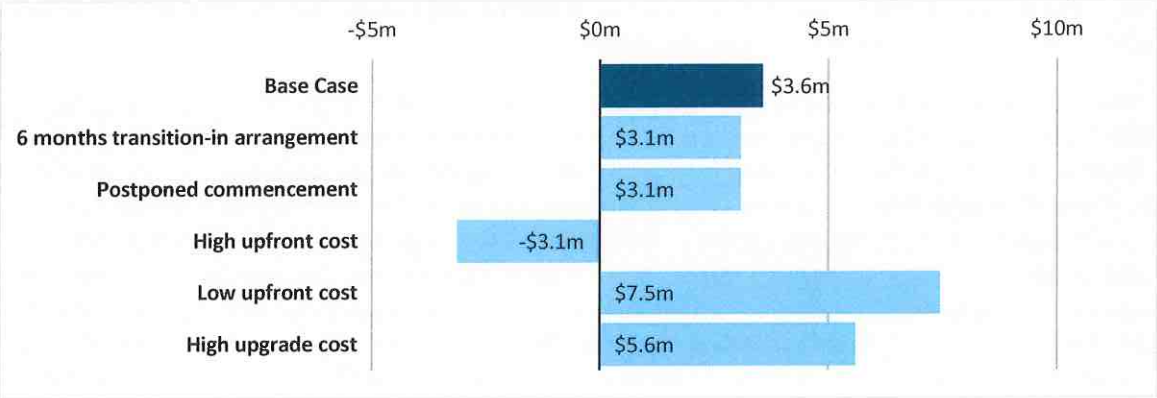
Core sensitivity analysis

Our analysis showed that these alternatives have minor impact on the net benefits to be achieved under each option. However, the results are highly sensitive to upfront costs and upgrade cost.

The following provides results for each option with the above sensitives plus the variations on the appliance and the upgrade cost of the electricity infrastructure in the building.

Option 1: Residential zones

Figure 9 Present value of total net benefits, Option 1



Upon implementation within residential zones (as planned under Option1), this regulation is anticipated to have an impact on 3,044 connections (majority of the Residentials and 10% of the small and medium businesses subject to the regulation) over a six-year period, 2024-2030, yielding considerable benefits for these consumers. These benefits primarily stem from the reduction in energy bills, which offsets the additional costs associated with investing in all-electric assets.

It's important to note that the magnitude of these benefits is highly contingent upon the initial costs of acquiring electric appliances. These upfront expenses are significantly influenced by factors such as the type (e.g., space heating, water heating, cooking), size, and technology (e.g., heat pumps, induction, electric cookers and heaters, etc.) of the equipment. Depending on these variables, upfront costs could decrease by as much as 60% or potentially even double. The base case assumes a median appliance price for all affected residences, while increased upfront costs assume all connections use high-cost appliances and decreased upfront costs assumes all connections use lowest cost appliances.

The results of this analysis are also sensitive to existing difference in retail electricity and gas rates as well as future movements. To maintain objectivity, our analysis is grounded in the standing contract rates, which do not incorporate any discounts. Although we haven't conducted a detailed rate projection, we have accounted for fluctuations resulting from shifts in wholesale energy prices. Additionally, it's important to note that any increase in gas network charges could impact retail gas rates, a factor we haven't explicitly modelled. We acknowledge that the choice of a different combination of retail rates (electricity versus gas) as a starting point has the potential to substantially influence ongoing savings and, consequently, the economic outcomes of the analysis.

Our base case analysis did account for the upgrade cost of the electricity infrastructure at the dwelling (additional plumbing and rewiring, upgrading power supply) to facilitate electrification at the end of 15 years. These upgrade costs can vary significantly, contingent upon factors like the dwelling type and the existing electricity infrastructure (more for apartments then detached houses). Since the base case results, factoring in the upgrade costs, demonstrate positive outcomes, any increase in these upgrade costs further strengthens the case for choosing the all-electric pathway.

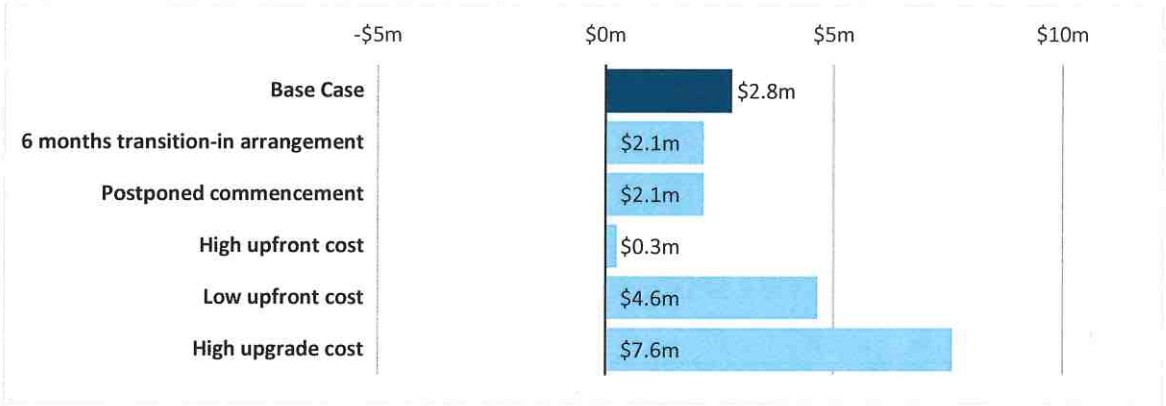
As mentioned earlier, the overall benefit assessment extends over a 15-year period from the time of connection. While this aligns to the asset life, average holding period for houses in ACT is 11.8 years

(9.7 years for units)[19] and some customers expect an average payback period for energy efficient appliances between 3.2-4.1 years[20]. Therefore, we have also evaluated net savings over a shorter period, ten years. The results reveal that over this shorter timeframe, the savings is just enough to offset the increased costs associated with expensive electric appliances. Any period shorter that ten-year result in an uneconomical outcome for this option.

Under various scenarios involving the regulation's commencement date, transition-in arrangements, and the time required to progress to connection, it is understood that certain connections face potential risks should they proceed with dual-fuel designs, especially the ones that recently lodged an approval application or secured an approval. If the regulation prescribes a period shorter than what is required to establish a gas network connection, some customers may subsequently incur additional costs associated with redesigning their plans at a later stage. The impacts associated with connection timeframes are explored further above in '*Final date for gas connection for projects with development approval*'. When the allowance for the final connection date is extended to five years, customers will have ample time to complete all necessary work and adhere to the regulations. This, in turn, helps mitigate the associated risks of project cost overrun and delays.

Option 2: commercial zones

Figure 10 Present value of total net benefits, Option 2



Under this option, the regulation is only implanted within Commercial zones, in which half of the small and medium-sized businesses and a fifth of the residential customers are situated. While the number of connections affected by this option is relatively modest compared to Option 1, the substantial scale of investment and resultant savings within commercial entities positions it closely to Option 1 in terms of net benefits. Despite the higher upfront costs primarily attributed to the need for larger equipment, commercial entities, driven by their higher energy consumption—approximately five times more than residential properties—stand to achieve proportionately greater savings.

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[19] McLean S (28 Feb 2021) 'Why Aussie homeowners are holding property longer than a decade ago', realestate.com.au, accessed 1 September 2023

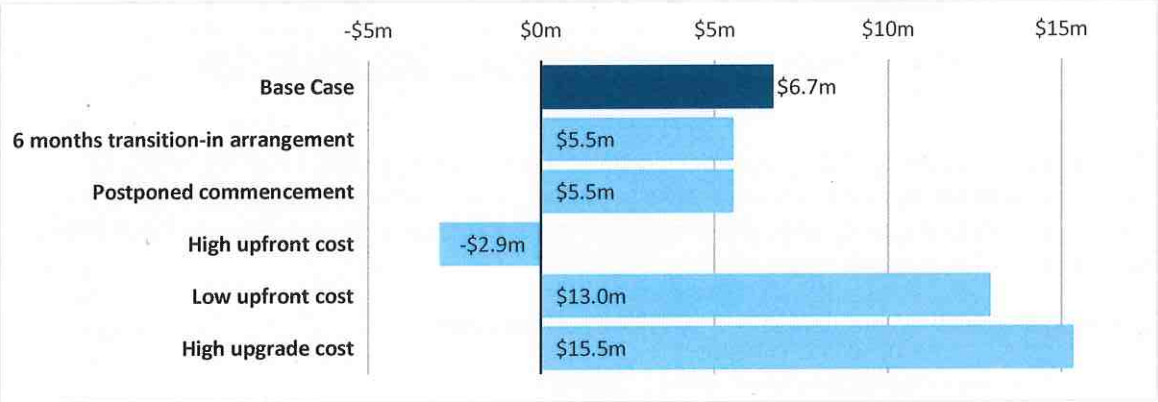
[20] Ginninderry (February 2017) Householder Attitudes to Residential Renewable Energy Futures Land Development Agency, ACT Government and Riverview Development Pty Ltd: 11

Similar to Option 1, the transitional arrangements or implementation of the regulation at a later date than the base case would impact the number of connections subject to this regulation, as those customers may opt to go ahead with dual-fuel connection.

It should be noted that within the commercial sector, there's a wide spectrum of business types, each with varying energy consumption profiles and specific equipment requirements. As a result, upfront and upgrade costs for commercial establishments have the potential to double in certain cases. The higher upgrade cost significantly improves the outcome, maximising the net benefits.

Option 3: all zones except commercial

Figure 11 Present value of total net benefits, Option 3

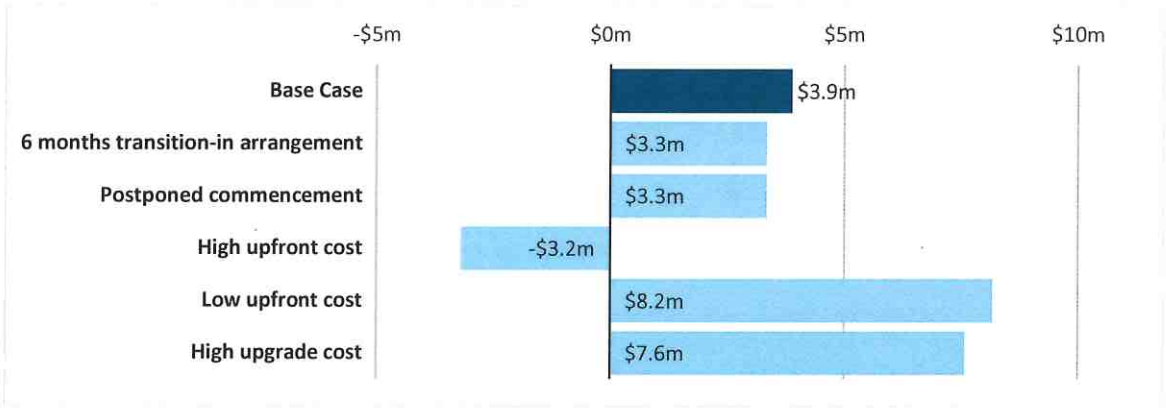


Option 3 encompasses all zones with the exception of industrial zones. Consequently, it affects nearly all connections, with only a small percentage (15%) of small and medium-sized business customers excluded, as they are located within the industrial zones. This option is anticipated to impact approximately 4,567 connections over the forthcoming six years.

In terms of overall impact, this option closely mirrors the previous ones regarding the timing of the regulation, transitional arrangements or the changes in upfront and upgrade costs. Variations in net benefits are most pronounced in accordance with fluctuations in upfront costs. Given that this option covers the largest number of connections, any changes in the timing of implementation are felt most significantly here.

Option 4: Residential and community facility zones

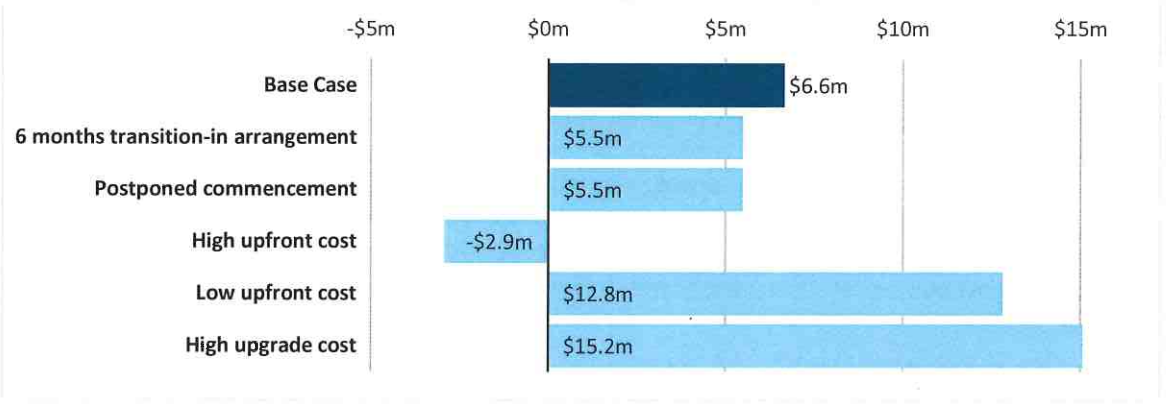
Figure 12 Present value of total net benefits, Option 4



Option 4 covers majority of the residential customers and a share of (21%) small and medium business customers located in community facility zones. Consequently, the outcomes closely align with those of Option 1, with modest improvement attributable to the higher coverage of small and medium-sized business customers within this option.

Option 5: Residential, commercial and community facility zones

Figure 13 Present value of total net benefits, Option 5



Option 5 closely resembles Option 3, differing primarily in its exclusion of less inhabited zones of parks and recreation, transport and services and non-urban. Those zones represent a minor fraction of small and medium businesses (collectively accounting for 4% of small and medium businesses), therefore results closely mirror those of Option 3.

5.2.3 Discount rate and perception of costs

Given the cost and returns profile of electrification technologies (Figure 6) consists of a high upfront capital cost in return for savings each year, the horizon over which the net savings are calculated, and the discount rate have a material impact.

For this impact assessment, given that we are considering holistic cost impacts to the system and population we consider it reasonable to align the horizon of the analysis to a representative asset lifetime of 15 years. For businesses or residential customers who move out of the building before the end of the asset lifetime, they might not receive the full benefit of the investment from gas use reduction. However, this technology would remain in the property, providing value to the new tenant. This value may be reflected in a higher sale price of the building, and thus recovered by the original occupant. In the Domain Sustainability in Property report, they observe a consistent premium on energy efficient homes compared to non energy efficient homes, as well as increased volume of views and lower time on market[21]. This price premium is reported as 17.1% or $125,000, reflecting clear buyer preference. It is likely that energy efficiency is not the sole driver of the premium, as energy efficient homes are more likely to have been built or renovated recently.

The perceived payback period sensitivity uses the base case 7% discount rate but changes the analysed lifetime to 8 years for small business and larger connections, and 12 years for residential connections. This is done to reflect a potential perspective of cost to occupants rather than the overall economic cost. The average home ownership period in the ACT is reported as 11.8 years[22] and the average small business lifetime we assume to be approximately 8 years.

Table 5 Sensitivity on perceived costs to consumers

	Horizon of costs considered	
	15 year	12yr / 8yr – excl. end of life costs
Option 1	$3.6m	-$0.9m
Option 2	$2.7m	-$5.0m
Option 3	$6.7m	-$7.8m
Option 4	$3.8m	-$2.5m
Option 5	$6.6m	-$7.5m

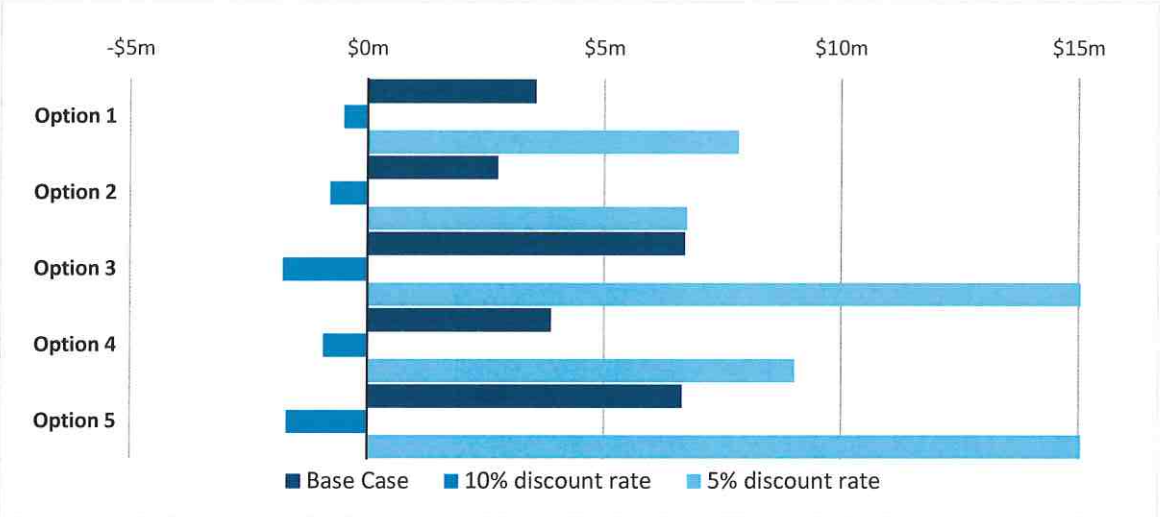
As shown above, the perceived cost by households may be higher when considering a horizon linked to average home ownership, compared to businesses. This is driven by proportionally higher upfront costs and lower gas consumption and therefore savings. It is important to note that these results are only the perceived costs to consumers over the timeline, and it is likely that the savings over the remaining economic life of the asset will be real in additional value of the asset.

In the base case scenario, a discount rate of 7% was selected as a reasonable middle ground between 5% (representing a long-term stable investment view, typical of a utility or government property) and 10% (which may represent more of shorter-term or higher risk business). Using a 10% discount rate results are significantly affected and there is an economic cost rather than an economic benefit in all cases. This is due to the high upfront costs of electricity-based appliances, with the lifetime savings from energy costs discounted through the lifetime. Using a 5% discount rate the opposite effect is observed with economic benefits through the 15-year lifetime approximately doubling in all scenarios.

[21] Domain (June 2022), Domain Sustainability in Property Report 2022

[22] McLean S (28 Feb 2021) 'Why Aussie homeowners are holding property longer than a decade ago', realestate.com.au, accessed 1 September 2023

Figure 14 Additional sensitivities on discount rates



5.2.4 Impact on emissions

Emissions from natural gas in the ACT are the second largest single source of emissions in the Territory[23], and implementing this regulation will avoid future emissions from natural gas connections that would have existed without this regulation in place.

To determine annual avoided emissions, annual natural gas connection data was analysed to determine the total volume and type of connection affected by this policy. The ACT has stated there will be zero emissions from fossil fuel gas by 2045[24], so connections after 2030 were assumed to be not impacted as they would not be viable for the full 15 year of natural gas connection lifetimes regardless.

[23] Point Advisory (November 2022) ACT Greenhouse Gas Inventory for 2021-22, Environment, Planning and Sustainable Development Directorate, ACT Government.

[24] ACT Government (August 2022), Our Pathway To Electrification

Figure 15 Cumulative avoided natural gas combustion emissions by implementation option.

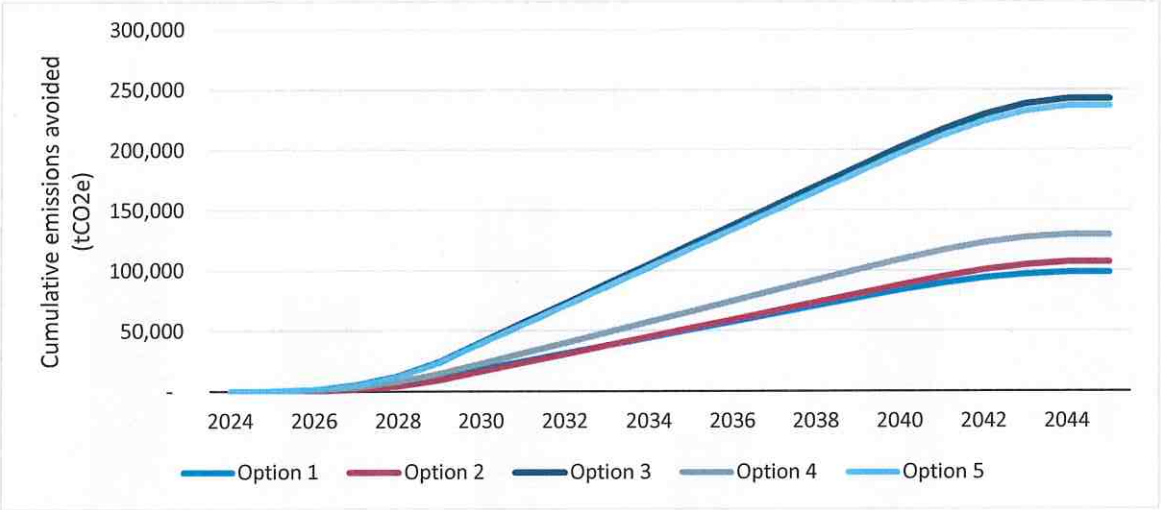


Figure 16 Cumulative natural gas combustion emissions by implementation option.

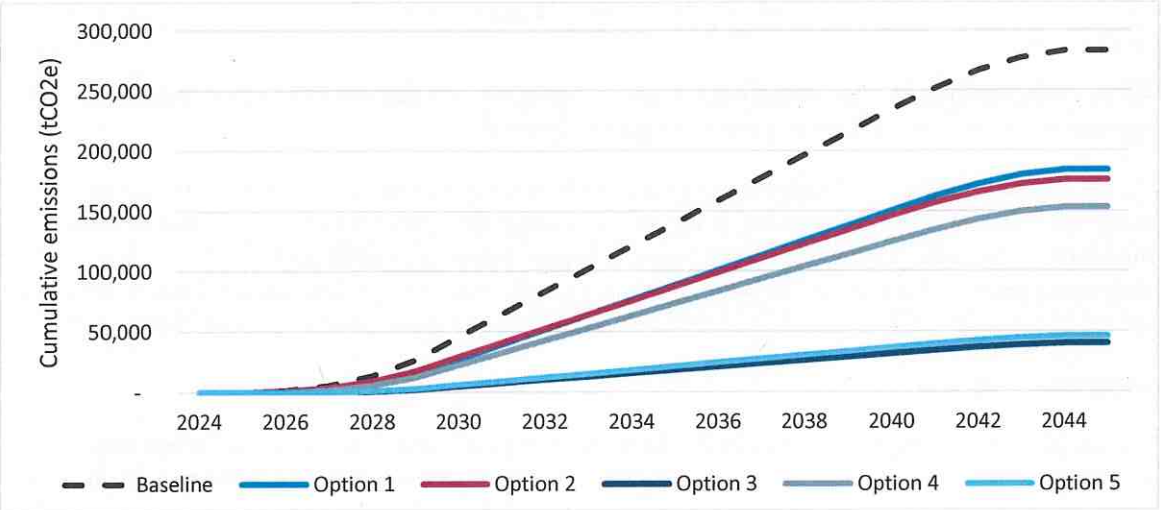
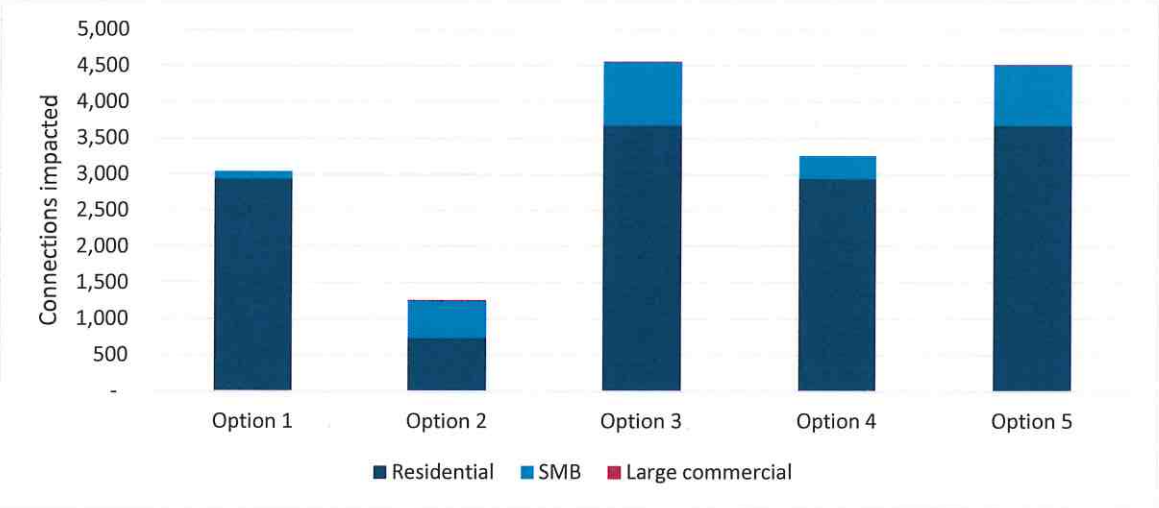


Figure 16 shows the cumulative emissions of new gas connections under each implementation option analysed in this report, as well as the baseline emissions if no connections were affected. **Error! Reference source not found.** Figure 15 shows the cumulative avoided emissions over the same period, essentially the difference between the baseline and the scenarios cumulative emissions in Figure 16. In option 3, which covers all land use zones except for industrial zones, annual avoided emissions are over 16,000 tCO2e per year, equivalent to 0.9% of the ACT's annual greenhouse gas inventory in 2021-22. In this scenario, cumulative emission reductions over the period are 242,000 tCO2e over the lifetime of affected connections. In comparison, option 1, which only includes residential zones has 98,000 tCO2e cumulative avoided emissions over the lifetime of affected connections.

Figure 17 shows the cumulative connections affected by the regulation in this analysis, highlighting the general trend of more connections impacted resulting in greater lifetime emission reductions.

However, in cases where a greater volume of larger connections are covered, this trend cannot be true, for example options 1 and 2 resulting in similar emissions outcomes while option 2 covers less than half the connections of option 1.

Figure 17 Cumulative connections impacted by regulation in quantitative analysis.



These emissions only include direct natural gas combustion, not including the associated increase in fugitive emissions from expanding the distribution network.

As the ACT has secured renewable energy supply, the emissions associated with electricity are assumed to be zero. This contracting of renewable energy does not mean that the electricity used in the territory is coming directly from the renewable generator contracted with. Even without renewable energy contracting, the emissions from an all-electric house are already lower than a gas reliant house and the decarbonisation of the grid is increasing the emissions savings every year[25].

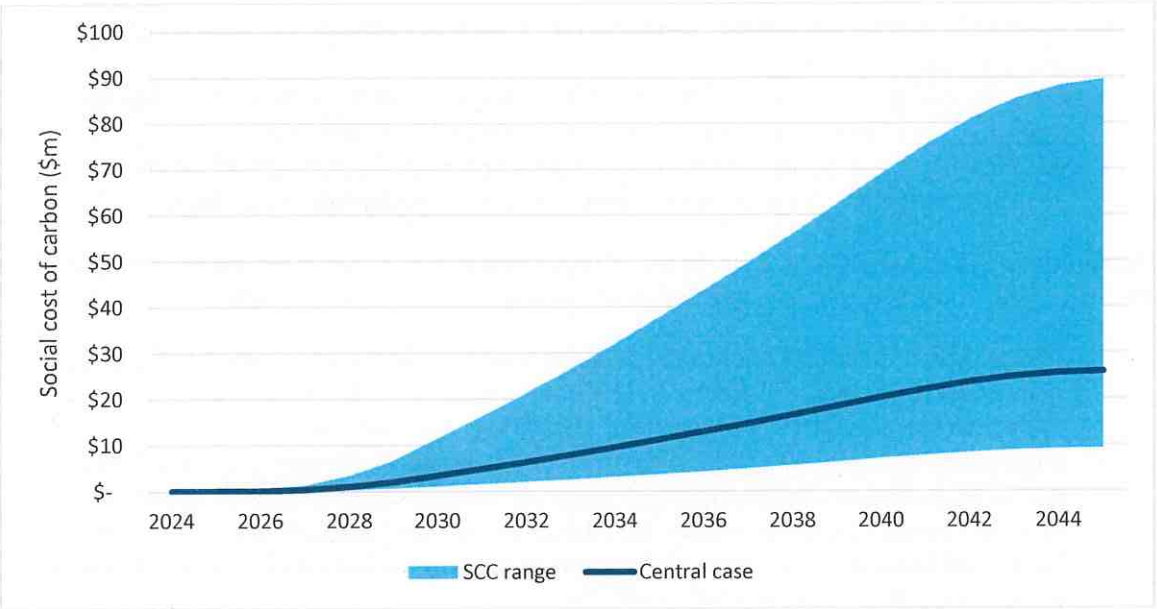
Social cost of carbon

The social cost of carbon (SCC) is an estimate of the economic damages that would result from emitting one additional ton of carbon dioxide into the atmosphere and can be used to estimate the value of emissions avoided by this regulation. Social cost of carbon values are created using integrated assessment models (IAMs). IAMs are computer models that combine climate science, economics, and other disciplines to project the future impacts of climate change and the costs of mitigation and adaptation. Variation between social cost of carbon values is primarily driven by the climate scenario used in the modelling, what is included within the modelling, how ethical and non-market damages are accounted for, and the discount rate applied. Discount rates applied to social cost of carbon are highly debated as is based more in ethics than economic theory, reflecting the value we place on future generations compared to our own.

[25] The Green Building Council of Australia (April 2022), A practical guide to electrification for new buildings

Figure 18 shows the range of potential economic impact of carbon emissions associated with this regulation across a range of SCC scenarios as recommended for use in the ACT[26]. The full data series used is detailed in below 0 below. In the central case, which uses a 3% discount rate to determine the social cost of carbon as increasing from 71 to 111 $/tCO$_2$e (real 2021) over the horizon, the economic impact to 2045 is $26 million, increasing the relative economic benefits of implementing the regulation by up to ten times. In comparison a low case sensitivity SCC results in economic impact of $9.3 million, while a high climate impact sensitivity SCC increases this impact to over $80 million. The impact of carbon emissions on the economy is not well understood, and is highly dependent on the broader climate scenario, leading to a large range of results.

Figure 18 Cumulative social cost of carbon range for option 3



5.3 Regulation exemption framework

The ACT Government acknowledges that in some cases where the costs of electrification are higher than average, the regulation may cause issues of competition or inequity in service accessibility by consumers. New entrants to some industries would be discouraged by the high upfront cost of large-scale electric alternatives to gas appliances and longer development timelines. Some services might become unavailable to consumers in areas with demand for these services. For these cases, an exemptions framework will be necessary to allow the connection of businesses and consumers that can demonstrate a genuine need for a gas connection and meet specific criteria. It also provides businesses with certainty and clarity. While exemptions could delay the transition to a net-zero economy, the ACT government can effectively manage this transition through a carefully designed framework that balances emission reduction objectives with the need to support businesses and communities. Developing and administering an exemption framework would incur additional ongoing costs for the ACT Government however it can minimize the economic disruption and smooth

[26] Rovingstone Advisory, ACT Government, (March 2021), A Social Cost of Carbon for the ACT

the transition. The exemptions framework is designed to ensure that the transition to a low-carbon economy is fair and equitable, and that businesses and consumers have the support they need to make the switch to other energy sources. The exemptions framework will also protect the interests of businesses and consumers who are unable to transition to other energy sources without significant hardship.

The framework will be administered by the ACT Government, and applications for exemption will be considered on a case-by-case basis. Close monitoring of specific businesses and the industries where exemption is granted, and regular review of the framework is required to ensure that it is serving the overall objectives of the ACT government. Exemptions may be provided to applicants who meet certain criteria, for example:

- Businesses that rely on gas for essential services, such as hospitals, commercial kitchens, and laundromats,
- Businesses who provide a significant benefit to Territory that are exposed to unfeasible capital or ongoing costs in using an energy source other than natural gas,
- Businesses exposed to significant extended development times for building all-electric, but have made provision for all-electric in their building design for future conversion

The exemptions framework is a critical aspect of the proposed regulation, ensuring adverse impacts are minimised. In designing an appropriate framework, key considerations include;

- **The breadth of potential applicants**: Allowing anyone to apply for an exemption will ensure that no single business which would benefit from an exemption is excluded. However, it will likely increase the number of exemption applications and effort required for review.
- **The amount of effort required from proponents to complete an exemption application**: Requiring an application for exemption will likely increase cost and time for developers of new sites subject to this regulation. This should be balanced with the need for robust and clear proof that the site requires a gas connection, given the benefits outlined in this paper will be reduced for every exemption granted.
- **The extent of pre-defined parameters from the ACT Government**. The ACT Government could choose to reduce the burden on developers by pre-determining the answers to key questions based on characteristics such as business type or size. This would require up-front work from the ACT Government and, given the wide range of costs for electrification driven by site-specific design parameters, risks losing nuance for specific cases. It would, however, increase transparency.

Potential decision-points and a range of means to consider these (ranging from ACT-led to Proponent-led) is explored in the example exemption framework below. Given we expect the cases requiring exemption to have a wide-ranging set of costs and business cases, it is expected that a Proponent-led approach will be more efficient. However, clear guidelines will be necessary to make applications efficient and possible to review.

Box 1: Example implementation of the exemption framework

Table 6 Example implementation framework

	Answer	Evaluation approach	
		Act Government-led	Proponent-led
Is the use of gas required for the economic provision of this service?			
Is there a technically feasible alternative to gas for the provision of the service?	Yes/No	ACT Government commission studies to form a view of industries or business types for which there is no technically feasible alternative.	Proponent to provide evidence of technical challenges and market research on alternatives for ACT Government to review
Is the use of a technically feasible alternative economic?	Yes/No	ACT Government form a view of business case economics and determines a list of business types which would be expected to have an economic electric alternative. Or ACT Government sets out framework for business case consideration, fixing some parameters (NPV discount rate, horizon, inclusion of a cost of carbon), allowing Proponent to complete with costs	Proponent-led business case template completed, with freedom to determine all parameters, with justification provided of each value chosen. ACT Government to review.
Can the electric alternative be delivered without incurring undue development risk?	Yes/No	ACT Government continuously review and form a government view of supply chain risk	Proponent makes case for development risk, providing evidence for ACT Government to review.

Does the economic value brought to the ACT by this business outweigh the emissions disbenefit of using gas? Or Is the business providing an essential service?	Yes/No	ACT Government calculate perceived benefit, and cost of emissions using a social cost of carbon metric. ACT Government pre-determine a list of essential services.	Proponent to calculate the revenue of the business vs. social cost of carbon in submission (using an ACT Government determined value for carbon cost). Proponents state case as to why the service should be considered essential, for review.
Would the prohibition of a gas connection lead to inequitable outcomes for the community?			
Is proximity to consumers essential to the provision of this service?	Yes/No	ACT Government to form a view of industries or business types for which proximity to consumers essential for delivering value.	Proponent to provide business case for location providing local benefits to community
Could the services be located in a different area than the proposed one?			
Is another area or parcel of land where a gas connection is available is suitable for the services?	Yes/No	ACT Government to identify available land/buildings with gas connection for specific industries and businesses to (re)locate	Proponent to provide the criteria for land/building requirements and state case as to why the location is chosen
What would be the estimated carbon emissions if connected to gas network?			
State the annual carbon emissions in tCO2e p.a.		ACT Government to estimate the carbon emissions based on gas usage and benchmark NGAF	Proponent to estimate the annual gas usage and emissions and provide detailed methodology and evidence
Exemption decision (by ACT Gov):			
Approved/Disapproved	The approach and methodology to be specified (i.e., ACT Gov or Proponent-led) The evidence to be presented		

It has not been possible to quantify the potential impact of an exemptions framework without forward-looking data available on the nature of new businesses looking to connect. By necessity, and due to data availability, this analysis considers a single average customer profile for small and medium business, and large commercial customers. However, the economic case for electrification will vary significantly based on the type of property and business considered. Table 7 provides an indication of impact on each option if 30% of connections in each category excluding residential are awarded an exemption. Each option has a slightly lower net economic benefit than the base case, as total connection numbers impacted are reduced and each connection results in net economic benefit.

Table 7 Example impact of exemptions framework

	30% of non-residential customer connections (total 2024-2030)			Base case benefit	Benefits lost due to exemption
	Residential	SME	Large Commercial		
Option 1	0	31	0	$3.6m	-$0.05m
Option 2	0	156	2	$2.8m	-$0.57m
Option 3	0	266	2	$6.7m	-$0.74m
Option 4	0	97	0	$3.9m	-$0.14m
Option 5	0	253	2	$6.6m	-$0.72m

Although the exemptions framework reduces the economic benefits and emission reductions based on the assumptions used in the quantitative analysis, the economic and social benefits of having it in place will likely outweigh the benefits lost. Exemptions provided will ensure equitable access to essential services and fair operation of businesses without compromising the ACT's emissions objectives.

5.4 Qualitative assessment

5.4.1 Assessment approach

In addition to the quantitative modelling results above, the impact of regulating new gas connections on non-quantified categories is assessed below.

The analysis is split into six key impact categories:

- Energy affordability: The impact of the regulation on the cost of energy for households and businesses.
- Energy grid impact: The impact of the regulation on the reliability and resilience of the energy grid.
- Supply chain impacts: The impact of the regulation on the availability of critical technologies such as residential and commercial electric appliances and other energy supplies.
- Industrial and economic impacts: The impact of the regulation on local industries and the resulting economic impacts.
- Workforce impacts: The impact of the regulation on the workforce, including the need for retraining and job losses.

- Consumer impacts: The impact of the regulation on consumers, including behaviour change, health impacts and development of low carbon ecosystems.

The impact of the proposed regulation on each of these categories has been discussed qualitatively, including key impacts as well as drivers to the scale of impact. Each option that is being considered for implementation zones is then assessed in reference to the driver.

5.4.2 Energy affordability

Retail electricity costs are likely to see no direct impact from this regulation as the scale of incremental electricity demand is not sufficient to drive change. The quantitative modelling shows that the maximum volume of affected load per year is 7 GWh, a small fraction of the ACT's current annual load. Previous modelling by GHD showed accelerating the gas transition would not have a material impact on retail electricity prices[27]. Electricity retail prices within the ACT are expected to increase over the period from 2022 to 2045[28]. This is driven primarily by distribution costs from infrastructure expenditure that is needed for the increase in electricity demand across all regions from EV uptake, electrification and customer growth. Wholesale price changes are passed on to retailers, so an increase in energy costs will further increase prices. Wholesale electricity prices may change over time, but this regulation is not a primary driver given that the electricity demand addition from ACT is small compared with NSW pricing so is not market moving. The magnitude of the increase in demand from this regulation makes it unlikely it will impact retail electricity prices.

Preventing new gas connections will likely lead to an increase in natural gas prices in the long term, regardless of wholesale natural gas price trajectories. Approximately 40% of retail gas prices are from shared network costs[29], meaning the costs required to maintain and operate the gas distribution network. This cost is shared between all consumers as part of their bills. As current consumers disconnect from the network, the pool of users splitting the cost reduces, leading to higher bills for those remaining. These costs are split by each user's consumption, so a reduction in residential users has significantly less impact than contract customers who on average use the equivalent of over 500 residential users' consumption. These drivers of potential cost increases are well-documented, and concerns about accelerated electrification of natural gas connections to decarbonise before 2050 leading to increased shared fixed network costs and future gas customers bearing the costs for unpaid past investments and stranded assets have been noted by the AER[30]. The regulation itself is not the driver of existing consumers disconnecting from the network but will have the effect of negating leaving customers being replaced by new ones coming in, so it will have a small, but lasting effect on gas prices.

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[27] GHD Advisory (April 2022), Retail price impacts of the gas transition, ACT Government

[28] GHD Advisory (April 2022), Economic and Technical Modelling of the ACT Electricity Network: Base Case Report

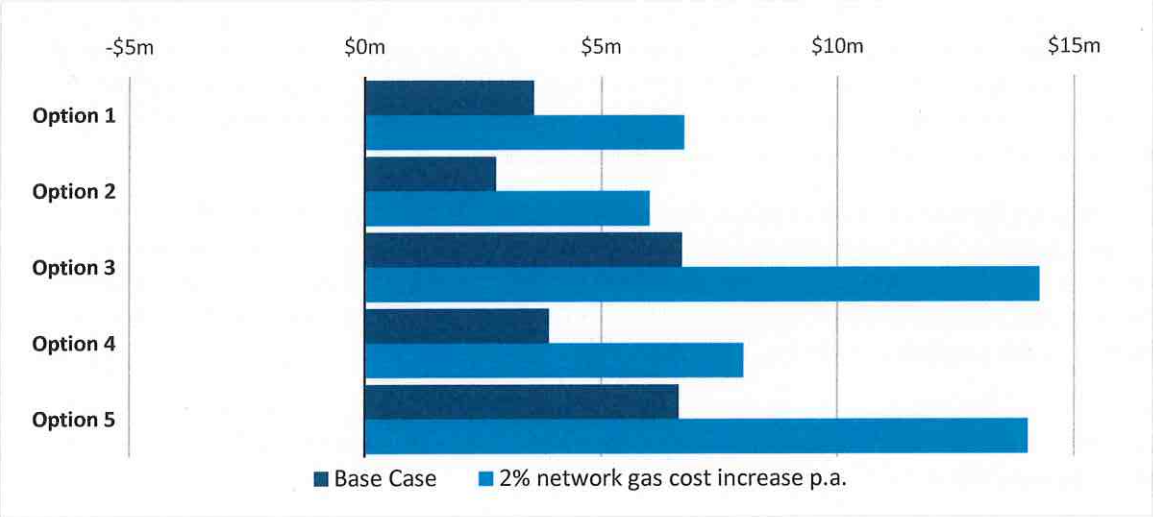
[29] AEMC (April 2021), Trends in ACT supply chain components

[30] AER (November 2021), Regulating gas pipelines under uncertainty

Shared network costs per customer are already increasing as current customers are leaving the network at a consistent rate[31]. This regulation will increase the magnitude of the effect by preventing new customers from connecting to replace leaving customers.

Quantitative analysis only focuses on connections affected by this regulation, so an annual increase to shared network costs for the broad customer base of existing gas users has not been modelled. A simple sensitivity increasing the network component of the retail natural gas costs by 2% p.a. results in net economic benefits increase by an average of 2 times over the 15-year economic life of affected connections. In this scenario the retail costs are 27% higher than in the base case by 2045.

Figure 19 Network retail gas cost increase sensitivity results



Prohibiting natural gas connections in specific regions could reduce costs required to maintain the gas network and prevent additional investment in regions with connection prohibitions in place, offsetting the additional network costs described above. This is unlikely to be of the required magnitude to prevent long term price increases to retail natural gas in the Territory but may soften the increase in the short to medium term.

Existing customers who remain reliant on the gas network are likely to experience the biggest change in energy affordability over the medium to long term. This could result in renters and people in apartments experiencing the largest impacts as they cannot directly control the energy source of their homes and owners are not incentivised to pay upfront costs to electrify. Although the regulation may accelerate gas price increases for consumers, it also has the effect of limiting consumer exposure to future price volatility by preventing the connections entirely.

[31] AER (November 2022), Evoenergy Gas pipeline information - RIN responses

5.4.3 Energy grid impacts

The scale of the impact of this regulation on the local power system in the ACT is dependent on the volume of affected potential new gas connections, the flexibility potential of new electricity demand and the total expected usage. Electricity demand that would have otherwise been gas will increase total electricity usage. Greater electrification will further accelerate the energy transition within the ACT, as the Government has defined electrification as their path in the energy transition in the Our Pathway to Electrification Position Paper[32].

This regulation is a supporting driver to the changes occurring to the electricity network in the ACT. Primary drivers of electrification in the ACT include government policy and regulation, cost of living challenges leading to voluntary electrification, environmental benefits and development of efficient houses planning to have solar, batteries, or electric vehicles. This can be seen in the year-on-year reduction of gas consumption on a per customer basis in the Territory, despite regulation not enforcing reduction in use from existing gas users. Electricity is likely to be more appealing than previously for consumers after a period of high gas prices since 2022.

As electricity demand quickly increases within the ACT, the electricity network has developed increasing issues with congestion, constraints and instability. Increasing demand is expected to continue at pace resulting in the network being the fastest growing in Australia[33]. These issues are amplified by an aging network, rapidly growing demand and changing nature of demand with an increasing penetration of solar and battery systems.

Peak demand is a key driver for electricity network constraints and congestion, and investment required to alleviate this. Peak demand is the maximum amount of electricity that consumers draw from the network at any given time.

Where this regulation prevents new connections to the gas network, consumers will need to electrify their load. This will increase the total demand on the electricity network. Through winter periods where space heating usage is highest, peak demand impacts are magnified, which may require network augmentation to ensure stability. In typical residential and business properties, 75% of gas usage is for space heating[34]. This could lead to a significant increase in winter peak demands depending on the connection scenario. In order to reduce risks to the network, the distributor may need to invest in network upgrades and implement effective demand management strategies. These costs would be recovered from consumers through the distribution network tariff.

In some cases, the distribution network may pass on infrastructure upgrade costs directly to developers of large energy use buildings. This can incentivise to minimise their energy footprint and

[32] ACT Government (August 2022), Our Pathway to Electrification

[33] Evoenergy (January 2023), Regulatory proposal, For the ACT electricity distribution network 1 July 2024 to 30 June 2029

[34] GHD Advisory (April 2022), Economic and Technical Modelling of the ACT Electricity Network: Base Case Report

prevent the need for infrastructure upgrades. Changes to the National Construction Code[35] are bringing in more stringent requirements on buildings energy efficiency, requiring buildings to meet high standards.

Many issues of constraints and congestion on the transmission and distribution network are highly localised, based on the network hosting capacity and electricity demand in a particular street or precinct. Modelling where these areas of congestion will arise is a detailed technical exercise that has not been completed as part of this impact assessment. However, at a very high level, it can be assumed that significant impacts on peak demand for the system are likely to increase changes in congestion and constraint.

Options that include a greater volume of total load have a greater impact on annual demand in the network. Options that include commercial and business loads are likely to have lower levels of flexibility, with these loads typically acting as a fixed load during working hours. Therefore options 3 and 5 have the highest impact, including both residential and commercial zones. Option 2 would have a higher impact than options 1 and 4 as these do not include commercial zones.

5.4.4 Supply chain impacts

Two conflicting impacts of accelerated electrification on the supply chain for required technologies affect the ability to achieve electrification requirements. Accelerated electrification will grow the clean energy sector, expanding the workforce and streamlining supply chain. However, global supply chains for key energy transition technologies such as commercial scale heat pumps have been constrained due to global electrification trends and ongoing issues from the covid-19 pandemic[36].

For residential conversion, supply chains are unlikely to constrain electrification rates as the supply chain is mature, the total incremental volume required by the ACT is comparatively small, and the workforce is existing and can be expanded with simple training. However, heat pump supply chains are under pressure globally, and the ACT is not immune to potential disruptions like those following Russia's invasion of Ukraine. In the *Future Homes Standard*[37], a similar legislation from the UK aiming to future-proof new homes with low carbon and efficient heating system, the role of industry in developing necessary supply chains, skills and construction practice needed to consistently deliver high quality results was highlighted as a key consideration by industry stakeholders. This will be important in the ACT to prevent issues. If supply chains become sufficiently strained, this could lead to increased cost of affected appliances to consumers. If the workforce is not sufficiently increased and upskilled in time, it is likely that there will be increased costs for labour as well.

There is a chance that residential consumers who are prohibited from connecting to the gas network may look to use riskier and more expensive unregulated supply chains such as wood heaters, LPG and ethanol. These products can be more expensive, have higher safety risks, health impacts and

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[35] Australian Building Codes Board, National Construction Code

[36] IEA (2023), Energy supply chains between transition and disruption

[37] Ministry of Housing, Communities & Local Government (2019), The Future Homes Standard: 2019 Consultation on changes to Part L (conservation of fuel and power) and Part F (ventilation) of the Building Regulations for new dwellings: Summary of responses received and Government response

large environmental impacts which would negate the benefits of all electric homes. We have not seen sufficient evidence of this occurring in other markets to determine likelihood but note this as a potential concern.

For large scale electric alternatives to gas appliances, there is a higher risk of supply chain constraints limiting the ability to electrify quickly, as the workforce needs to be highly skilled and the supply chains are less mature, with the majority of manufacturing outside of Australia[38].

Options including a greater number of total connections and including commercial and business connections have a comparatively higher impact on supply chains. This impact could require greater streamlining of supply chains to prevent issues in electrifying to the required timeline but is unlikely to have a direct impact to consumers even for the highest impact scenario.

5.4.5 Workforce impacts

This regulation will contribute to the electrification the ACT which requires a change in workforce structure with new job opportunities coming from electrifying, upgrading, and maintaining homes, businesses, vehicles, and the electricity network required to support. In the gas industry, there will likely need to be a reduction in the workforce over the medium to long term. Overall, the regulation is likely to increase total workforce over the medium to long term and accelerate the upskilling of workforce for the clean energy industry.

The workforce dedicated to gas network operations will need to transition from a focus on expansion, new connections, and maintenance, to one that is primarily focused on maintenance, safety, abolishment and disconnection services to reflect the changing needs of the market. This is likely to lead to a reduction in the size of the workforce dedicated to gas network in the ACT as existing customers disconnect and the volume of new customers quickly reduces. We note that this specific regulation is not the sole driver of a transition away from gas, but it may accelerate the changes outlined.

It is important that the ACT Government works with the gas industry and the trade unions to ensure that workers who are affected by the transition to an all-electric city are supported. Workers that are displaced by the energy transition can be trained and upskilled to service additional needs in electrifying the Territory and servicing the additional needs of the electricity network. Implementing this regulation will provide certainty to industry, allowing them to invest securely in retraining and upskilling the workforce.

The workforce dedicated to the electricity network and supporting roles in electrifying the ACT is likely to require significant additional resources to support the electrification of the economy, maintain current operations and perform necessary upgrades to support network reliability as the ACT transitions and electricity demand increases. Upgrades and network expansion required will include new substations, substation upgrades and community batteries. This workforce could become strained if the workforce does not increase quickly enough, potentially leading to increased labour costs.

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[38] Energy Efficiency Council & Australian Alliance for Energy Productivity (February 2023), Harnessing heat pumps for net zero

The workforce required to electrify residences and buildings within the ACT is reported challenge, for example, the note of an aging workforce of qualified electricians struggling to cope with accelerating demand nationwide[39]. By accelerating the electrification of the ACT, these roles may not be effectively filled by appropriately skilled workers, potentially resulting in supply chain disruption and increased costs to consumers. Labour costs are a key factor in the overall costs of electric appliances as they required a skilled workforce, and shortages in the workforce are likely to drive this cost up, increasing the level of upfront costs required.

The size of the workforce will need to increase to facilitate the transition, as well as existing electrical and plumbing tradespeople needing to be upskilled to familiarise themselves with new electric appliances and technologies. This may require additional training or certification. In Victoria, where they have announced a similar policy banning gas connections to new homes, significant government effort is directed at upskilling the workforce, including an $11m training and workforce development program aimed at upskilling plumbers and electricians to prepare[40]. Likewise, in the UK the government is offering discounts of up to £500 towards the costs of courses to be trained in heat pump installations[41].

All options considered will contribute to the reduction and retraining of workers focused on the gas network, with the volume of connections having some impact to the rate this change occurs. The workforce required to enable the electrification of Canberra in the required timeline is a known challenge, and the regulation will accelerate some aspects of the change. Across many sectors and jobs impacted the transition, targeted upskilling and workforce growth will be necessary to prevent issues. A significant differentiator between different zone options for their impact on the workforce is on the inclusion of commercial zones. The workforce capable of installing commercial scale electric appliances is skilled and currently unlikely to be large enough to enable rapid transition so new jobs and training will be required for these implementation options.

5.4.6 Industrial and economic impacts

The impact of the regulation on industries and the subsequent economic impact is most dependent on what businesses are included in the implementation scenario, mainly if commercial and industrial zones are included.

Implementing the regulation on residential zones is likely to have minimal macroeconomic impact as only a subset of properties is not already prevented from gas connection and electric options are more mature, resulting in positive lifetime cost impacts. This has been shown through the quantitative analysis. While our work did not analyse the impact of energy efficiency investments on house prices, a UK study[42] demonstrates the increased sales value of homes with heat pumps, solar and other decarbonisation investments. Homes affected by this regulation may be slightly higher priced than otherwise due to the lower ongoing costs in comparison to gas as shown in the

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[39] ABC News (November 2022), Tradie shortage could cripple governments emissions reduction targets

[40] Solar Victoria, Training and workforce development

[41] UK Government, Heat Training Grant

[42] ScottishPower & WWF-UK (August 2022), Better Homes, Cooler Planet

quantitative modelling. Houses that remain reliant on gas will need to electrify before 2045 ensuring that this cost is recognised in the long term.

Although building all electric business and commercial buildings can be seen as more expensive or not technically viable today, the inclusion of the requirement to eventually retrofit commercial properties to electrify them significantly changes this. The Green Building Council of Australia's practical guide to electrification, highlights the availability of appropriate and cost effective electrification solutions for all buildings. Not connecting to the gas network at all can result in significant lifetime cost savings as well as avoided connection, disconnection and retrofitting costs. For new buildings, electric options are most cost effective as retrofitting existing gas buildings with all electric appliances results in higher costs than if it was built all electric from inception. Buildings that are reliant on gas are also at risk of changing economic and regulatory environments and are at risk of becoming uncompetitive to more efficient and less emissions intensive.

Although the majority of natural gas use in commercial-scale connections is for space and water heating, which have viable electric alternatives at all scales, there are some instances where natural gas is used for other purposes such as manufacturing or chemical processing. Viable electric alternatives for large scale users in general have higher upfront costs which can be a barrier to commercial users, and some have higher technical feasibility challenges.

Existing larger users are poised to feel the impact of the regulation as they face the prospect of higher gas prices. Exposure to these costs is not solely caused by this regulation, but enforcing no new gas connections may accelerate the timeline and scale of the impact. It can be more challenging for existing industries to electrify than for residential properties and small businesses as the upfront costs required are higher and the technology is generally more bespoke[43]. As such, electrifying before the useful life of their gas appliances is over is difficult to justify. Additionally, there are significant costs associated with retrofitting commercial scale gas systems with electric alternatives such as space heating and cooling in office buildings. These costs are higher than building electric at the original connection timing[44]. The impact of this effect could be higher prices in the medium term as they pass on gas and electrification costs to consumers, while a long-term price reduction after electrification is completed and ongoing costs are reduced. Some large industry stakeholders have indicated that electric alternatives were not viable or cost competitive to gas alternatives in their sectors, and that higher gas costs would need to be passed on to customers.

There are some instances where electrifying may not be technically or commercially viable for a variety of reasons. If the regulation includes commercial and industrial zones, the regulation could have significant impacts to new entrants in some industries. Higher upfront costs for large scale electric alternatives to gas appliances may be prohibitive for new entrants in some industries, limiting competition to existing industry participants. Businesses in this category will be able to connect in industrial zones or other zones not covered in the final implementation option. Otherwise, they will be able to use the exemption framework from the regulation or can use an existing gas connection for supply if they are moving into a building with an existing connection.

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[43] IEA (2023), Energy supply chains between transition and disruption

[44] GHD Advisory (March 2022) Survey of large gas consuming assets. Condition and Concept Report. Environment, Planning and Sustainable Development Directorate

Restricting gas connections in certain areas is expected to lead to regional disparities in the availability of certain products and services. Some professional services and manufacturing processes depend on gas, which could leave new areas unable to serve customers or access markets without exemptions from the gas connection restrictions. Examples of this type of service include commercial kitchens, laundromats, dry cleaners, and chemical manufacturing. In order to minimize the impact of gas connection restrictions on businesses and consumers, it is important to carefully consider the needs of these industries and develop a plan for a smooth transition to a low-carbon economy. The exemptions framework has a key role in allowing continued connections for products and services in this category.

Options including commercial zones will have a greater impact on industries as the majority of commercial connections are located here. The volume of residential connections will have limited direct industrial and economic impact, despite some business connections occurring in residential zones.

5.4.7 Household impacts

Impacted residential consumers are likely to experience largely favourable changes in comparison with if they had been natural gas connected. Removing natural gas consumption is likely to result in increased safety, health benefits, reduced emissions and significantly lower ongoing costs but comes with additional upfront cost that can be challenging for some consumers. All electric buildings can encourage the uptake of solar, batteries and electric vehicles to take advantage of their benefits.

Electrifying traditionally gas-based appliances requires minimal change in consumer behaviour. A recent survey by NESTA in the UK found that heat pump users are generally satisfied with their new heating systems, but they are less satisfied with the ease of use and control than gas boiler users[45]. This suggests that there is a need to improve the education and handover of low-carbon technologies to heat pump users. By understanding these customer pain points, policymakers can better address them when implementing new policies to promote the adoption of heat pumps.

Households will have simpler billing processes without natural gas bills combined with electricity bills. This will allow a deeper understanding of the costs and allow consumers to more efficiently consume energy and implement cost savings behaviours, for example minimising time of day costs or installing solar and other low carbon technologies.

Preventing new gas connections can accelerate the development of low carbon technologies, such as heat pumps, RCAC, electric vehicles, batteries and solar panels to support as consumers electrify and improve their energy efficiency. Integrating these technologies into efficient homes can result in significantly lower ongoing costs to consumers and the technologies will be integrated into the low carbon technology ecosystem in the ACT. Fully electrified and efficient homes and businesses can act as a flexible load as energy is stored through low demand periods and used in high demand periods. Homes with heat pumps and storage can provide flexibility to the electricity grid by storing energy during the day and using it at off-peak periods. Flexibility provided by these technologies can reduce peak demand and improve grid reliability.

[45] Nesta (May 2023), Heat pumps: a user survey, nesta.org.uk, accessed 31 August 2023

Preventing new homes from connecting to the gas network may have positive health impacts for residences, particularly in preventing gas stovetops. Evidence of natural gas stovetops having negative health impacts has emerged over recent years, with some experts pushing to move away from gas cooking for both health and environmental reasons [46]. Gas stoves emit nitrogen dioxide (NO2), a respiratory irritant that can cause or worsen childhood asthma. A study published in the International Journal of Environmental Research and Public Health in 2021 found that preventing new gas stove installations in the United States could prevent an estimated 12.7% of childhood asthma cases[47].

The differentiation between options is largely dependent on the inclusion or exclusion of residential zones, with some increase if more zones are included within the option. These impacts are largely favourable to the consumer experience, cost, health and the environment. The impact from all other options will be similar to each other, with some differentiation in options including more connections having a larger impact.

5.5 Summary

The table below summarises the level of impact from the both the quantitative and qualitative analysis.

It is important to note that the impacts described are the incremental impact of the regulation. For example, accelerated network investment required to alleviate issues has been assessed as low to moderate, but there will be significant investment required regardless because of the energy transition occurring in the ACT.

Table 8 Summary of quantitative and qualitative assessment

		Option 1	Option 2	Option 3	Option 4	Option 5
Quantitative						
Economic impact	Total net benefits	*$3.6m*	*$2.8m*	*$6.7m*	*$3.9m*	*$6.6m*
Emissions	Cumulative emissions avoided	*98 ktCO2e*	*107 ktCO2e*	*242 ktCO2e*	*130 ktCO2e*	*237 ktCO2e*
Total	Net benefits including social cost of carbon central case	*$40.2m*	*$40.4m*	*$94.1m*	*$51.5m*	*$91.9m*
Qualitative						

[46] Eric D. Lebel, Colin J. Finnegan, Zutao Ouyang, and Robert B. Jackson, Environmental Science & Technology, (January 2022), Methane and NOx Emissions from Natural Gas Stoves, Cooktops, and Ovens in Residential Homes

[47] Gruenwald T, Seals BA, Knibbs LD, Hosgood HD III. International Journal of Environmental Research and Public Health, (December 2022), Population Attributable Fraction of Gas Stoves and Childhood Asthma in the United States.

Energy affordability	Accelerated gas price increase	*Low*	*Low*	*Moderate*	*Low*	*Moderate*
	Electricity price impact	*Low*	*Low*	*Low*	*Low*	*Low*
Energy grid impacts	Accelerated network investment required to alleviate issues	*Low*	*Low*	*Moderate*	*Low*	*Moderate*
Supply chain impacts	Potential for limiting timeline of residential uptake	*Low*	*Low*	*Low*	*Low*	*Low*
	Potential for limiting timeline of commercial uptake	*Low*	*Low*	*Moderate*	*Low*	*Moderate*
Industrial and economic impacts	Potential to limit new entrants to some industries	*Low*	*Moderate*	*Moderate*	*Low*	*Moderate*
	Existing consumers electrification and higher ongoing costs passed on to consumers	*Low*	*Moderate*	*Moderate*	*Low*	*Moderate*
Workforce	Accelerated reduction of gas workforce	*Moderate*	*Low*	*High*	*Moderate*	*High*
	Challenges in increasing electricity workforce limiting timeline of transition	*Low*	*Moderate*	*High*	*Low*	*High*
Other consumer impacts	Improved health to residential consumers	*High*	*Low*	*High*	*High*	*High*
	Reduction in consumer satisfaction	*Low*	*Low*	*Low*	*Low*	*Low*
	Accelerated development of low carbon solutions	*Moderate*	*Low*	*Moderate*	*Moderate*	*Moderate*

Option 1 covers only residential zones in the Territory, affecting a majority of household connections with some small and medium businesses included. For connections included in the quantitative methodology (excluding connections post 2030) implementing will result in $3.6 million in net economic benefits along with 98,000 tCO2e of emissions avoided.

Household consumers will be the most affected group, with some impacts to business consumers and government consumers. Household will experience long term benefits in reduced energy costs, simpler billing, and reduced risk of health impacts from exposure to natural gas in the home. Consumers affected by the regulation will be impacted in requiring higher upfront costs but receiving

savings over a long-term period. One of the key impacts to consumers will likely be to new property owners who own their property for less than 15 years. For these consumers, a clear framework which means that the residual value of the electric appliances are incorporated into the sale value of the property will be key. Clear regulation, including clarity on long-term ambition to phase out existing gas consumption is an important part of this, and the government could consider addressing this further through consumer education, or building standards which clearly demonstrate the economic benefit and allow this to be valued in sale.

Implementing to residential zones will slightly accelerate the electrification of the Territory, but it is expected this will not have significant impacts to workforce, supply chains and energy grid required to enable the energy transition. Supply chains for residential electrification appliances such as heat pumps are experiencing pressure globally, but the magnitude of the ACTs requirements is small and unlikely to limit electrification timelines. The workforce does require targeted upskilling and will need to be increased to ensure a smooth, low-cost transition. The volume of impacted energy is also low and will be unlikely to require any acceleration in energy infrastructure upgrades required.

Option 2 covers only commercial zones, including 50% of small and medium business and 40% of large commercial consumers. For connection from now to 2030, implementing will result in $2.8 million in net economic benefits along with 107,000 tCO2e of emissions avoided.

Consumer impacts are mostly to businesses, with some residential connections included. Businesses may be more affected by the additional upfront costs required for electrification over gas than households, as they are often heavily capital constrained and are considering economic benefits on horizons less than 15 years due to shorter business lifetime or property tenancy. As most businesses do not include gas cooking appliances, the health benefits are lower, as they are not directly exposed to gas in indoor spaces.

Requirements for ensuring a smooth implementation to commercial zones are different to residential zones, with supply chains for large scale appliances such as heat pumps being less mature, and the required workforce needing to be more skilled. This will require a targeted effort to ensuring supply chains for appliance and an increase in the workforce that can complete required work to prevent increased costs and delays. However, this option sees the smallest number of connections impacted, meaning the number of systems required for electrification is the lowest of all options and strain on equipment manufacturing slightly lower. The additional demand from commercial zones may require electricity network infrastructure upgrades depending on the state of the local networks in affected areas.

Like any of the options which include commercial businesses, there is likely to be a clustering of businesses which require gas into industrial zones. This may cause some inequity in ability to access services for the community, based on location, but an exemptions framework would ensure that any essential services were not directly impacted. Long-term it will be important to consider the location of these zones compared with connecting essential services to ensure that the gas network can be used and maintained in an efficient manner. For example, if the vast majority of gas users can be serviced by a small part of the network, it may become increasingly inefficient to maintain the rest of the network, and costs will increase on a per customer basis accordingly. This locational analysis has not been considered in this study.

We would expect the impact on Government of including commercial zones to be an increase in effort for assessment of exemption applications, which would require a detailed understanding of the often bespoke nature of individual business needs.

Option 3 includes all zones excluding industrial zones, covering the vast majority of connections across the territory, with industrial zones including the largest gas users in the territory and some large commercial consumers. Over the period to 2045 implementing will result in the largest impact and emissions reductions, with $6.7 million in net economic benefits along with 242,000 tCO2e of emissions avoided.

Consumer impacts cover both the commercial zones and residential zones previously described, with some additional impacted business and households included in community facility, parks and recreation and transport and services zones.

Implementing in line with option 3 will have the largest impact in accelerating the electrification of the territory, having the highest risk of workforce and supply chains constraints occurring and accelerated network infrastructure upgrades required. As such, the impacts of both the previous two options are included, and government support will be required to ensure a smooth and effective transition.

Option 4 covers residential and community facility zones, and shares similar, slightly reduced impacts to option 1, as community facility zones only include a small additional volume of small and medium business consumers. Over the period to 2045 implementing will result in $3.9 million in net economic benefits along with 130,000 tCO2e of emissions avoided.

The inclusion of community facility zones does not make a large impact to the quantitative results, due to the small number of connections per year. However, it is likely that a higher proportion of businesses planned for these areas are providing social benefit which is dependent on their location. We would expect this to be addressed through the exemption framework.

Option 5 covers residential, commercial and community facilities, and shares similar, slightly reduced impacts to option 3. Over the period to 2045 implementing will result in $6.6 million in net economic benefits along with 237,000 tCO2e of emissions avoided.

6 Appendix A

6.1 Modelling Approach

In order to understand the impact of the prohibiting new gas connections in both new construction and renovation projects that require either a new gas connection or alteration of an existing one, our focus was on the primary gas-consuming processes in dwellings and commercial premises. We conducted a comparative analysis of the total cost of ownership for typical appliances that are powered by either gas or electricity. The major processes and their associated appliances in our analysis are:

- Space heating: For all customers, gas ducted systems or ducted electric heat pumps
- Water heating: For residentials and small and medium businesses, gas or electric hot water systems
- Cooking: Residentials only, gas cooktop or induction cooktop

The cost components of total cost of ownerships are:

	Dual-fuel pathway (Gas connection)	All-electric pathway (Electric connection)
Network connection cost	√	X
Appliance purchase and installation	√	√
Running cost	√	√
Network disconnection cost	√	X
Upgrade cost	√	X

- **Connection cost:** Regulated standard fees for connection to gas network, varies by customer segment. Electricity network connection cost is not included for the electrified option as is it assumed that this is required regardless. The potential cost of more-expensive electricity connection (e.g., three phase) for all-electric pathway to accommodate all types of electric appliances are assumed to be covered under the premise's development costs.
- **Upfront costs:** Initial expenses associated with the purchase and installation of the appliances (either gas or electric)
- **Running costs:** Energy expenses (either gas or electricity) incurred over an estimated asset life of 15-year period. Based on gas/electricity consumption and retail rates. Daily supply charge included for gas assets. Maintenance costs are excluded from the assessment as these costs tend to be more relevant to large commercial connections, and obtaining comprehensive data on those remains a challenge.
- **Gas disconnection cost:** Considered at the end of the 15-year period.
- **Upgrade cost:** Costs related to premise's electricity supply upgrade to be able to switch to electric appliances when gas appliances reach end-of-life. We have not included costs of alternative accommodation for example if apartment tenants need to move out of the

property during an upgrade, given these costs are very property-specific and we are modelling on an average basis. However, this may add additional costs for certain cases.

The net benefit for each individual connection is determined by calculating the difference between total cost of ownership for gas appliances and the total cost of ownership for electric appliances presented in Net Present Value. A positive value confirms net benefit or saving to the customer. Total aggregated benefits for the implementation option is achieved by scaling up individual net benefits by the number of customers in each option.

Our analysis draws upon a variety of public and confidential sources to gather the necessary inputs:

Parameter	Source
Number new connections	Attachment 3 and 6 provided by the ACT Government
Upfront Cost	Residential: GHD (April 2022), All-Electric New Homes Cost Assessment. Department of Environment, Land, Water and Planning. Appendix B Small and medium businesses and large commercials: GHD (March 2022) Survey of large gas consuming assets, Condition and Concept Report. Environment, Planning and Sustainable Development Directorate
Upgrade cost	Residential: Frontier Economics (June 2022), Cost of switching from gas to electric appliances in the home. Gas Appliance Manufacturer's Association of Australia. Small and medium businesses and large commercials: GHD (March 2022) Survey of large gas consuming assets, Condition and Concept Report. Environment, Planning and Sustainable Development Directorate
Energy consumption	GHD, Acil Allen (April 2022), Economic and Technical Modelling of the ACT Electricity Network Strategic Report. EPSDD.
Retail rates	ActewAGL, ACT Standard plan electricity prices. Schedule of charges from 1 July 2023. (Standard Plan Home & Standard Plan Business) ActewAGL, ACT Standard plan natural gas prices. Schedule of charges from 1 July 2023. (Standard Plan Home & Standard Plan Business)
Discount rate	7% (real, pre-tax)
Asset useful life	15 years

The limitations of modelling approach are predominantly outlined in the main body of the report where relevant, however two further points are noteworthy:

- We did not define and analyse economics for customer sub-segments beyond residential, small and medium businesses and large commercial, which is an oversimplification. However,

this simplification was necessary to facilitate the work within the desired timeframe. Additionally, previous data collection efforts by the ACT government posed challenges in this regard. The sensitivities on upfront and upgrade costs aims to estimate the range possible solutions in the absence of sub-segment details.

- Our analysis assumes that large customers are billed at standard retail rates. Typically, large customers enjoy preferential rates, which are often lower than the published ones. If we had considered these bespoke rates (lower than the standard tariffs) in our analysis, the calculated savings would have been reduced. However, due to the low number of large connections the direction of results would not change.

6.2 Social cost of carbon

AUD 2021, discount rate and climate sensitivity				
	Low - discount rate sensitivity on Central case	***Central case***	***High - discount rate sensitivity on Central case***	***High impact – 95th percentile impact***
	Rovingston Advisory, 2021, A social cost of carbon for the ACT Government (unpublished)	*ACT Climate Change Council, 2021, Updated advice on the use of a social cost of carbon in the ACT (unpublished)*	*USA Interagency Working Group on Social Cost of Greenhouse Gases, 2020, Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990*	*USA Interagency Working Group on Social Cost of Greenhouse Gases, 2017, Technical Support Document: - Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis - Under Executive Order 12866*
	5%	***3%***	***2.5%***	***3%***
2020	20	71	104	207
2021	21	72	106	211
2022	21	73	108	216
2023	22	74	110	221
2024	23	76	112	226
2025	24	77	114	232
2026	24	79	116	236
2027	25	80	117	241
2028	25	81	119	246
2029	26	83	121	250
2030	27	84	123	255
2031	28	86	124	260
2032	28	87	126	266
2033	29	89	128	271
2034	30	91	129	277
2035	30	92	131	282
2036	31	94	133	287
2037	32	96	135	292

2038	33	97	137	297
2039	34	99	139	302
2040	35	101	141	307
2041	36	102	143	312
2042	37	103	144	317
2043	37	105	146	321
2044	38	106	148	326
2045	39	107	149	331
2046	40	109	151	336
2047	41	111	153	341
2048	42	112	155	346
2049	43	114	157	351
2050	44	116	160	356