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Powering progress: Energy upgrades to low-income housing

Energy upgrades to low-income housing supports decarbonisation and economic growth.

July 2024

Deloitte Access Economics

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Acknowledgement

This project was prepared for the Australian Council of Social Service who received funding from Boundless Earth and Paul Ramsay Foundation. The views expressed in this document do not necessarily reflect the views of Paul Ramsay Foundation and Boundless Earth.

We would like to acknowledge the collaboration of Tom Quinn, Springmount Advisory, who compiled, analysed and provided Census (2021) data, AIHW (2023) data and Climateworks Renovations Pathway data to inform the modelling. As well as Dr Gill Armstrong and Joshua Danahay of Climateworks Centre, who provided data extracts and findings from the Renovation Pathways Program, particularly findings from their national housing stock model and data specific to each state and territory.

Foreword

Climate change is driving the need to accelerate emission reductions to avoid more dangerous impacts and build resilience to deal with the climate impacts already locked in. People and communities on lower incomes and experiencing disadvantage are impacted first, worst and longest by climate change, particularly where the solutions are too slow, inequitable and non-inclusive.

We are faced with a serious choice between allowing actions to address climate change to make poverty and inequality worse or to seize the opportunities for a brighter future for all.

For example, people on lower incomes and experiencing disadvantage are more likely to live in poor energy performing homes that are too hot in summer and too cold in winter and are getting sick or dying. But these same people lack the resources and control to improve the energy performance of their homes to reduce costs and make them climate safe.

Home energy upgrades play a crucial role in cost effectively reducing emissions and building climate resilience, along with reducing energy bills, creating jobs and improving energy security and reliability.

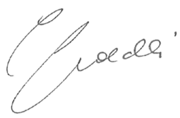
We should accelerate home energy upgrades for low-income housing so we help those most in need and prevent people most at risk being left further behind. We can significantly reduce energy hardship, poverty and inequality, and substantially improve health and wellbeing.

The 2024 ACOSS report Funding and Financing Energy Performance and Climate-resilient Retrofits for Low-income Housing, identifies barriers, objectives and solutions to rolling out home energy upgrades across the different types of low-income housing. Government funding will be needed.

This report spells out some of the direct benefits to low-income households of home energy upgrades, as well as the broader economic and social opportunities for Australia of accelerating these upgrades over the next seven years.

The benefits to the economy in GDP, job creation and emissions reductions are substantial and should provide the impetus for Treasuries to make the investment. It is the positive and long-lasting impacts on the lives of people most in need that should be the impetus for Governments to make it an investment priority.

Dr Cassandra Goldie
CEO of ACOSS



Key insights

There is **a $10-17 billion opportunity for Australia's economy** from delivering on thermal efficiency and electrification upgrades to 1.2 million low-income households. The upgrades not only lower energy bills for those most in need, but support economic and job growth by bringing forward energy efficiency and electrification retrofits that need to occur as Australia becomes a net zero economy.

- Households will play a central role in helping Australia achieve its net zero target by 2050. Improving energy efficiency and increasing electrification through renovation and upgrades offers a clear national economic opportunity that can be kick-started by targeting low-income households.
- Barriers exist to improving the energy efficiency and energy performance of low-income housing. If home energy upgrades could be achieved, it would bring multiple benefits to the household including lower energy bills, reduced energy hardship, better health outcomes and climate resilience.
- To help accelerate the uptake of home energy upgrades across different types of low-income housing dwelling types,[I] the Australian Council of Social Service (ACOSS) has proposed a suite of policies supported by a funding mechanism, the Australian Efficiency Resilience Retrofit Fund (AERRF). The AERRF would deliver a mixture of direct funding and low-cost financing over the next seven years.[1]
- This study models the benefits of accelerating home energy upgrades as per the ACOSS proposal. It quantifies taking this action above and beyond existing government policy, and measures direct benefits to households and Australia's economy.
- The upgrades that form the main focus in the study based on Climateworks' 'quick-fix scenario', include insulation, draught proofing, curtains, window shades and a shift from electric appliances (e.g., electric cooktops, heat pumps).[2]
- The average one-off cost of upgrades considered in the 'quick-fix scenario' are around $13,600 per household, while the average energy bill savings resulting from the upgrades are expected to reach around $1,650 per household, per year.[3]
- The spend on upgrades and additional spending stimulated by bill savings of low-income households, generates up to **$10 billion** in additional Gross Domestic Product (GDP) over the rollout period, in present value terms.[II]
- Economic and employment benefits are driven by the significant construction upgrades (including a direct increase in construction and installation employment, as well as flow on employment in other parts of the economy, like services and manufacturing) and from the bill savings that low-income households gain, supporting greater flexibility to spend on other goods and services which supports further growth in the economy.
- At the same time, the demand for certain workers changes between sectors as part of Australia's broader transition to net zero. The net national employment effect peaks at 12,630 additional jobs in 2028. On average, **7,160 additional jobs are supported each year** due to the quick-fix home energy upgrade rollout.
- The emissions reductions supported by these upgrades are estimated at up to 2,400 kt CO_2e per year. This could be worth another **$3 billion in avoided emission abatement costs on the path to net zero**, in present value terms.
- Further expanding upgrades would drive larger household and economic benefits. The Climateworks 'modest **+** solar scenario', increasing floor insulation, improving window glazing, and adding solar in addition to the quick-fix upgrades, could generate additional household savings of $3,350 a year, **$17 billion** in GDP in net present value terms and support a further 12,700 FTE (average) jobs per year over the rollout period, relative to the baseline economic trajectory.
- By investing in low-income housing upgrades, Australia can drive home energy upgrades, which have to occur on the path to net zero. This lowers the cost to the wider economy and appropriately designed financing and policy mechanisms could lower the up-front cost to low-income households, driving longer run cost-of-living and economic benefits.

[I] Public housing, community housing, First Nations community-controlled housing, private rental properties, and owner-occupier homes.
[II] The net present value is an estimate of the additional gain to GDP using a 7% discount rate.

Figure i Housing energy efficiency and electrification upgrade 'scenarios'

QUICK-FIX ROLLOUT

Energy efficiency upgrades

- Insulation - Ceiling Draught proofing
- Curtains - Heavy drapes
- Window shades - Roller shutters
- Thermal appliances - Electric heat pump

Electrification

- Efficient electric hot water heaters and cooktops

$10 billion
economic opportunity for Australia

7,160 jobs
additional FTEs supported per year

ECONOMIC BENEFITS

- Economic stimulus from expenditure on household upgrades
- Savings on energy bills among low-income households
- Reduction in energy poverty in Australia

MODEST + SOLAR ROLLOUT

Energy efficiency upgrades

- Insulation - Ceiling Draught proofing, floor insulation
- Curtains - Heavy drapes
- Window shades - Roller shutters
- Window system - additional layer or glass or film
- Thermal appliances - Electric heat pump

Electrification

- Efficient electric hot water heaters and cooktops

Solar

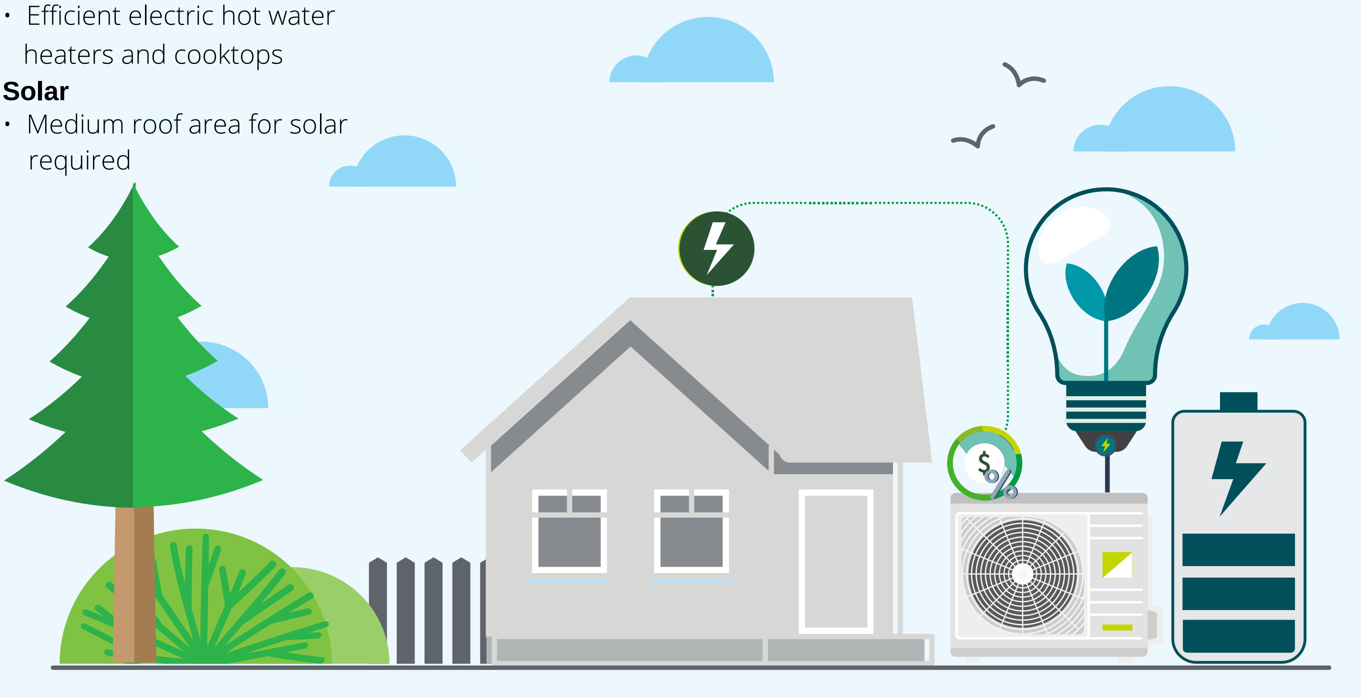
- Medium roof area for solar required

$17 billion
economic opportunity for Australia

12,700 jobs
additional FTEs supported per year

ECONOMIC BENEFITS

- Economic stimulus from expenditure on household upgrades, greater than quick-fix
- Higher savings on energy bills among low-income households
- Reduction in energy poverty in Australia



Source: Deloitte Access Economics, adapted from Climateworks (2024).[4]

Executive summary

A national economic opportunity

Upgrading low-income housing to be more energy efficient, electrified and climate resilient represents a significant economic opportunity on the path to net zero. Despite some recent policy initiatives to encourage household energy upgrades, a program tailored to the circumstances of low-income households is required.

The economic benefits of improving energy efficiency and electrifying 1.2 million low income households could add $10-17 billion to Australia's economy and save $3 billion in avoided abatement costs.

Australian housing: too hot in the summer, too cold in the winter

The poor energy efficiency of Australia's existing housing stock is a challenge to realising the transition. Many Australian homes waste energy, are unnecessarily expensive to power, are too hot in summer and too cold in winter. This contributes to the 24% of overall electricity and over 10% of total carbon emissions used by households in Australia.

In Australia, the average energy efficiency rating of existing homes is only 1.7 stars compared with an average of 7 stars out of 10 required of new homes.[5] A greater share of low-income households occupy low energy efficiency housing, which contributes to energy hardship and poor health and wellbeing.[6]

There are almost 2 million low-income households across public housing, community housing, First Nations community-controlled housing, private rentals, and owner occupiers,[7] who lack choice and control to improve the energy performance of their homes.

A starting point, but not enough and not targeted at low-income households

The Australian Government established a $1.3 billion Household Energy Upgrades Fund (HEUF). The HUEF includes $1 billion in equity to the Clean Energy Finance Corporation to partner with banks and other lenders to provide discounted consumer finance for home energy upgrades to more than 110,000 homes. The HEUF also includes $300 million to upgrade 60,000 social housing properties.[8]

While this is a start, a gap remains in the ambition to achieve net zero emissions in buildings, especially for people who would benefit from upgrades the most. A tailored package of financing, funding and policy arrangements to prioritise and accelerate low-income household home energy upgrades is required to drive a renovation wave and improve the health and wellbeing of low-income households.

The proposal

The Australian Council of Social Service (ACOSS) is calling for the acceleration of home energy upgrades for low-income housing. Specifically for federal, state and territory governments to fully fund all social housing upgrades by 2030/31, provide assistance for low-income owner occupiers through a combination of subsidies and zero-interest loans by 2030/31, and upgrade private rental properties through a combination of mandatory energy performance rental standards and conditional incentives via combination of subsidies and concessional loans.

ACOSS has proposed a finance mechanism, the Australian Efficiency Resilience Retrofit Fund (AERRF), as a way to fund the delivery of home energy upgrades for these low-income housing dwelling types. An initial $2 billion of Federal Government investment in year 1, scaling up over the next seven years, would help to catalyse a range of state and territory, philanthropic, and other private sources of funding to reduce the significant up-front costs associated with the upgrades.

The upgrades

This study draws on the Climateworks Renovation Pathway modelling, and looks at the benefits of accelerating the Climateworks home energy upgrades 'quick-fix scenario' and the 'modest + solar scenario' to low-income households.

The 'quick-fix scenario' would deliver insulation, draught proofing, curtains, window shades and electric appliances (e.g., electric cooktops, heat pumps).

The 'modest + solar scenario' would deliver the quickfix upgrades plus floor insulation, window treatment and rooftop solar.

The study focuses on households in the lowest income quintile, those earning less than $800 per week (in 2021). It considers existing government policy and assumes not all 2 million low-income households need comprehensive upgrading. The study also assumes a baseline case, that without the AERFF policy suite or another form of dedicated funding, the upgrades would occur, but at a slower rate. Based on these assumptions and estimates provided by ACOSS (2023),[9] a quick-fix low-income housing energy upgrade program was modelled that would involve a one-off investment averaging around $13,600 per household, reaching around 1.2 million homes over a seven-year timeframe (section 2).

The AERRF intent is for funding and financing to accelerate the rollout of these upgrades and deliver them within a seven-year period. The upgrades would ultimately result in lower energy consumption for low-income households, reducing both emissions and energy bills among this cohort. The rollout would also generate significant direct capital investment and flow on benefits across the economy. The 'quick-fix scenario' would generate an average annual household saving estimate of around $1,650 per year for energy-efficiency thermal upgrades and electrification.

With additional expenditure on household upgrades, to achieve the 'modest + solar scenario', there is potential for greater energy savings and greater economic impacts associated with the higher expenditure. These could deliver further household bill savings of up to $3,350 per year.[10]

Economic impact results

It is estimated that accelerating electrification and energy efficiency upgrades (quick-fix upgrades) for low-income households, facilitated by the AERRF, could deliver up to $10 billion in additional Gross Domestic Product (GDP) in net present value terms above the baseline over the rollout period.[III] These upgrades can also generate a significant uplift in employment associated with installation and wider supply chain impacts. On average, between 2024 and 2031, employment is estimated to be more than 7,160 FTE jobs higher on average per year. At the peak of the construction rollout in 2028, net national employment reaches 12,610 FTE jobs additional to the baseline. These economic and employment benefits are driven by the significant construction upgrades and from the bill savings that low-income households gain, supporting greater flexibility to spend on other goods and services which supports further growth in the economy.

A larger scale of upgrades (modest + solar upgrades) would drive larger economic benefits and support reaching net zero emissions. Increasing floor insulation, adding solar and improving window glazing, in addition to the quick-fix upgrades, could generate an additional $17 billion in GDP in net present value terms and support a further 12,700 FTE jobs per year (one average) over the rollout period relative to the baseline economic trajectory. At the peak of the construction rollout in 2028, net national employment reaches 22,550 FTE jobs additional to baseline.

Wider impacts

Wider benefits from reduced emissions and reduced costs to the public sector in managing health issues arising from poorly thermal controlled housing. Household-level engagement in the energy transition may also generate increased public support and improved social license.

The emissions reductions supported by these upgrades could be up to 2,400 kt CO2e per year. This is approximately equivalent to the emissions of 750,000 of Australian passenger vehicles today.[11] This could be worth a further **$3 billion in avoided abatement costs on the path to net zero, in present value terms**.

By investing in low-income housing upgrades, Australia can drive a renovation wave and lower the costs to the wider economy on a path to net zero. Targeted and appropriately designed Federal Government financing mechanisms could lower the up-front costs to low-income households, driving longer run cost-of-living benefits.

[III] The net present value is an estimate of the additional gain to GDP using a 7% discount rate. This discount rate is applied for all net present value calculations.

1 Energy efficient and electrified housing is key to a net zero Australia

Improving energy affordability, achieving emissions reduction targets, and lowering the cost of the transition to households require a once-in-a-generation renovation of Australia's housing stock. There is an opportunity to drive this transformation via low-income housing energy upgrades.

Housing is not yet a focus in Australia's transition to net zero emissions. But it needs to be.

Australia has a legislated net zero emissions target by 2050. To deliver on this, Australia's entire economic and energy system will need to rapidly transform to become low- or no-emissions. In this transformation, there will be a constant focus on the affordability of this change and trade-offs created by it – for households, industry, and governments alike.

Current policy settings focus on the immediate role for industry and governments in shifting the energy system to become renewable and low emissions. This is a fundamental step in supporting broader decarbonisation across the economy, particularly in households.

Residential buildings use around 24% of overall electricity and generate over 10% of total carbon emissions in Australia,[12] and there is an increasing understanding of the role that housing – and households – must play in decarbonisation. The long recognised poor quality of energy efficiency in Australia's housing stock means that these upgrades are not just essential to supporting emissions reduction but can be central to the quality of life of many Australians.

The 2023–24 Commonwealth Budget allocated $1.3 billion to establish the Household Energy Upgrades Fund (HEUF). This includes $1 billion to the Clean Energy Finance Corporation to partner with lenders to offer low-cost finance and mortgages for energy performance upgrades, which low-income households are unlikely to take up. The HEUF also includes $300 million to match funding with state and territory governments to do home energy upgrades for 66,000 (15%) social houses. These are necessary steps that recognise the need to support households to play a role in decarbonisation, but much more needs to be done, especially for low-income households.

Older Australian homes are energy inefficient

The majority of Australian homes have an average rating of 1.7 stars (out of 10), with new homes required to meet a minimum threshold of 7 stars.[13] For millions, this means the design of their home allows for energy loss, giving rise to unnecessarily high energy bills and uncomfortable living, and energy intensive practices for heating, cooling, and living.[14] Approximately 73% of residential dwellings (about 8 million) were built before the development of any energy efficiency standards in Australia.[15]

Lower income households are more likely to live in energy inefficient homes and there are a range of barriers to improving efficiency and broader access to low-emission technology.[16] Affordable housing tends to be older and less energy efficient. These houses are also less likely to have solar, home batteries, or broader electrification (they rely on gas, for example) to reduce energy bills. The costs of maintaining a comfortable standard of living for those in poor quality homes becomes increasingly higher.[17] The homes are too hot in summer and too cold in winter, leading to significant health impacts.

As a result, lower income households are likely to spend a larger proportion of their income on energy bills or experience energy deprivation leading to energy hardship, and face poor health outcomes.

These households:

- Have limited capacity to invest in energy performance improvements to reduce household bills, which adds to cost of living pressures. It is a persistent cycle of inefficiency causing higher costs, and higher costs maintaining inefficiency.
- Low-income renters have limited choice or control to alter the energy performance of dwellings they reside in. Properties are rented (and sold) with a limited understanding of energy performance ratings for prospective tenants or purchasers. With the exception on insulation requirements in the ACT and heating requirements in Victoria, there are no requirements for landlords to improve the energy performance of their rental properties.
- For low-income owner-occupiers, cost and access to the capital required to improve energy performance is a barrier to achieving the longer-term financial benefits of increasing energy performance.

These challenges, particularly amid broader housing market challenges and dynamics, mean lower income households are not positioned to participate in the necessary changes required in housing for the economy to transition to net zero at *lower cost*.

The Australian Efficiency and Resilience Retrofit Fund would provide financing solutions for deep electrification and energy upgrades for low-income households

ACOSS is calling for the acceleration of home energy upgrades for low-income housing. Specifically for federal, state and territory governments to fully fund all social housing upgrades by 2030/31, provide assistance for low-income owner occupiers through a combination of subsidies and zero-interest loans, and upgrade private rental properties through a combination of mandatory energy performance rental standards and conditional incentives via combination of subsidies and concessional loans.

ACOSS has identified a range of funding and finance solutions needed to enable retrofits to low-income housing to increase their energy performance. ACOSS' proposed finance mechanism, the establishment of the Australian Efficiency and Resilience Retrofit Fund (AERRF), would deliver support to a range of low-income housing dwelling types (refer Figure 1.1) to enable and encourage the rapid uptake of deep home energy upgrades.

The assumption here is that without the AERFF policy suite or another form of a dedicated funding, the upgrades for low-income housing would occur, but at a slower rate and after everyone else. In line with ACOSS' policy intent, the impact of properly funding social housing, overcoming capital and financing constraints for low-income households and private landlords, and more clearly communicating the benefits of these upgrades, will bring forward this rollout.

The details of the AERRF

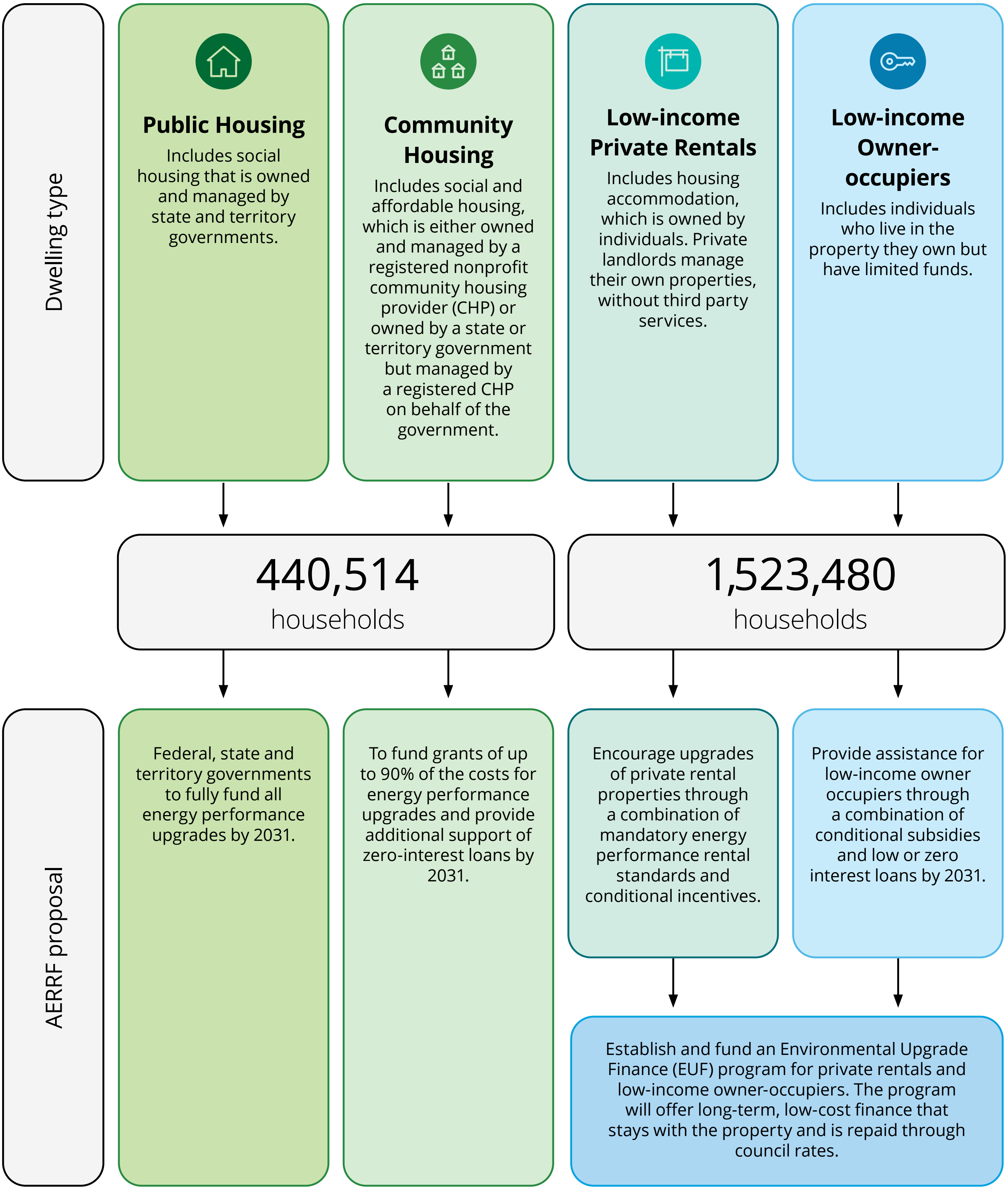
An initial $2 billion of Federal Government investment in year 1 to establish the AERRF would need to scale up in the next seven years to help to catalyse a range of state and territory philanthropic and other private sources of funding to reduce the significant up-front costs associated with low-income home energy upgrades and address the split incentives that exist between homeowners and renters.

The policy approach identified by ACOSS includes the implementation of a seven-year low-income household energy upgrade program to enhance energy performance and climate resilience, building on existing Government programs.

The funding and financing recommendations as part of the AERRF would depend on housing dwelling type:

- Public housing, State owned, and Community Housing Provider managed, and First Nations community-controlled Housing upgrades would be fully funded by federal, state and territory governments.
- Community Housing Provider owned and managed Housing would receive fund grants of up to 90% (or more if required) of the costs for energy performance and climate-resilience retrofits with the additional support of zero-interest loans.
- Establishing and funding an Environmental Upgrade Finance (EUF) program for private rental properties and low-income owner-occupiers, offering long-term, low-cost finance repaid through council rates.
- Until EUFs are implemented, private rentals (alongside minimum energy performance rental standards) and low-income owner-occupiers would receive offers that depend on specific eligibility criteria and involve a combination of zero-interest loans, free audits/in-home advice, and subsidies.

Figure 1.1 The four low-income household dwelling types targeted by the AERRF



Source: Deloitte Access Economics adapted from ACOSS and Springmount Advisory based on Census (2021); AIHW(2023).

Economic analysis in this report

This report focuses on the impacts of delivering energy upgrades to low-income households – a transformative upgrade to 20% of Australia's dwellings. This rollout would be enabled and part-financed by the AERRF, crowding in investment from a range of sources and drive Australia's renovation wave.

The analysis has used scenario modelling based on Deloitte Access Economics' in-house integrated climate-economy model, D.Climate. This economic modelling looks at the impacts of policy changes, such as energy upgrades, on Australia's emissions, energy system and economy on the path to net zero.

The scenario reflects data collated by Climateworks and ACOSS and is referred to as a 'quick-fix rollout'.

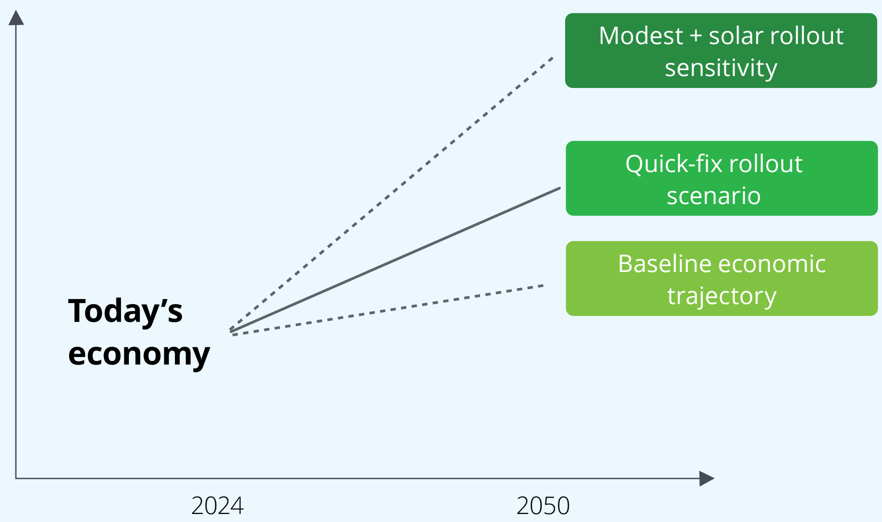
The scenario is compared to a baseline, which assumes that these upgrades occur at historical rates.

The 'quick-fix rollout' would deliver an initial boost to construction and installation expenditure, followed by additional economic and employment benefits derived from energy bill savings for low-income households.

The expenditure enabled by these savings, supports economic activity in other parts of the economy, highlighting the wider benefits of driving a climate-resilient renovation wave with low-income housing.

A 'modest + solar rollout' sensitivity analyses the additional benefits that could be realised with more extensive energy upgrades, which come at a higher cost to government and households, but deliver larger bill savings.

Figure 1.2 Approach to modelling the Australian Efficiency and Resilience Retrofit Fund



Baseline economic trajectory

The baseline economic trajectory assumes low-income housing upgrades are completed by 2050. Lower emissions reduction and slower technology change characterise the economy.

Quick-fix rollout scenario

The quick-fix rollout scenario describes a situation where low-income households are supported to undertake a range of energy efficiency and electrification upgrades that ultimately reduce the emissions from low-income homes.

Modest + solar rollout sensitivity

The modest + solar rollout sensitivity describes a situation where low-income households are supported to undertake a wider range of energy efficiency and electrification upgrades, as well as solar installation that greatly reduces the emissions from low-income homes.

Source: Deloitte Access Economics.

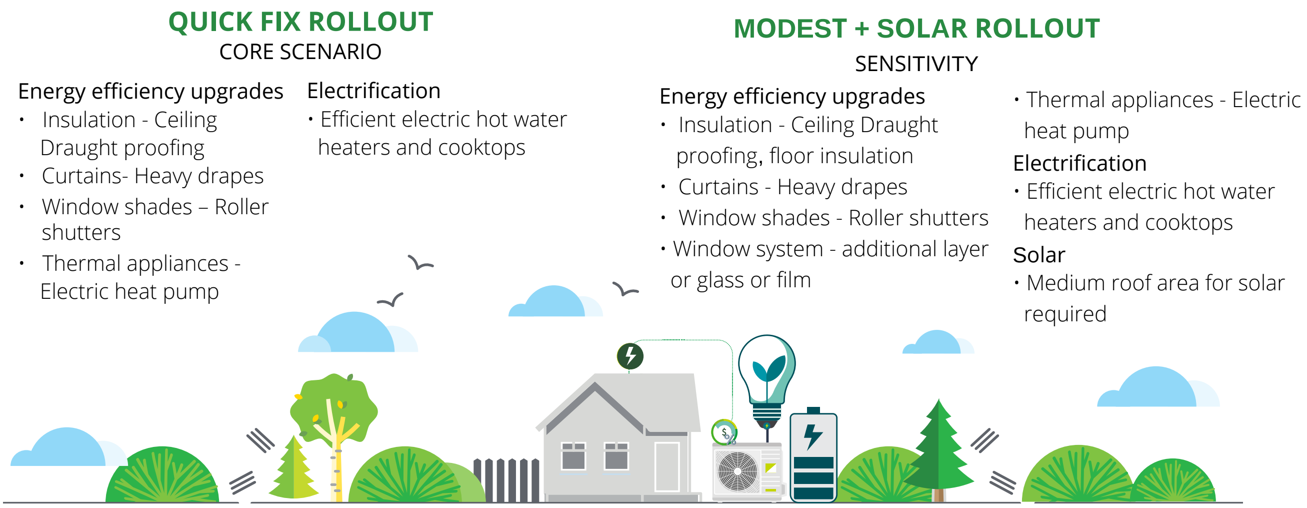
Limitations: This analysis considers the economic impact of the energy upgrades described by the quick-fix rollout. It does not quantify the distribution of funding by sources (e.g., households versus government). The feasibility of the rollout over the time frame may face constraints (e.g., supply chain disruptions) that are not able to be represented in model.

2 Quantifying the low-income housing energy upgrade wave

Defining housing energy upgrades

The housing upgrades described in this report are based on scenarios developed by Climateworks as part of its Renovation Pathways project. They include insulation, draught proofing, curtains, window shades and electric appliances (e.g., heat pumps) (Figure 2.1).[18]

Figure 2.1 Housing energy efficiency and electrification upgrades



Source: Deloitte Access Economics adapted from Climateworks (2024).[19]

The housing energy upgrades benefit low-income households via reduced energy bill costs, including both electricity and gas. This enables the reallocation of household spending households to other goods and services. Household savings from energy upgrades differ by state and territory, driven by variations in climate and energy use across the country. At the national level, average annual household savings is estimated at $1,650 for the quick-fix rollout scenario (Table 2.1).

The increased construction sector activity that would be required has also been included in each scenario, based on the estimated cost of the energy upgrades. On average, the cost of the upgrades is estimated at $13,581 for the quick-fix rollout per household.

Based on the uptake of the policy by households from 2025 to 2031, the total construction cost is estimated at $16.5 billion (undiscounted) for the quick-fix rollout.

Estimating the uptake of housing energy upgrades

Low-income households are defined in this report as the lowest 20% of income earners, equivalent to almost 2 million households.[20] This group includes a range of tenancy cohorts with different upgrade needs and financing requirements, including, owner-occupiers and renters, public and community housing, as well as state owned and managed Indigenous and Indigenous community housing.

Table 2.1 Overview of housing energy upgrade improvements

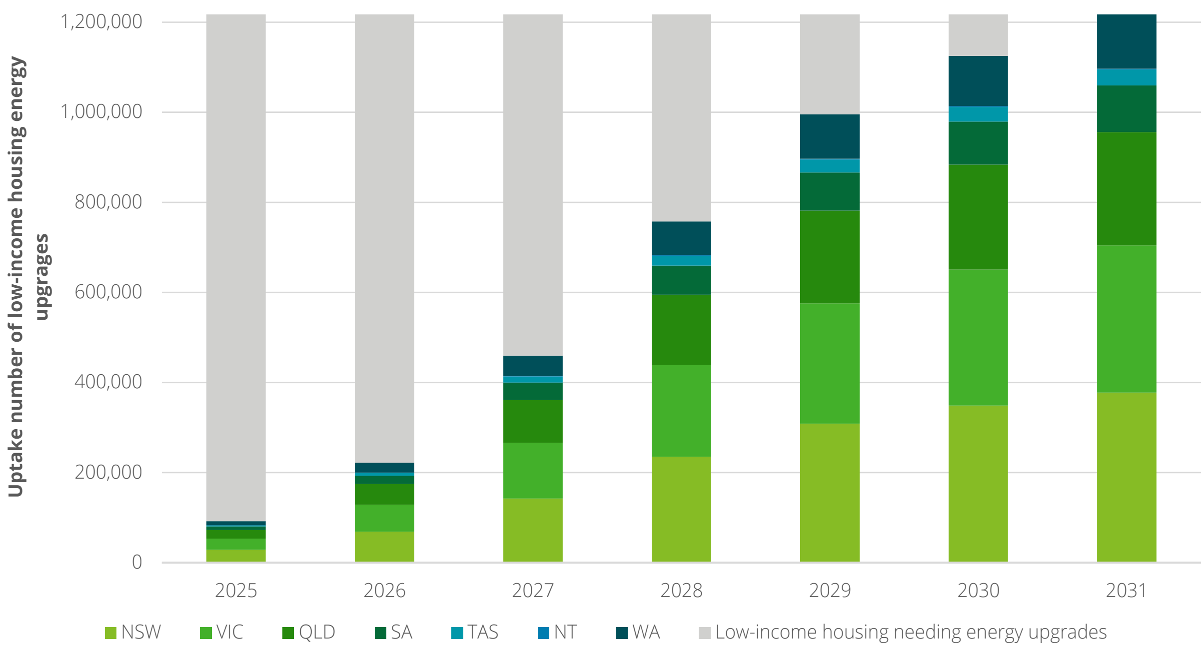
House type	Residences ('000)	Average savings ($/ dwelling)	Total savings ($ billions)
Low-income (Renters and owner occupiers)	1,112	$1,660	$1.8
Social housing (Public and community housing)	105	$1,630	$0.2
Total	**1,217**	**$1,650**	**$2.0**

Note: The number of households targeted by the AERFF for the purpose of this analysis are estimated relative to a baseline rate of upgrades (Appendix A).

Source: Provided by Springmount Advisory based on Census (2021); AIHW (2023).

Upgrades are assumed to be incrementally introduced at the beginning of 2025 (Chart 2.1). The duration of the rollout reflects the proposed design of the AERRF as a seven-year funding program. The policy brings forward energy upgrades and allows low-income households to start saving money on energy bills earlier for longer.

Chart 2.1 Uptake of low-income housing energy upgrades, quick-fix scenario



Note: Data has been collected and analysed at the state and territory level, with results presented at a national level.

Source: Deloitte Access Economics. Note: NSW includes ACT.

Baseline assumptions

To assess the benefits of implementing a nationwide policy of low-income housing energy upgrades, it is important to define what would occur in the future if such a policy were not implemented.

The low-income housing upgrade rollout is targeted at Australia's lowest income quintile, those earning less than $800 per week, totalling almost 2 million households. The baseline in this analysis accounts for already announced policies targeting energy upgrades for social housing, as well as estimating the share of households that would require upgrades based on the quality of the existing building stock.

As it is expected that some households already have upgrades planned based on announced policies, it is assumed that the AERFF policy suite will support 1.2 million households, rather than the full 1.9 million low-income households.

The baseline assumes energy efficiency upgrades would occur but more slowly than under the policy. Uptake assumes public and community housing are initially targeted, and all receive upgrades by 2031. Low-income housing follows a slower 'market led' path where all households are eventually upgraded by 2050. Under the policy, all energy upgrades are brought forward and completed over a seven-year period, finishing in 2031.

The economic impacts of the National Low-Income Energy Productivity Program

In 2021, Deloitte Access Economics undertook a previous independent economic analysis for ACOSS of the proposed National Low-Income Energy Productivity Program (NLEPP) to investigate the economic impacts of energy efficiency retrofits for low-income homes. The NLEPP was primarily designed as a jobs measure coming out of COVID with household co-benefits, therefore a lower scope of upgrades was considered.

The Australian Efficiency and Resilience Retrofit Fund (AERRF) would enable a larger scope of upgrades to be undertaken for low-income homes, generating a greater economic impact, larger household energy bill savings, and larger emissions reductions.

Revisiting the economic impact of energy upgrades for low-income households is driven by a significant change in policy context:

- The Australian Government has legislated a target for achieving net zero emissions by 2050.
- To achieve net zero targets, households will need to play a role by improving energy efficient, electrifying homes, and improving access to renewable energy sources. Climateworks' Renovation Pathways model the type of home energy upgrades required to achieve emissions reductions targets for households.
- Higher energy prices and elevated official interest rates following the COVID-19 pandemic have driven a fall in household disposable income, which particularly influences the ability of low-income households to pay for housing upgrades.
- As cost-of-living pressures have increased, household spending on non-essentials has decreased, which has driven lower demand for household renovation activity.
- This report builds on ACOSS' recommendations pertaining to funding and finance solutions for retrofitting low-income housing to improve energy efficiency. It builds on ACOSS' key findings that the low-income cohort need financing support to retrofit homes and identifies the economic impact associated with a capital works program to support the transition of low-income households.

3 The economic impacts of low-income housing energy upgrades

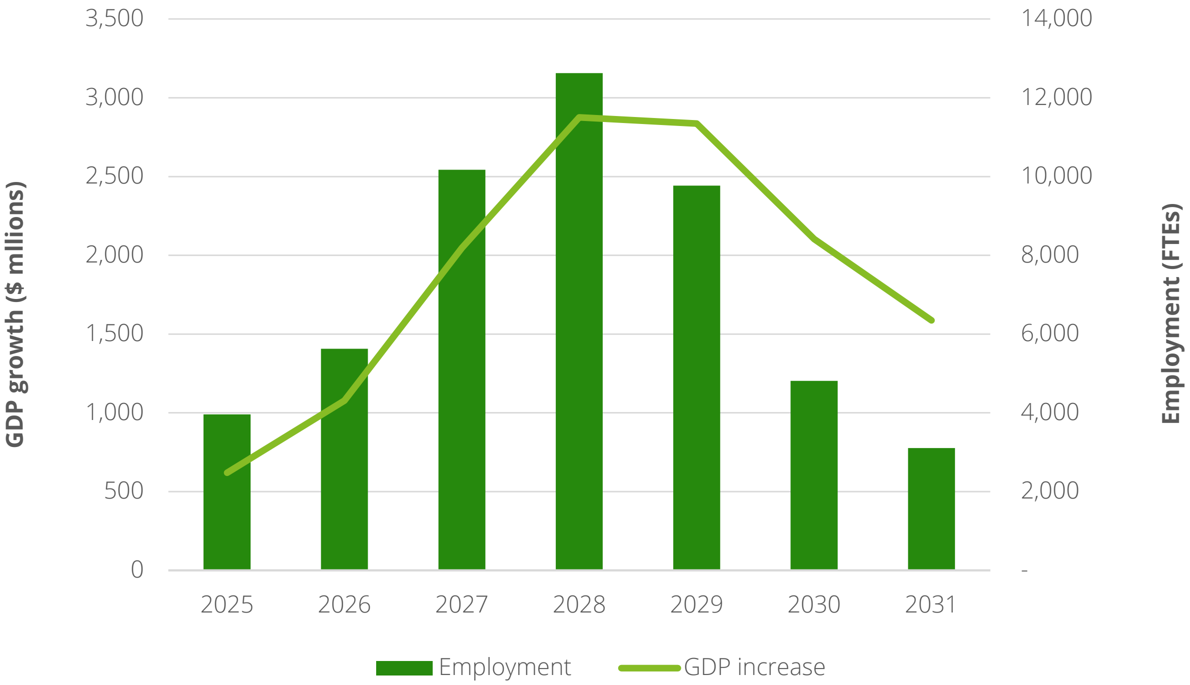
Low-income housing energy upgrades across Australia deliver an additional $10 billion in GDP over the quick-fix rollout period (2025 to 2031), in net present value terms. Over this period, an average of more than 7,160 jobs are supported each year.

It is estimated that accelerating the electrification and energy efficiency upgrades to low-income households, facilitated by the AERRF policy suite, would deliver up to $10 billion in additional Gross Domestic Product (GDP) in net present value terms above the baseline over the rollout period.[iii]

As uptake accelerates during the rollout from 2025 to 2031, the Australian economy experiences a boost.

The first four years is primarily driven by increased construction and installation expenditure. During the peak of the rollout, in 2028, the economy experiences the largest gain of almost $3 billion in additional GDP (undiscounted) and supports more than 12,610 FTE jobs (Chart 3.1).

Chart 3.1 Economic impact of quick-fix rollout relative to the baseline, 2024 to 2031



Source: Deloitte Access Economics

Towards the end of the seven-year period, most households have undertaken the upgrades. The construction and installation expenditure gives way to the smaller, but still material bill savings, which also benefit the economy and compound over time. Over time, the baseline rate of upgrades will mean that the economic and employment benefit attributable to energy savings reduces to zero.

iii The net present value is an estimate of the additional gain to GDP using a 7% discount rate. This discount rate is applied for all net present value calculations.

Bringing forward the low-income household energy upgrades results in higher employment in the Australian economy, with an average of 7,160 additional FTE jobs being supported per year over the rollout period (Table 3.2). The increased economic activity drives a direct increase in construction and installation employment, as well as flow on employment in other parts of the economy, like services and manufacturing. At the same time, the demand for certain workers changes between sectors as part of Australia's broader transition to net zero. Initiatives like the AERRF, and the widespread local-level activity they can induce, will play an important role in supporting employment during Australia's transition to net zero.

Table 3.2 Economic impact of the quick-fix rollout

Result	Construction peak (2028)	Full period (2025-2031)
GDP ($billions, NPV)	$3	$10
Employment (FTE)	12,630 (point in time)	7,160 (average per year)

Source: Deloitte Access Economics.

Modest + solar rollout sensitivity

While this report has focused on the economic impact of a quick-fix rollout for energy efficient housing upgrades, there is the opportunity to invest additional funding into low-income household retrofits to further improve household energy efficiency. A modest + solar rollout would increase the number of energy efficiency upgrades for households (i.e., floor insulation and window double glazing) and include the installation of residential solar. Combined, these upgrades are expected to generate close to $3,350 in annual energy bill savings.

The average cost of a modest + solar household upgrade is estimated to be $24,300. As this represents a higher cost than the quick-fix rollout, it follows that the modest + solar rollout would deliver a larger economic impact.

On average, the cost of the modest + solar upgrades is estimated at $24,300 for the quick-fix rollout per household. Based on the uptake of the policy by households from 2025 to 2031, the total construction cost is estimated at $29.2 billion (undiscounted) for the modest + solar rollout.

Relative to the baseline economic trajectory, the modest + solar rollout is expected to generate an additional $17 billion in GDP in net present value terms over the rollout period. Over this same period, an average of 12,700 additional FTE jobs would be supported on an annual basis.

The largest boost occurs at the peak of the rollout in 2028, where GDP is estimated to be around $5 billion (undiscounted) above the baseline economic trajectory, while there are 22,550 additional FTE jobs.

4 Emissions, health and social benefits

Not all benefits from emissions reduction can be adequately represented through economic modelling and there is likely to be a wide range of co-benefits that arise from emissions reduction, providing benefits for the broader community.

The analysis shows that enhancing the energy efficiency of low-income housing could increase GDP and employment levels in the Australian economy. In addition to economic impact, these upgrades can also drive broader environmental, health, and social benefits (Figure 4.1).

These wider benefits include emissions reductions, health benefits, enabling a least-cost energy transition by reducing peak electricity demand and energy grid costs as well as driving wider acceptance of nationwide climate policies, initiatives, and First Nations impacts.

Figure 4.1 Broader benefits framework

Broader benefits of energy efficient and electrified housing

Environmental benefits

- Contributes towards emissions reduction and the ultimate goal of achieving net zero

Health benefits

- Improves the health outcomes of households, with the greatest improvements available to lower income households

Social benefits

- Reduces the financial burden of the transition for lower income households
- Improves social license associated with the energy transition

Emissions benefits

Home energy upgrades for low-income housing can contribute to Australia achieving its national emissions reduction targets.

Australian households produce emissions through their use of fossil gas for heating and cooking. The upgrades listed in this report cut emissions by substituting gas, and indirectly reduce emissions by lowering demand for grid electricity (which itself is decarbonising over time).

At the national level, the upgrades described here are estimated to reduce carbon emissions by around 2,400 kt CO2e per year at their peak. Australia's total residential emissions in 2021 (including those from electricity consumption), were reported at around 56 Mt CO_2e.[21] The estimated carbon emissions reductions per year is equivalent to an approximate average of 750,000 cars off the road or roughly 5% of Australia's currently registered vehicles.[22]

This is an economically significant contribution to Australia's emissions reduction efforts. The avoided abatement costs – or the cost to the economy of reducing these emissions elsewhere to meet targets - has recently been provided by Infrastructure Australia in its guidance on valuing carbon emissions. Starting at $56 per tonne of CO_2e in 2024, this value increases annually as Australia's emissions reductions increase and reaches $375 by 2050.[23] By multiplying the annual abatement cost of carbon value by the estimated total annual household emissions reductions over the period from 2024 to 2050, the present value of emission reductions is estimated at $3 billion when comparing the quick-fix rollout scenario to the baseline.[24]

For a more detailed overview on the calculations used to estimate the emissions reductions benefits, please refer to Appendix C.

Impacts of energy upgrades for First Nations housing

Home energy upgrades have the potential to have a positive impact to First Nations households in Australia by providing more affordable housing via energy bill savings, guaranteeing access to appropriate and comfortable living, whilst simultaneously facilitating Government initiatives already set in place to help close the gap.

Targeted financing arrangements and policy to encourage home energy upgrades are likely to minimize the disproportionate barriers faced by Aboriginal and Torres Strait Islander people in accessing stable, affordable and quality housing. According to the 2021 Census of Population and Housing, First Nations households represent 3.8% (352,041 dwellings) of all households in Australia.[25] Housing inequality persists between Aboriginal and Torres Strait Islander people and non-Indigenous people across a range of housing measures.[26] In 2021, the home ownership rates for Aboriginal and Torres Strait Islander people were 42%, 20 percentage points lower than non-Indigenous people. These disparities demonstrate the disproportionate barriers faced by Aboriginal and Torres Strait Islander people in accessing stable, affordable and quality housing.

Accelerating home energy upgrades is likely to aid the Governments initiatives to help Close the Gap. The National Agreement on Closing the Gap aims to meet a set of targets for 17 socio-economic outcomes, one of which includes outcome 9 "Aboriginal and Torres Strait Islander people sure appropriate, affordable housing that is aligned with their priorities and needs." The Federal and Northern Territory Governments recently announced a $4 billion dollar investment for remote community housing, involving a 10-year commitment to support repairs and maintenance and see up to 270 homes built each year.[27] The Federal Government also committed to investing an additional $120 million over three years to complement the Northern Territory Government's yearly investment to improve homes and provide essential infrastructure upgrades in remote communities. These significant public investments have an opportunity to make a significant difference by incorporating place-based energy upgrade improvements.

Health benefits

Australians spend between 80% to 100% of their time indoors.[28] Therefore, energy efficient housing can be associated with a range of health benefits. These benefits include minimising the health risks associated with extreme weather conditions, indoor and outdoor air pollution from gas appliances, financial stress, and an overburdened healthcare system.

- Protection from extreme heat and cold: Household energy upgrades can protect homes from extreme outdoor weather conditions, particularly in the winter and summer months, by providing households with a safe and well-regulated indoor environment. The World Health Organisation has identified that household exposure to cold indoor temperatures is a source of unhealthy housing and increases the risks of disease.[29] Improving insulation within households can significantly reduce children's sleep disturbances and school absences.[30] Upgrading households to be more energy efficient can also protect homes from heatwaves. Heatwaves have caused more deaths than any other environmental disaster in Australia,[31] with most heat-related deaths occurring indoors in homes built prior to 2006.[32]

- Minimising the burden of asthma associated with gas appliances: Upgrading household energy performance through the electrification of indoor gas appliances can minimise the burden of childhood asthma in Australia. Gas stoves have a harmful effect on occupant health and safety. Research shows that exposure to gas stoves is associated with 12.3 % of Australia's total childhood asthma burden.[33] These health impacts have had substantial economic costs, with the burden of disease of asthma estimated to cost the Australian economy $24.7 billion.[34]
- Improving mental health outcomes: Home energy efficiency upgrades can improve mental well-being by reducing household energy costs, thereby alleviating stress associated with finances and the ability to consume other essential needs. As energy bills continue to increase and energy inefficient households continue to face higher energy demand, more Australians are facing energy poverty. Energy poverty occurs when households are unable to afford adequate heating or cooling needs, resulting in higher financial stress and lower consumption of other essential goods as households substitute between goods. Research shows a strong positive relationship between energy poverty and mental health effects, particularly amongst adults.[35]
- Alleviating the strain on the healthcare system: By improving individual health outcomes, energy efficient housing can drive wider economic outcomes, including lower healthcare system costs and government spending. A cost benefit analysis of improving energy amenity for low-income households in NSW valued these health benefits to be approximately $83 million over a 15-year period.[36] The NSW government was estimated to avoid $34 million on indirect health costs over the same period due to the program. Savings to the healthcare system from home upgrades in Victoria were estimated to be $887 per person over a 3-month winter period.[37]

Reducing the need for transmission infrastructure

To deliver Australia's legislated targets, Australia's energy system is rapidly transitioning, with coal-powered generators being phased out and the core focus on transforming the National Electricity Market (NEM) to be predominantly supplied by renewable sources.

The Australian Energy Market Operator (AEMO) developed a draft 2024 Integrated System Plan (ISP), which identified renewable energy connected with transmission, firmed with storage and back up by gas-powered generation as the cheapest way to supply electricity to consumers throughout Australia's transition to net zero.[38] Investment in new transmission and modernised distribution networks will be needed to connect renewable energy sources to towns and cities.

Household energy performance upgrades can enable a least-cost energy transition by reducing the investment in energy grid infrastructure required for a net zero pathway. This will be beneficial to both the Australian economy and household consumers.

Household energy upgrades will reduce peak energy demand, which typically occurs in the summer and winter evenings, because households that are more energy efficient are subjected to less energy loss.[39] Ultimately, this means managing household energy demand will reduce the need for additional investment into expensive infrastructure, saving the Australian economy and households from extra costs

Reducing the need for transmission infrastructure will benefit consumers by keeping the grid affordable. Infrastructure investment for delivering the electrical grid spillover to households in the form of network charges.[40] Over the last decade, network charges in Australia have accounted for between 40 and 50% of household bills. The relationship between network expansion and electricity bills has been well established, with average electricity prices increasing by 70% between 2007 and 2012. Therefore, to sustain affordable electricity prices for households, investment in grid infrastructure will need to be limited.

Encouraging household support for the transition

Improvements to household energy amenity can help to encourage broad-based support for the energy transition, facilitating Australia in achieving its interim emission reduction goals more effectively and swiftly. Upgrades also at the household level can be material and direct in their benefits, providing long-term cost-of-living relief.

In addition to greater community acceptance, it is important that households contribute to the transition and reap the long-term benefits associated with energy efficient housing. As the abatement task accelerates towards net zero, households will need to be in a position to manage the costs associated with emissions reductions. Otherwise, the broader acceptance of transition policies will be at risk, impeding Australia's energy transition progress. Supporting low-income households with the abatement task will go a long way in improving overall household support for the transition, particularly as low-income households are those with the least financial means to invest in energy efficient housing.

The increase in momentum for the energy transition, driven by greater household acceptance via stronger household policy support, provides the added economy-wide benefit to households improving their energy efficiency and electrification.

Appendix A Housing energy upgrade scenarios

This appendix captures the key data and assumptions underlying the estimated number of low-income households that are captured in the scope of the analysis, in addition to detail regarding the scope and cost of upgrades undertaken.

A.1. Baseline definition

A baseline was developed to reflect the number of households that are the focus of the AERRF policy suite based on their building quality and that are not included in already announced policies focusing on energy efficiency upgrades. The following steps were taken to develop the baseline:

1. Total number of households who are the focus of ACOSS' AERFF policy suite
2. Adjust for the number of properties who would require these energy upgrades
3. Assume a baseline rate of upgrades in the absence of the AERRF policy suite

A.1.1. Total number of low-income households

Based on data from Census 2021 and the AIHW, there are approximately 1.96 million low-income, public and community housing households who are the focus of the financing solutions for upgrades supported by the AERRF (Table A1).

Table A.1 Number of low-income households by dwelling type

	Low-income renters and owner-occupiers	Social housing	Community housing	Total
NSW[1]	454,366	111,576	60,754	626,696
VIC	419,044	63,987	18,023	501,054
QLD	325,033	55,872	16,708	397,613
SA	128,150	32,941	13,312	174,403
TAS	45,562	4,999	9,348	59,909
NT[2]	-	10,318	2,285	10,544
WA	151,325	32,034	10,416	193,775
Total	**1,523,480**	**311,727**	**130,846**	**1,963,994**

Source: Provided by Springmount Advisory based on Census (2021); AIHW (2023). Notes: (1) NSW includes ACT (2) All low-income households for the NT is the sum of public and community housing.

A.1.2. Adjust for the number of properties requiring upgrades

The Australian Government has already committed to invest $300 million over four years to partner with state and territory governments to support energy efficiency upgrades to 60,000 social housing properties as part of its $1.6 billion Energy Savings Package.[41]

In general, there is a lack of detailed information available on the quality and energy performance of Australia's housing stock and this is particularly acute when specifically investigating low-income housing. This is noted as a limitation of the analysis.

The number of low-income households requiring upgrades has been based on CSIRO data of the Nationwide House Energy Rating Scheme (NatHERS) star ratings.[42] This data shows that 73 per cent of existing dwellings in Australia have a star rating below 3 Stars.

The current Australian National Construction Code requires new builds to achieve a minimum 7 Star rating, therefore this share of low-income households have been assumed to require upgrades in future.

The AIHW National Social Housing Survey 2021 contains state-level information on whether tenants' needs for an amenity have been met, including thermal comfort (whether tenants are too hot or too cold in their home environment).[43] Tenants who report they are not satisfied with their level of thermal comfort have been assumed to require a house energy upgrade in the future.

Combining these two approaches results in 1.2 million households that are the focus of the AERRF and included in the modelling, summarised in Table A3.

Table A.2 Total number of households included in modelling analysis, by state

	Low-income renters and homeowners	Public and community housing (excluding announced policies)	Total
NSW[1]	331,687	45,807	377,495
VIC	305,902	20,913	326,815
QLD	237,274	14,493	251,767
SA	93,550	9,916	103,465
TAS	33,260	1,997	35,257
NT[2]	-	2,005	2,005
WA	110,467	10,018	120,485
Total	**1,112,140**	**105,148**	**1,217,289**

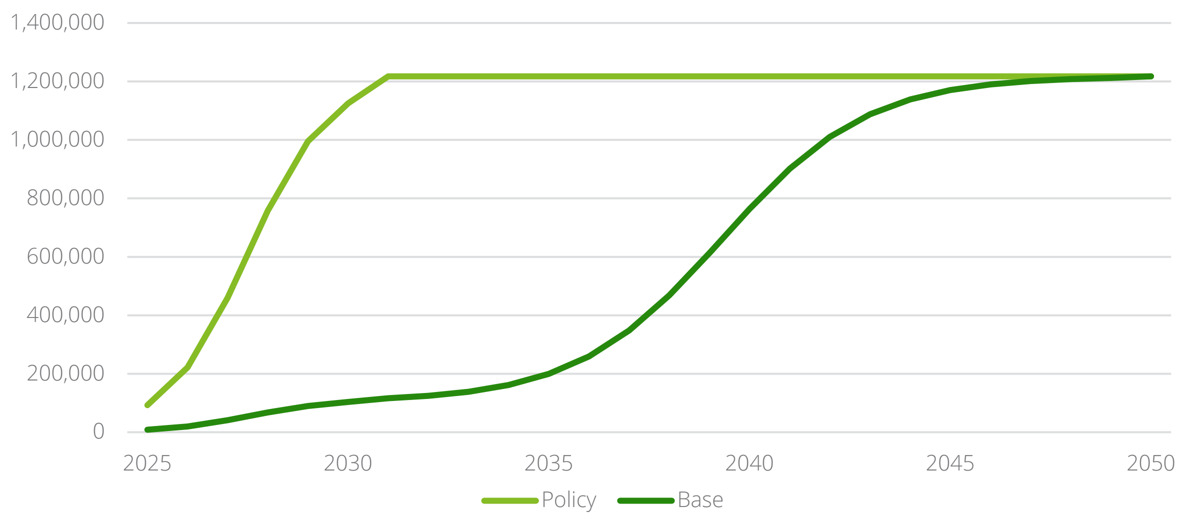
Source: Deloitte Access Economics based on AIHW (2021). Notes: (1) NSW includes ACT (2) All low-income households for the NT is the sum of public and community housing.

A.1.3. Assume a baseline rate of upgrades

In the absence of any policy change, energy efficiency and electrification upgrades are assumed to occur slowly. Public and community housing are assumed to be targeted initially and all receive upgrades by 2031. With no additional assistance, low-income households follow a 'market led' path where dwellings are assumed to adopt the defined upgrades by 2050.

Under the AERRF, all energy upgrades are brought forward and completed over a 7-year period, finishing in 2031 (Chart A.1). This is achieved through a range of state and territory, philanthropic and other private sources of funding to reduce the significant up-front costs associated with the upgrades and addressing the split incentives that exist between homeowners and renters.

Chart A.1 Cumulative uptake of low-income housing energy upgrades, baseline and policy



Source: Deloitte Access Economics.

A.2. Modelling scenarios

The low-income household energy upgrades modelled in this report are based on scenarios developed by Climateworks as part of its Renovation Pathways project. The central modelling scenario is based on Climateworks' quick-fix scenario. The modest + solar scenario including solar has been included as a sensitivity to demonstrate the impact of a fully comprehensive set of efficiency upgrades.

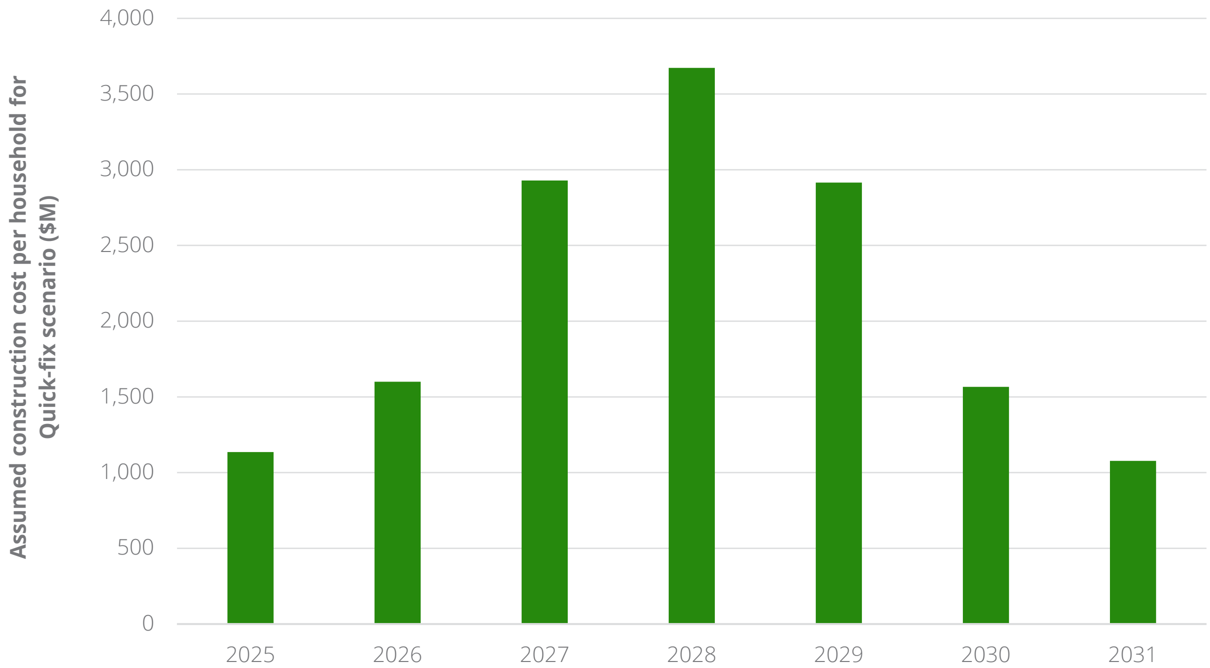
Both scenarios include thermal upgrades (e.g. insulation) and electrification (e.g. replacing gas cooktops with electric). Rooftop solar was only included in the modest + solar scenario. A summary of the household energy upgrades is detailed in Table A1. Climateworks provided data on the costs of these upgrades and the expected bill savings to ACOSS.

Table A.4 Household energy upgrade assumptions

	Quick-fix rollout scenario		Modest + Solar rollout sensitivity	
	Household upgrade cost	Energy bill savings per household	Household upgrade cost	Energy bill savings per household
NSW1	$13,302	$1,567	$23,848	$3,525
VIC	$13,559	$1,848	$24,287	$3,689
QLD	$13,574	$1,435	$24,294	$2,621
SA	$13,685	$2,031	$24,498	$3,782
TAS	$14,156	$2,569	$25,233	$4,157
NT	$13,054	$814	$23,410	$2,435
WA	$13,737	$1,284	$24,575	$2,791

Source: Provided by Springmount Advisory based on Climateworks (2023; Census (2021); AIHW (2023). Note: (1) NSW includes ACT.

Chart A.2 Assumed construction costs over the lifetime of policy



Source: Provided by Springmount Advisory based on Census (2021); AIHW (2023).

Appendix B D.Climate approach

B.1. Overview

The analysis in this report reflects an update to Deloitte's previous analysis for ACOSS on the National Low-Income Energy Productivity Program. The updates are based on detailed housing upgrade cost and bill savings data published by Climateworks. The modelling has also used Deloitte Access Economics' in-house integrated climate-economy model called 'D.Climate'. In contrast to Deloitte Access Economics regional general equilibrium model, DAE-RGEM, D.Climate accounts for emissions and damages caused by climate change, and Australia and the world's net zero transition pathways.

At its core, D.Climate has a Computable General Equilibrium (CGE) modelling component, which is a best practice methodology for estimating the economic impacts of change in any one part of the economy. It is the preferred method of most major Commonwealth and State government agencies in estimating the economic impacts of a project or program.

This is because CGE frameworks account for a range of impacts that are otherwise omitted in alternative models. In particular, CGE models incorporate the following assumptions:

- Resource constraints (the use of labour or capital by one activity or industry comes at the expense of its use elsewhere);
- The possibility of changes in the mix of inputs used in production due to changes in relative prices or technology; and
- The responsiveness of prices and other variables to policy changes affecting such things as tariffs on imported goods, budgetary support to industry, industry productivity and workforce participation.

Because of these assumptions, CGE models enable estimation of impacts across the entire economy and allow for second round impacts — where agents respond to changes in price signals.[44] Other economic modelling techniques (such as input output modelling) are unable to address the above assumptions and therefore can produce inflated results of economic impacts.

B.2. Computable general equilibrium modelling

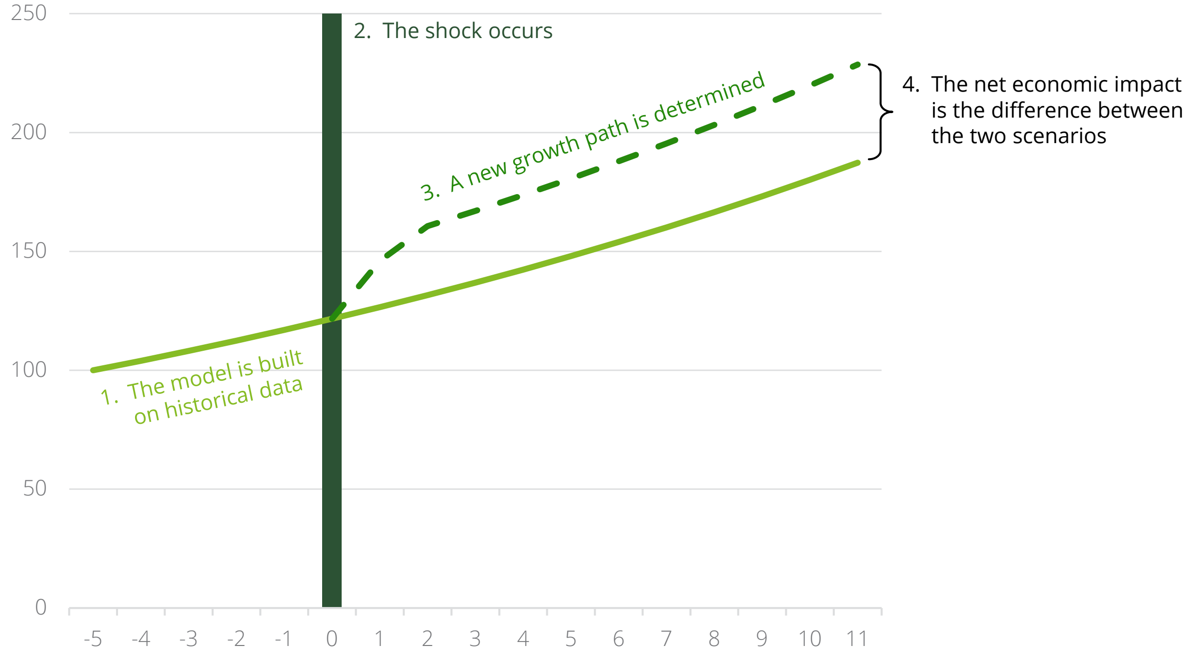
CGE models estimate economic impacts by comparing a policy scenario against a baseline. The baseline scenario is built off historical data with the economy growing as per 'business as usual' (Figure B.2 below; 1). Here the baseline refers to a world where low-income housing energy upgrades are not delivered.

Data on an issue, project or policy in focus is then introduced into the model (2). This enters the model as a shock to the economy and represents change to the baseline. Here the shock includes the expected energy cost savings which low-income households are projected to receive as a result of implementation of low-income housing energy upgrades, as described in Chapter 1.

CGE models then solve for the market-clearing (equilibrium) levels of demand and supply across all specified goods and factor markets in the economy. This effectively creates a new path for the economy over time (3). This new path is typically referred to as the policy scenario and here represents a world where low-income housing energy upgrades are delivered across Australia.

Comparing this new policy path to that of the baseline (where the change does not occur), shows the economic impact of the shock (4).

Chart B.1 Estimating economic impacts via a shock to a CGE model



Source: Deloitte Access Economics

For this project, the model has been customised to explicitly identify core sectors of the Australian and global economy and has split each jurisdiction into greater city and rest of jurisdiction regions.

The figure over the page is a stylised diagram showing the circular flow of income and spending that occurs in D.CLIMATE. To meet demand for products, firms purchase inputs from other producers and hire factors of production (labour and capital). Producers pay wages and rent (factor income) which accrue to households.

Households spend their income on goods and services, pay taxes and put some away for savings. The government uses tax revenue to purchase goods and services, while savings are used by investors to buy capital goods to facilitate future consumption. As D.CLIMATE is an open economy model, it also includes trade flows with other regions, interstate and foreign countries.

Figure B.1 The components of D.CLIMATE and their relationships

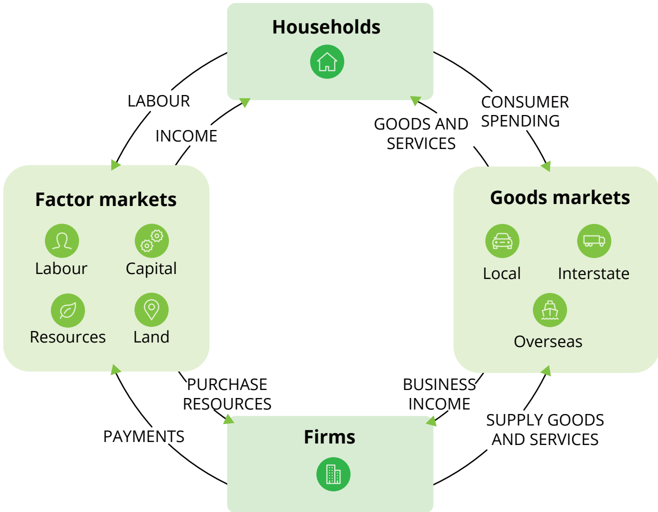
Inputs

Upgrade spending and bill savings: The household-level expenditure and the savings on bills is a key input into the modelling.

Rollout pace: The rate of upgrades in the policy case and the baseline.

Climate module: Climate policy (Australia's net zero target), emissions and damages components are included in the modelling.

Economic module (DAE-RGEM)



Source: Deloitte Access Economics

D.Climate's economic module (DAE-RGEM) is based on a substantial body of accepted microeconomic theory. Key assumptions underpinning the model are:

- The model contains a 'regional consumer' that receives all income from factor payments (labour, capital, land and natural resources), taxes and net foreign income from borrowing (lending).
- Income is allocated across household consumption, government consumption and savings so as to maximise a Cobb-Douglas (C-D) utility function.
- Household consumption for composite goods is determined by minimising expenditure via a CDE (Constant Differences of Elasticities) expenditure function. For most regions, households can source consumption goods only from domestic and imported sources. In the Australian regions, households can also source goods from interstate. In all cases, the choice of commodities by source is determined by a CRESH (Constant Ratios of Elasticities Substitution, Homothetic) utility function.
- Government consumption for composite goods, and goods from different sources (domestic, imported and interstate), is determined by maximising utility via a C-D utility function.
- All savings generated in each region are used to purchase bonds whose price movements reflect movements in the price of creating capital.
- Producers supply goods by combining aggregate intermediate inputs and primary factors in fixed proportions (the Leontief assumption). Composite intermediate inputs are also combined in fixed proportions, whereas individual primary factors are combined using a constant elasticity of substitution production function.
- Producers are cost minimisers, and in doing so, choose between domestic, imported and interstate intermediate inputs via a CRESH production function.
- The model contains a more detailed treatment of the electricity sector that is based on the 'technology bundle' approach for general equilibrium modelling developed by ABARE (1996).
- The supply of labour is positively influenced by movements in the real wage rate governed by an elasticity of supply.

- Investment takes place in a global market and allows for different regions to have different rates of return that reflect different risk profiles and policy impediments to investment. A global investor ranks countries as investment destinations based on two factors: global investment and rates of return in a given region compared with global rates of return. Once the aggregate investment has been determined for Australia, aggregate investment in each Australian sub-region is determined by an Australian investor based on: Australian investment and rates of return in a given sub-region compared with the national rate of return.
- Once aggregate investment is determined in each region, the regional investor constructs capital goods by combining composite investment goods in fixed proportions, and minimises costs by choosing between domestic, imported and interstate sources for these goods via a CRESH production function.
- Prices are determined via market-clearing conditions that require sectoral output (supply) to equal the amount sold (demand) to final users (households and government), intermediate users (firms and investors), foreigners (international exports), and other Australian regions (interstate exports).
- For internationally traded goods (imports and exports), the Armington assumption is applied whereby the same goods produced in different countries are treated as imperfect substitutes. But, in relative terms, imported goods from different regions are treated as closer substitutes than domestically produced goods and imported composites. Goods traded interstate within the Australian regions are assumed to be closer substitutes again.
- The model accounts for greenhouse gas emissions from fossil fuel combustion. Taxes can be applied to emissions, which are converted to good-specific sales taxes that impact on demand. Emission quotas can be set by region and these can be traded, at a value equal to the carbon tax avoided, where a region's emissions fall below or exceed their quota.

Appendix C Emissions reduction estimates

C.1. Estimating emissions reduction

Household energy upgrades in low performance households play a critical role in emissions reduction as the demand for energy in peak times will be lower. Emission benefits can be valued by using the annual emission reductions of household upgrades per annum and either an estimate for the social cost of carbon or for the abatement cost of carbon. Available calculations on emission reductions in tonnes of CO_2e of thermal and electrification upgrades for apartments, stand-alone houses and townhouses were utilised to determine a weighted average of total household national emission reductions per annum. Emissions reductions from thermal and electrification upgrades were estimated for the quick-fix rollout scenario, for apartments, townhouses and standalone houses. Emissions reductions were available on a state-by-state basis, to account for the variance in energy efficiency and energy needs of each state's housing stock (Tables C.1).

Table C.1 Emission reductions after energy upgrades per household, annually, by state (tCO_2e)

State	Apartments	Standalone houses	Townhouses
NSW	1.13	2.33	1.33
VIC	1.07	2.97	1.87
QLD	0.67	0.86	0.66
SA	1.09	3.67	3.29
WA	1.31	1.71	1.41
TAS	2.37	3.87	3.27
NT	1.09	0.71	0.71
ACT	3.17	5.17	2.57

Source: Provided by Springmount Advisory

C.2. Valuing emissions reductions

Valuing emissions reductions consists of assigning a value to carbon and multiplying that value by the emission reductions resulting from a change in policy (the AERRF). Assigning a monetary cost to carbon dioxide emissions aims to capture the social, environmental and economic impacts of emissions. Two ways to value carbon include using the abatement cost of carbon and the social cost of carbon.

C.2.1. Using the abatement cost of carbon to estimate emissions benefits

The abatement cost of carbon is Infrastructure Australia's recent development of a national set of emissions values. The recommended emissions values are estimated through a target consistent approach. This means that they are based on the projected future abatement costs necessary for the Australian economy to achieve its national emissions reduction targets. The purpose of calculating the abatement cost of carbon was to provide evidence-based estimates corresponding to Australia's emission reduction targets and ensure a consistent and comparable evaluation of initiatives in areas impacted by emissions.

The 'central' scenario abatement cost of carbon for 2024 is $56 per tonne of CO2e and increases annually as the proportion of Australia's total abatement increases. The average abatement cost of carbon between 2024 and 2050 is $234 per tonne of CO2e.

By multiplying the annual abatement cost of carbon by the total household emission reductions over the period from 2024 to 2050, the total value of carbon emissions abated is estimated to be $3 billion in present value terms, for the quick-fix rollout scenario.

The total emissions benefit was calculated by multiplying the carbon emissions savings per households by the share of households that are expected to be beneficiaries of the rollout every year from 2024 until full rollout is implemented by 2031. The emissions savings post the full rollout period to 2050 were calculated by taking the difference between dwellings upgraded less the baseline scenario. These values were then multiplied by the abatement cost of carbon for each year. The final estimate for the quick-fix scenario is presented in Table C.2.

Table C.2 Total emissions benefit ($millions) in the quick-quick rollout scenario, abatement cost of carbon

Upgrade Type	Total emissions benefits 2024-2050 ($million)
Quick-fix rollout	2,877

Source: Deloitte Access Economics

C.3. Using the social cost of carbon to estimate emissions benefits

Emissions benefits can also be valued using the social cost of carbon. The social cost of carbon is a dollar estimate of the damage done to society for each additional ton of carbon emissions. Since carbon emissions not only impose a direct private marginal cost, but also an external cost on society, the social cost of carbon is typically higher than the market cost. The purpose of calculating the social cost of carbon is to quantify the social benefits of reducing carbon emissions. The social benefits of reducing emissions include, but are not limited to, reducing damage to crops, ecosystem services and human health.

The 'mid' scenario social cost of carbon for 2024 is $82 per tonne of CO2e and because future emissions produce larger incremental damages, the estimate increases over time, but at a slower rate compared to the abatement cost of carbon. The average social cost of carbon between 2024 and 2025 is $105 per tonne of CO2e.

Therefore, by multiplying the annual social cost of carbon by the total household emission reductions over the period from 2024 to 2050, the total value of carbon emissions benefits is estimated to be $1.5 billion in present value terms, in the quick-fix rollout scenario (using a 7% discount rate).

The social cost of carbon was obtained from the Interagency Working Group on Social Cost of Carbon, US Government (February 2021).[45] The initial estimates of the social cost of carbon in the 'Mid' series range were taken (assumes 3% discount rate), converted to AUD based on a 2020 average exchange rate of 1AUD = 0.69 USD. These values were adjusted to 2023 dollars from 2020 dollars using ABS CPI data. The final estimate of the average social cost of carbon from 2024 to 2050 is $105 per tonne of CO2e AUD. The final emissions benefits for the quick-fix scenario is presented in Table C.3.

Table C.3: Total emissions benefit ($millions) in the quick-quick rollout scenario, social cost of carbon

Upgrade Type	Total emissions benefits 2024-2050 ($million)
Quick-fix rollout	1,454

Source: Deloitte Access Economics. Note: When each scenario is rounded, the result is the same. The table presents the rounded value for each scenario.

Appendix D State and territory impacts

Table D.1 Economic impact of the quick-fix rollout, by state and territory

	GDP (NPV of deviation from baseline, $million 2025-2031)	Average increase in employment (FTE deviation from baseline, 2025-2031)
NSW	$2,760	1,740
VIC	$2,500	1,670
QLD	$2,380	2,050
SA	$880	610
WA	$1,000	840
TAS	$270	240
NT	$20	10
Total	**$9,810**	**7,160**

Note: Present values calculated at 7% discount rate.

Source: Deloitte Access Economics.

Table D.2 Economic impact of the modest + solar rollout, by state and territory

	GDP (NPV of deviation from baseline, $million 2025-2031)	Average increase in employment (FTE deviation from baseline, 2025-2031)
NSW	$4,810	3,060
VIC	$4,390	2,960
QLD	$4,220	3,630
SA	$1,540	1,090
WA	$1,780	1,520
TAS	$480	440
NT	$40	20
Total	**$17,260**	**12,720**

Note: Present values calculated at 7% discount rate.

Source: Deloitte Access Economics.

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