ACIL ALLEN

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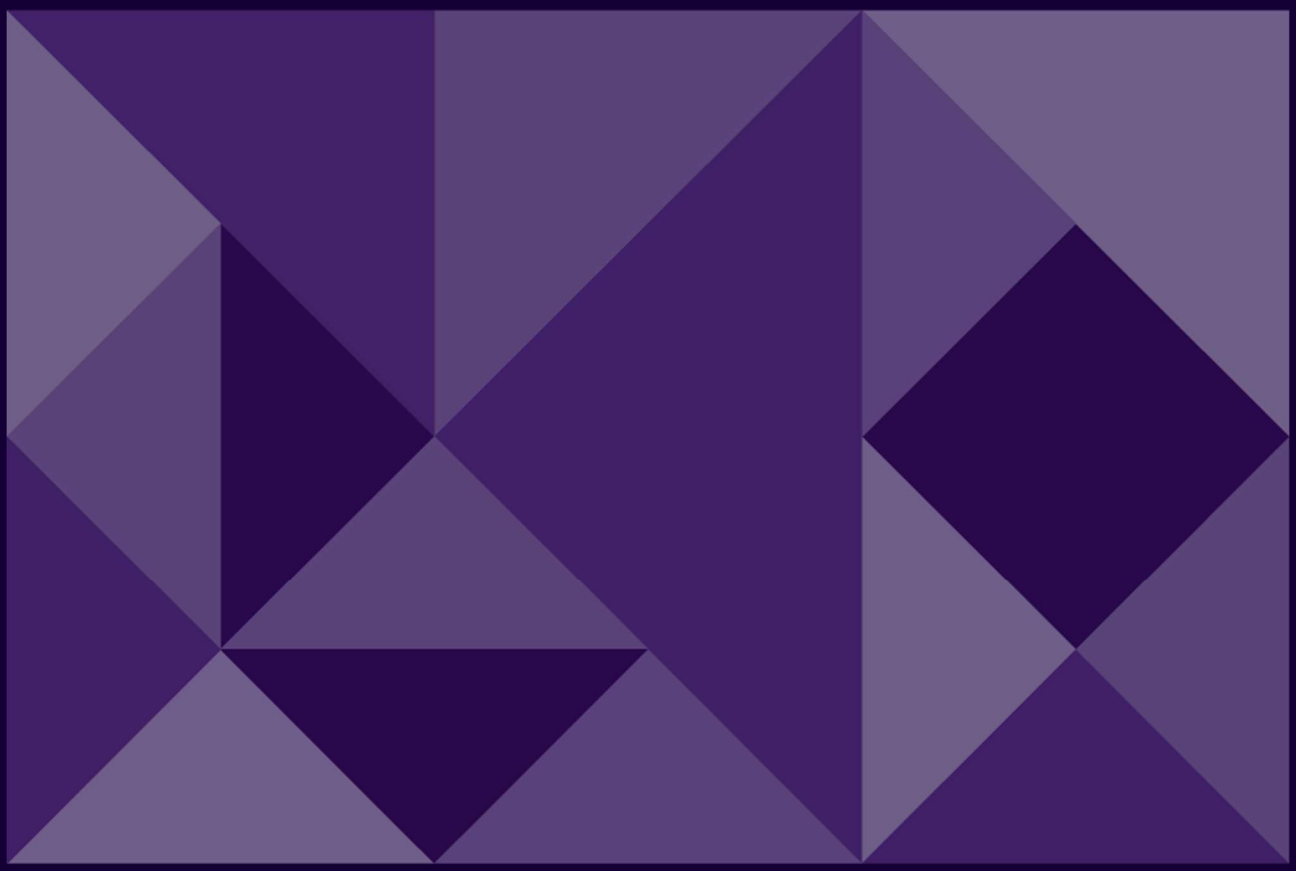
Report to Department of Planning and Environment

Solar for Low Income Households Trial Outcome evaluation

Final report



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ACIL Allen acknowledges Aboriginal and Torres Strait Islander peoples as the Traditional Custodians of the land and its waters. We pay our respects to Elders, past and present, and to the youth, for the future. We extend this to all Aboriginal and Torres Strait Islander peoples reading this report.

Goomup, by Jarni McGuire

Contents

Glossary

AEMO	Australian Energy Market Operator
CCF, the Fund	Climate Change Fund
CER	Clean Energy Regulator
CO_2-e	Carbon dioxide equivalents
COAG	Council of Australian Governments
DER	Distributed Energy Resources
DVA	Department of Veterans' Affairs
EHP	Empowering Homes Program
Framework	NSW Climate Change Policy Framework
GHG	Greenhouse gas
KEQ	Key Evaluation Question(s)
kW	Kilowatt
kWh	Kilowatt hour
LIHR	Low Income Household Rebate
MW	Megawatt
NEM	National Electricity Market
NSW	New South Wales
OECC	Office of Energy and Climate Change, NSW Treasury which performed analysis for the SLIH Trial and is responsible for delivering the SLIH Trial from April 2022
Paris Agreement	A 2015 international, legally binding treaty that aims to limit global warming to below 2.0 degrees, preferably to 1.5 degrees Celsius, compared to pre-industrial levels
PCC	Pensioner Concession Card
PJ	Petajoules
PV	Photovoltaic
RFT	Request for tender
ROI	Return on investment
SLIH	Solar for Low Income Households

(the) Department	The NSW Department of Planning and Environment, which commissioned the evaluation, along with its predecessor (the NSW Department of Planning, Industry and Environment) involved in launching and delivering the SLIH Trial
TOU	Time of use

Executive summary

The NSW Climate Change Fund (CCF, the Fund) was established in 2007 under an amendment to the *Energy and Utilities Administration Act 1987*.[1] The CCF was established to address the impacts of climate change, encourage energy and water saving activities, increase public awareness and acceptance of climate change, and support NSW to transition to a net zero emissions future.[2]

Administered by the NSW Department of Planning and Environment (the Department), the CCF is currently investing $1.4 billion between 2017-22 in a series of programs aimed at supporting households and businesses to:

— save energy and money

— improve energy reliability and affordability

— improve the resilience of communities across NSW to climate change.[3]

The Department commissioned ACIL Allen to undertake an evaluation of a clean energy program, the Solar for Low Income Households (SLIH) Trial. The SLIH Trial aimed to assist concession holders and low-income households by providing free 3 kilowatt (kW) solar systems to help reduce their energy bills. Participants could upsize to higher capacity solar systems at their own expense, and 96.5 per cent of participants did so, thus leveraging NSW Government investment. The analysis conducted by the Department, the Office of Energy and Climate Change (OECC), Australian Energy Market Operator (AEMO) and ACIL Allen included both participants with the free 3 kW solar systems as well as those that opted to upsize to a larger system. This analysis (excepting ACIL Allen's) was designed and largely conducted prior to the evaluation commencing. This did not enable direct comparison between the NSW Government's investment (of 3 kW systems) and the leveraged investment (greater than 3 kW). Participants were required to forgo their annual Low Income Household Rebate (LIHR) for 10 years to offset the costs of the solar system.

The evaluation was guided by the SLIH Trial evaluation framework developed by the Department and the OECC, NSW Treasury. It focuses on program outcomes and impact, and only addresses process issues (i.e., those issues pertaining to administrative efficiency) as they directly impinge on outcomes.

[1] NSW *Energy and Utilities Administration Amendment (Climate Change Fund) Act 2007 (No. 35)*, s 34E.

[2] NSW Department of Planning, Industry and Environment (n.d.). *NSW Climate Change Fund*. Accessed 23 December 2020: https://www.environment.nsw.gov.au/topics/climate-change/nsw-climate-change-fund.

[3] Ibid.

Methodology

The evaluation was undertaken in four phases, as follows:

— project inception including assessing data availability and key focus areas

— project planning including review of program documentation/data and key informant interviews

— consultation and analysis, which involved detailed program data analysis; energy savings methodology review; interviews with 32 stakeholders

— reporting, which involved two draft reports, a final report, a findings workshop and a presentation to NSW Government executive.

Key findings

The key findings from the evaluation of the SLIH Trial are outlined below according to KEQs.

A. To what extent are electricity bill savings achieved by participating households? Which participants benefit the most and how can savings be optimised in future programs?

The SLIH Trial has delivered an annual average of almost 4,900 kWh in energy benefits[4] to each participant in the sample analysed. Assuming the sample is representative for the 12-month period analysed for all participants in the SLIH Trial, the total energy benefits of the SLIH Trial were 5,930 MWh per annum. Participants with solar systems less than 3.5 kW[5] achieved annual average energy benefits amounting to 3,794 kWh, while participants with solar systems greater than 3.5 kW achieved annual average energy benefits of 6,974 kWh. This has resulted in an annual average of $804 (including GST) in electricity bill savings with a time of use tariff (TOU). Most bill savings are above the $600 (excluding GST) per year target set by the Department and more than double the $285 value of the LIHR (excluding GST).

The SLIH Trial has delivered greater benefit to participants who have the capacity (i.e., financial resources and engagement) to invest more in their system. This includes participants that upsized their solar systems, those who could access smartphones and used the smartphone applications to monitor their use, or could invest in system maintenance. While this is positive in helping these participants maximise their benefits, there are opportunities to further explore ways to better target the program to ensure those that are most at need can equally benefit from the program.

Savings can be optimised by providing more information and guidance to participants to educate and support them on how to best operate their solar systems and how to change their energy behaviours in response to their installation, assisting participants to choose and install a system that is best suited to their needs and would deliver the most benefit, and assisting them with the processes around smart meter installation.

A.1. How did network congestion/restrictions impact participant savings?

Some SLIH Trial installations have experienced network issues including export limits and inverter tripping. The full extent of this problem is unknown, although anecdotal evidence from consultation with an installer suggests this could be as high as 1 in 5 installations. If this is representative across the cohort of SLIH installations, this will have impacted the benefits delivered by the SLIH Trial and has reduced the potential impact of the program in terms of electricity bill savings, renewable energy generation and greenhouse gas (GHG) emission reductions. The program will continue to

[4] Energy benefits as measured by AEMO's energy analysis is from a grid perspective, that is, it assesses energy consumed from the grid the year prior to installation compared with post installation, self-consumption and energy exported to the grid. This allows for an assessment of the change in energy used from the grid.

[5] The AEMO analysis grouped solar systems into those sized below and above 3.5 kW, as, with no systems sized precisely 3.5 kW, this represented a 'natural break' in the data.

encounter network issues as the program scales and as more solar capacity is installed in NSW until the distribution networks evolve to support the energy transition to locally produced and exported energy.

A.2. How did system quality and performance impact these savings?

Given the solar systems being installed have at least an expected 10-year life span (at which time the inverter may require replacement), it is difficult to assess system quality and performance after only two years of operation. As such, this question focused on a performance assessment of a small sample of solar systems as well as audit information.

Auditing of the installations identified minor issues with electrical compliance, but no areas of immediate concern with regard to workplace health and safety. Some households have experienced technical issues with their solar system, as analysed by OECC. Most of these technical issues had a minor impact and were resolved quickly, resulting in a limited impact on bill savings. A small number had more significant issues that impacted on bill savings.

A.3. What impact (if any) did the program have on the network?

The total solar photovoltaic (PV) capacity installed as part of the SLIH Trial was over 5,300 kW. This represents 0.13 per cent of the total NSW rooftop solar capacity installed during that period, a fraction of the total solar PV capacity in NSW. A survey of participants suggests that 62 per cent of respondents considered that they would not have installed their solar systems without the SLIH Trial, with 31 per cent considering that they would have installed without the program (noting that there is no guarantee of this occurring). As such, the impact of the SLIH Trial on the network is marginal.

Some anecdotal evidence of micro-level impacts on local areas were identified (these predominantly related to network issues). As the program scales up across NSW, it will have a more material impact on the network due to the addition of further capacity to the network and resulting impact of accumulated potential network issues (noting that this is a far broader question relating to the need for distribution networks to evolve to support the energy transition to locally produced and exported energy).

A.4. What is the net financial impact of the program on participants?

As a condition of participating in the SLIH Trial (and receiving a free 3 kW solar system), participants agree to forgo 10 years of the LIHR (valued at $2,850 - $285 per annum (excluding GST)). This is predicated on the basis that participants will realise a minimum of $285 (excluding GST) per annum in electricity bill savings. The OECC's analysis shows that the participant's net benefit is positive for all solar system sizes (including the 3 kW solar systems and upsized systems), with solar systems less than or equal to 3.5 kW[6] having the shortest payback period and solar systems greater than 6 kW having the greatest net benefit of 25 per cent and the highest bill savings, $1,190 (including GST). The payback period ranges between two years for a 3.5-5 kW and three years for a 5-6 kW system. The payback period was not provided by the OECC for solar systems of 3.5 kW or less (solar systems of 3 kW were provided is free of charge and had no payback period).

These findings could inform future system sizes offered as part of the SLIH program. However, subsidising larger systems would likely require a trade-off between the number of participants that could be supported through the program and the optimal benefit that could be achieved by each individual participant, noting that as feed-in tariffs decrease, the value of the exported energy will decrease, shifting more of the benefit toward the energy used internally by individual households.

[6] The AEMO analysis grouped solar systems into those sized below and above 3.5 kW, as, with no systems sized precisely 3.5 kW, this represented a 'natural break' in the data.

Table ES 1 Net benefit and payback period of SLIH Trial solar systems, by solar system size

System size	Number of solar systems	Average bill savings ($ inc. GST)	Net Benefit (%)	Payback period (years)
All	74	$860	22%	-
Less than or equal to 3.5 kW	33	$619	22%	-
3.5 – 5 kW	9	$828	22%	2.07
5 – 6 kW	8	$906	19%	3.12
Greater than 6 kW	24	$1,190	25%	2.53

Note: Only includes sample data with sufficient information for this calculation. Payback period for upsized systems is calculated by dividing the cost of the upsize by total yearly savings. The total yearly savings has been reduced by $285 (excluding GST), which is the value of the yearly LIHR. The sample size for systems between 5-6 kW is small - this may impact results (and account for drop in benefit compared to systems greater than 6 kW).

Source: OECC analysis.

A.5. What motivators were relevant for customer uptake of SLIH? What barriers did the program remove for participants?

The primary motivation for participant uptake was financial, as it removed the initial up-front cost for participants. Environmental (as well as financial, self-sufficiency, and social and community) factors also strongly contributed to participant's motivations for installing solar, as the SLIH Trial allowed them to contribute to positive environmental outcomes (e.g., reduced GHG emissions and reduced impact on climate change), make the necessary transition to renewable energy, and participate in climate change action.

It has provided participants with access to solar systems, which would not have otherwise been affordable by removing the financial barriers to installation.

B. To what extent has the program increased renewable energy generation?

Under the SLIH Trial, a total of 1,211 solar systems have been installed and over 5,300 kW of solar PV capacity has been added in NSW.

C. To what extent has the program reduced GHG emissions?

Based on the sample of participants analysed, the SLIH Trial has delivered an annual average of 3,137 kg of GHG emissions avoided per participant. Assuming the sample is representative of all participants in the SLIH Trial and for the 12-month period analysed, the total GHG emissions avoided by SLIH Trial participants were 3,799 tonnes per annum. In comparison, the average household generates more than 18 tonnes of GHG per year (ranging from 3-30 tonnes depending on location and lifestyle).[7]

D. To what extent have program participants changed their electricity consumption practices in accordance with the information they received to utilise their solar system and maximise their electricity bill savings?

The Department/OECC and installers set the foundation for changing electricity consumption practices by providing information and support for participants to understand their systems. This approach worked well and the information provided has been instrumental in bringing about behavioural change by participants, in particular driving a shift in the use of electrical appliances during the day, limiting the use of major 'energy hungry' appliances (i.e., clothes dryers) where possible, and to cut back on overall energy use. Although not directly assessed via the 1-year post-installation follow up survey (as this focused on outcomes, not the installation or education

[7] Australian Greenhouse Calculator (n.d.). *Households and GHG emissions*. Accessed 8 July 2022: https://apps.epa.vic.gov.au/AGC/r_emissions.html#/!.

process), it is likely that those participants who better understood their systems (i.e., made good use of the information provided) and modified their behaviour accordingly, achieved greater benefits from their solar system. This was confirmed by consultation with participants. However, some participants used more energy on heating and cooling to improve comfort. This adjustment reflects an underuse of energy prior to installation – it appears these customers now feel they can afford the level of comfort desired without undue bill stress.

E. What, if any, unintended impacts have participants and suppliers experienced?

The SLIH Trial enabled participants to contribute to environmental outcomes and benefit from a perception of a more reliable supply of energy. Some participants consider that it has provided 'future-proofing' options in that they will be well placed should they wish to install a battery in the future or purchase an electric vehicle. The SLIH Trial also prompted some households that were eligible for, but were not already receiving, the LIHR to apply. This allowed them to be eligible for the SLIH Trial.

However, the SLIH Trial also encountered some negative unintended impacts, including issues with exports being limited, inverters tripping (due to voltage issues and power clipping) reducing the maximum output of a solar system, technical issues with the installation, poor visibility and management of Distributed Energy Resource (DER) installations in NSW, and uncertain feed-in tariffs and price pressures on installers (e.g. supply chain issues, labour and lifetime warranty, and additional audit requirements). These issues affect NSW solar system owners more broadly and are not specific to participants in the SLIH Trial.

E.1. To what extent has the trial improved household living conditions through non-energy benefits including, for example, reduced financial stress or improved thermal comfort?

The SLIH Trial improved household living conditions by enabling participants to receive lower energy bills, thereby reducing financial stress (worry/anxiety) in relation to energy costs (and the ability to pay their energy bills). This is likely to have flow-on impacts for both households (allowing them to better optimise their financial resources), and for society (in improving living conditions for low-income households). Other participants were simply satisfied with the savings they were making on their energy bills.

The target audience for the SLIH Trial commonly underuse electricity (because they cannot afford to use as much as they would like). The SLIH Trial had a positive impact on participant wellbeing, including feeling a greater sense of pride in their home and a freer use of heating and cooling to improve their comfort. This may also lead to health benefits in the future.

F. How did the quality and performance of the solar systems installed, compare to non-program installations?

The SLIH Trial had a strong focus on compliance with required regulatory requirements and as such installations were much more highly scrutinised in comparison to the industry norm. Furthermore, participating installers were provided with regular feedback on how to improve their processes under the SLIH Trial. Nevertheless, the installation quality and panels installed under the SLIH Trial were on a par with industry wide installations. While some installers offered a 'premium' product from other manufacturers, the price was outside the parameters of the SLIH Trial and generally beyond the reach of participants.

The 10-year whole of system warranty period provides participants with the comfort that they can get faults rectified. However, the SLIH Trial does not establish a clear dispute resolution mechanism (nor does one exist for the industry as a whole) should issues arise with installers.

G. To what extent have the internal LIHR processes removed the risk of potential double-dipping between this program and the LIHR?

SLIH Trial participants were required to forgo the LIHR to cover the cost of the system and installation. Responsibility rests on the NSW Government to inform the energy retailer of participant's involvement in the SLIH Trial. Participant are required to advise the NSW Government if they change energy retailers and if the energy rebate benefits are reinstated. While most participants arrange for the LIHR payments to cease through their energy retailer, some inadvertent double-dipping occurs. While this is mostly unintentional (e.g., due to misalignment of the timing between joining the Trial and notifying the energy retailer), it does impact the NSW Government's return on investment from the program, as in these cases, the government covers both the cost of the LIHR and the installation.

Recommendations

Recommendations arising from the evaluation of the SLIH Trial are as follows:

Recommendation 1

Support participants (through engagement with installers) to improve their understanding of how to change their behaviour to best use their systems by improving installer-delivered education and follow-up support. This could also include educating participants on housing efficiency (e.g., window and door seals, insulation, and using electricity rather than gas appliances) to support them to optimise the benefits from their solar system.

Recommendation 2

Require installers to provide more support and technical expertise to participants to enable them to understand which solar system size is most appropriate for their circumstances and work with installers to support them to better advise participants where upsizing the solar system would deliver a greater benefit. This should focus on optimising outcomes for participants, considering their lifestyle choices and personal objectives (e.g., achieving energy independence, optimised savings, thermal comfort).

Recommendation 3

Smart meters are a core requirement for a solar system and should be better embedded in program delivery (i.e., actively managed by the installer during installation, noting that it is ultimately the responsibility of the participant and retailer) to generate the most benefit to participants. Furthermore, the smart meters should have at least two elements to future proof the metering technology (to facilitate future battery installation and enhance user knowledge).

Recommendation 4

Explore opportunities to revise the program design and ensure it is fit for purpose to achieve the intended outcomes by:

— consider raising the 3 kW solar system size limit

— broaden the eligibility criteria to address the needs of energy-stressed households that are currently not holding a PCC or DVA Gold Card.

Recommendation 5

The NSW Government has an opportunity to invest in promotion and awareness raising for the program by:

- increasing the number and breadth of tailored promotional activities that are fit for purpose for the intended target audience
- requiring installers to conduct awareness raising activities
- using additional avenues to target eligible applicants (i.e., specific targeting via Service NSW)
- increasing the number of installers.

Recommendation 6

To maximise the benefits delivered by the program and mitigate risks to the achievement of these benefits:

- invest in understanding why some participants experience more network issues than others to inform ongoing decisions about program deployment and to enable this experience to feed into broader work (both policy and grid enhancement works) to resolve network issues, and thus improve the benefits generated
- engage with energy distributors to better understand where network issues are likely to emerge to guide program deployment (including where the grid may benefit from additional support, i.e., from local solar energy production) and ensure participants can be made aware of potential curtailments
- require installers to update the DER Register (including sanctions for non-performance) to help the distributors manage the network and improve the visibility of DER installations.

Recommendation 7

Consider establishing an affordable dispute resolution process in NSW to support customers and installers more broadly.

Recommendation 8

Ensure expansion of the program is supported by appropriate monitoring and support systems to protect participant information and enable future evaluations.

Recommendation 9

Improve visibility and information exchange between the LIHR and SLIH data holders to prevent double-dipping and streamline administrative processes for energy retailers and the NSW Government.

1 Introduction

Climate change is increasingly impacting environments, communities and economies around the world. At the global level, climate change presents an extreme challenge to human safety and wellbeing. At the household level, poor energy efficiency and reliance on fossil fuels creates stresses on families and exacerbates the climate challenge.

The challenge has global consequences and requires international cooperation. In response, the Intergovernmental Panel on Climate Change reached an international, legally binding treaty in 2015: the Paris Agreement. The Paris Agreement aims to limit global warming to below 2.0, preferably to 1.5, degrees Celsius compared to pre-industrial levels. Achieving this target requires global economic and social transformation.

Australia is contributing to global action on climate change by agreeing to reduce greenhouse gas (GHG) emissions to 26-28 per cent below 2005 levels by 2030 (under the Paris Agreement).

State and territory governments play a key role in driving climate change adaptation. The New South Wales (NSW) Government's NSW Climate Change Policy Framework (the Framework) outlines the Government's commitment to effective action on climate change. It identifies the long-term objectives of achieving net-zero emissions by 2050 and making NSW more resilient to climate change. The Framework aims to maximise the economic, social, and environmental wellbeing of NSW in the context of a changing climate.

The Climate Change Fund (CCF, the Fund, see section 1.1) supports the implementation of the Framework.

The NSW Government's action on climate change is also guided by:

— *Net Zero Plan Stage 1: 2020-2030*: which prioritises emission reduction technologies and innovations, and empowers consumers and businesses to make sustainable choices.

— *NSW Electricity Strategy*: which plans for a reliable, affordable and sustainable electricity future that supports economic growth. It aligns closely with the NSW Government's Net Zero Plan Stage 1: 2020 2030.

1.1 The Climate Change Fund

The Fund was established in 2007 under an amendment to the *Energy and Utilities Administration Act 1987*.[8] The CCF was established to address the impacts of climate change, encourage energy and water saving activities, increase public awareness and acceptance of climate change, and support NSW to transition to a net zero emissions future.[9]

[8] NSW *Energy and Utilities Administration Amendment (Climate Change Fund) Act 2007 (No. 35)*, s 34E.

[9] NSW Department of Planning, Industry and Environment (n.d.). *NSW Climate Change Fund*. Accessed 10 May 2022: https://www.environment.nsw.gov.au/topics/climate-change/nsw-climate-change-fund.

Administered by the NSW Department of Planning and Environment (the Department), the CCF has invested $1.4 billion between 2017-22 in a series of programs aimed at supporting households and businesses to:[10]

— save energy and money
— improve energy reliability and affordability
— improve the resilience of communities across NSW to climate change.

Household energy efficiency

Poor thermal control results in higher energy costs to achieve comfortable, healthy and safe homes. The residential sector accounts for approximately 8.3 per cent of NSW's energy use, which amounted to 127.6 petajoules (PJ) in 2018-19.[11] Since 1974, residential energy use has increased by an average rate of 1.4 per cent per year.

In the short to mid-term, residential energy use will rely on fossil fuels (with some use of firewood), notwithstanding the increasing penetration of renewable electricity in the energy mix. The residential sector is the second largest contributor of GHGs in NSW, accounting for 17.9 Mt CO_2-e of NSW's direct emissions (12 per cent of the total) and 15.9 Mt CO_2-e (28 per cent) of the state's indirect emissions from purchased electricity.[12]

At the household-level, energy use is a major expense, costing each Australian household approximately $43 per week on average, in largely unavoidable costs.[13]

The energy bill burden is even more pronounced for low-income households where energy costs can make up a larger portion of the household's expenditure relative to income. Of those households in the lowest income quintile, a quarter were spending more than 8.8 per cent of their income on energy. Of those on Newstart, or similar allowances, a quarter were spending more than 9.7 per cent of their income on energy use.[14] Rising energy costs have exacerbated this trend, with cost increases proportionally affecting lowest-income households by a larger degree. This can cause many to choose between heating/cooling and other essential household costs.

1.2 Solar for Low Income Households Trial

Low income households face income constraints that limit their ability to invest in solar photovoltaic (PV) systems and reap the longer-term benefits that such systems provide. Typically, they also spend more of their household income on energy costs. The Solar for Low Income Households Trial (SLIH Trial, the program) aimed to assist concession card holders and low-income households by providing free 3 kilowatt (kW) solar systems to help reduce their energy bills.

The SLIH Trial originally provided for solar systems of approximately 2.5 kW to be installed free of charge to help reduce the energy cost burden. The size of the systems was later revised to

[10] Ibid.

[11] Energy use for NSW and the Australian Capital Territory is combined in the source data.

[12] NSW Environment Protection Authority (2021). NSW State of the Environment 2021. Accessed 18 June 2022: https://www.soe.epa.nsw.gov.au/sites/default/files/2022-02/21p3448-nsw-state-of-the-environment-2021_0.pdf.

[13] ABS. (2021). *Household Expenditure Survey, household expenditure 1984 to 2015-16. Canberra: Australian Bureau of Statistics*. Accessed 10 May 2022: https://www.abs.gov.au/statistics/economy/finance/household-expenditure-survey-australia-summary-results/latest-release.

[14] Phillips, B. (2018). *Trends in household energy expenditure. Canberra: ANU Centre for Social Research Methods*. Accessed 10 May 2022: https://www.acoss.org.au/wp-content/uploads/2018/10/energy-stressed-in-australia.pdf.

approximately 3 kW. These 'base' systems were approved at a standard cost to the NSW Government. A smart meter is required to be installed with any solar system to access the relevant tariffs. There was also provision for up to an additional $1,200 to cover the cost of modifications to meter boards, if required. Participants could select to upsize to higher capacity solar systems, and pay the difference in cost at their own expense.

Participants were required to forgo their annual Low Income Household Rebate (LIHR) (see below) for 10 years to offset the costs of the solar system.

The LIHR provides Government support to low income households in NSW to help cover the costs of their energy bills. It is paid as a credit on each quarterly energy bill to a total value of $285 per year (excluding GST). Households are eligible for the rebate provided they are NSW residents; hold an account with an energy retailer; and hold a Pensioner Concession Card (PCC) issued by the Department of Veterans' Affairs (DVA) or Services Australia, or a DVA Gold Card or a Health Care Card issued by Services Australia.[15] Only a subset of LIHR recipients, those holding a PCC or a DVA Gold Card, were eligible to participate in the SLIH Trial. Health Care Card holders are not included as they are typically shorter term and less likely to have the opportunity to forego the LIHR for 10 years.

The average savings from the SLIH Trial were expected to be around $600 (excluding GST) per household per year (about two times the value of the LIHR), although savings depend on participant's lifestyle and electricity use.[16]

The intended objectives and outcomes of the SLIH Trial are provided in Table 1.1.

Table 1.1 Intended objectives and outcomes of the SLIH Trial

Objective	Outcome
Reduce electricity bills for participating households by more than the LIHR	Reduction in participating households' electricity bills by more than the annual LIHR amount
Increase solar installations and distributed renewable energy generation across NSW	Installation of up to 3,000 x 3 kW solar systems or 8.5 Megawatt (MW) of distributed behind-the-meter solar power in total (this was revised downwards from 3,400 installations and upwards from 2.5 kW solar systems)
Reduce Treasury's energy rebate liability and cost to government.	NSW Government liability reduced with fewer households accessing the LIHR
Reduce GHG emissions	

Note: No outcomes were set for the final objective.

Source: Department of Planning, Industry and Environment (2020). SLIH Evaluation Plan. Sydney: NSW Government.

The SLIH Trial operated in select postcodes in NSW, including the North Coast, South Coast, Illawarra-Shoalhaven, Central Coast and Sydney South. The SLIH Trial intended to install up to 3,000 systems over four years from 2018-19 to 2021-22. The evaluation assesses the operation of the SLIH Trial from the time it opened in late 2019 through to February 2022 (i.e., a period of a little over two years). The purpose of the Trial was to test implementation risks prior to a potential state-wide expansion.

[15] Service NSW (n.d.). *Apply for the Low Income Household Rebate (retail customers)*. Accessed 6 May 2022: https://www.service.nsw.gov.au/transaction/apply-low-income-household-rebate-retail-customers.

[16] NSW government (n.d.). *Solar for low income households FAQs*. Accessed 6 May 2022: https://www.energysaver.nsw.gov.au/browse-energy-offers/household-offers/apply-solar-low-income-households/solar-low-income-households-faqs.

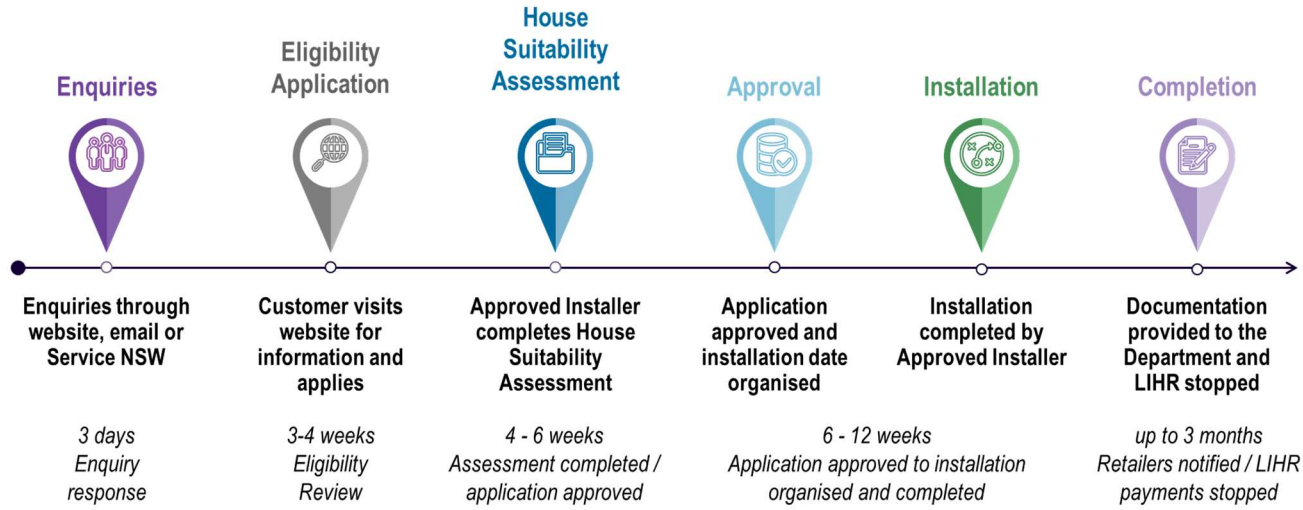
The Department selected three installers, namely SAE Group (SAE), Origin Energy (Origin) and SolarHub. SAE operated on the North Coast of NSW, SolarHub on the South Coast, and Origin in the Central Coast, Sydney South and the Illawarra-Shoalhaven regions.

The broader goals of the program were to boost energy productivity and put downward pressure on household electricity bills; support achievement of net-zero emissions by 2050; maximise the economic, social and environmental wellbeing of NSW residents in the context of a changing climate; and take advantage of opportunities to grow new industries in NSW.[17] Through achieving these goals, the SLIH Trial aimed to deliver benefits to both low-income households and the NSW Government.

1.2.1 The SLIH Trial application process and eligibility

The application process for the SLIH Trial involved six stages, as summarised in Figure 1.1. The steps are described at Appendix B.

Figure 1.1 SLIH Trial application process



Source: SLIH Application Process, the Department

1.2.2 Expansion of the SLIH program

The SLIH Trial was limited to selected postcodes in five NSW regions. A $50 million state-wide expansion of the SLIH program was announced by the NSW Government in October 2021 as part of the Government's COVID-19 Economic Recovery Strategy. This provided for initial access in selected Local Government Areas in Greater Sydney, with expansion over the following 12 months.

This evaluation considers SLIH Trial program data up to December 2021, with AEMO analysis including installations up to February 2022. The expansion of the program is out of scope.

1.3 The evaluation of the SLIH Trial

The Department engaged ACIL Allen to conduct an independent outcome evaluation of the SLIH Trial to assess how effectively the program objectives have been met; the legacy of the long-term benefits (including the impact of the program on electricity bill savings and benefit distribution across participants); renewable energy generation and GHG emission reductions; changes in electricity consumption practices; any unintended impacts; the net economic benefit of the

[17] Department of Planning, Industry and Environment (2020). *SLIH Evaluation Plan*. Sydney: NSW Government.

program; the quality and performance of the solar systems installed; and interactions with the LIHR program.

The project leveraged existing work conducted by the NSW Government to monitor SLIH Trial delivery and to prepare for this evaluation, as well as the NSW Government Program Evaluation Guidelines. The project delivered an end-of-program evaluation report that address the key evaluation questions (KEQs) (see section 1.3.1), identifies opportunities to improve on aspects of the program design and risk mitigation measures, and seeks to inform the NSW Government on future programs and initiatives.

The evaluation has been guided by the evaluation framework developed by the Department and OECC, NSW Treasury. It focuses on program outcomes and impact, and only addresses process issues (i.e., those issues pertaining to administrative efficiency) as they directly impinge on outcomes.

The analysis conducted by the Department, the Office of Energy and Climate Change (OECC), Australian Energy Market Operator (AEMO) and ACIL Allen included both participants with the free 3 kW solar systems as well as those that opted to upsize to a larger system (96.5 per cent of participants), thus leveraging NSW Government investment. This analysis (excepting ACIL Allen's) was designed and largely conducted prior to the evaluation commencing. This did not enable direct comparison between the NSW Government's investment (of 3 kW systems) and the leveraged investment (greater than 3 kW).

1.3.1 Key evaluation questions

The KEQs for the SLIH Trial (relevant to this report) are presented in Box 1.1. The KEQs address the energy, bill and emissions outcomes achieved by the SLIH Trial, the influence of the Trial on participants' knowledge, attitude and practices, the performance and quality of the solar systems, and the participant's transition from LIHR to SLIH.

Box 1.1 SLIH Trial KEQs

A. To what extent are electricity bill savings achieved by participating households? Which participants benefit the most and how can savings be optimised in future programs?

- A.1. How did network congestion/restrictions impact participant savings?
- A.2. How did system quality and performance impact these savings?
- A.3. What impact (if any) did the program have on the network?
- A.4. What is the net financial impact of the program on participants?
- A.5. What motivators were relevant for customer uptake of SLIH? What barriers did the program remove for participants?

B. To what extent has the program increased renewable energy generation?

C. To what extent has the program reduced GHG emissions?

D. To what extent have program participants changed their electricity consumption practices in accordance with the information they received to utilise their solar system and maximise their electricity bill savings?

E. What, if any, unintended impacts have participants and suppliers experienced?

- E.1. To what extent has the trial improved household living conditions through non-energy benefits including, for example, reduced financial stress or improved thermal comfort?

F. How did the quality and performance of the solar systems installed, compare to non-program installations?

G. To what extent have the internal LIHR processes removed the risk of potential double-dipping between this program and the LIHR?

Source: Department of Planning, Industry and Environment (2020). SLIH Evaluation Plan. Sydney: NSW Government.

1.3.2 Approach to the evaluation

ACIL Allen's approach to the evaluation involves four phases:

- **Project inception**, during which the Department provided background information and documentation on the project and discussed key areas of focus for the project.
- **Project planning**, which involved a preliminary review of key program documentation and data, and key informant interviews on the background, context for the program and the availability of information to inform the evaluation. This was incorporated into a project plan which guided the evaluation.
- **Consultation and analysis**, which involved analysis of program data; energy savings methodology review; stakeholder interviews with 32 stakeholders, including 12 NSW Government staff, five participants, three installers, two auditors and 12 experts and market actors (see Appendix A); and a findings validation workshop.
- **Reporting**, which involved two draft reports, a final report and a presentation to NSW Government executive.

1.3.3 Data sources

The primary sources of evidence used as inputs into the analysis were:

- background information on the SLIH Trial, including evaluation documents and program guidelines
- energy data analysis conducted by the OECC and the AEMO (see below)
- program and NSW Government records of governance, funding and administrative arrangements
- program data and reporting, including monitoring activities and data developed by the Department and OECC, and documentation of data sources through the Department and OECC's data assurance process
- surveys of SLIH Trial customers, including:
  - pre-launch with 271 respondents – to assess pre-existing knowledge and behaviour on solar system and electricity savings among households potentially interested in engaging in the SLIH Trial
  - application/pre-installation process with 161 respondents – to understand experiences with the SLIH Trial or reasons and constraints for not participating
  - installation process with 187 respondents – to assess behavioural changes following installation and participant satisfaction and experiences
  - a 1-year post-installation follow up survey with 295 respondents – to assess lasting behavioural changes and outcomes, and benefits arising from the SLIH Trial.
- stakeholder consultation conducted by ACIL Allen for this evaluation.

Energy data analysis

Analysis of SLIH Trial energy data was performed by OECC and AEMO. In brief, these analyses involved:

- **AEMO analysis**: an assessment of the energy benefits, electricity bill savings and GHG emission savings over a period from March 2021 to February 2022. This involved a sample of 98 households.
  - AEMO's analysis is from a grid perspective, that is, it assesses energy consumed from the grid the year prior to installation compared with post installation, self-consumption and energy exported to the grid. This allows for an assessment of the change in energy used from the grid.

— **OECC analysis**: an assessment of the net benefit for the participant from their involvement in the SLIH Trial. This is based on data collected from April to October 2020. This involved a sample of 74 households.
  — OECC's analysis is from a participant perspective. It assesses energy generation, consumption and export from metered data and compares this case against a counterfactual where the solar energy is not generated.

1.3.4 Data limitations

In conducting this evaluation, several gaps were identified where insufficient information was available to inform the analysis. The data limitations are:

— Survey data presented in the report is from separate surveys of participants involved in various stages of the SLIH Trial. It is not a representative sample nor a longitudinal survey of SLIH Trial participants.

— The AEMO analysis examines savings under four different solar system size groupings. The sample sizes for each grouping were small which may have limited the representativeness of the analysis.

— Differences in the methodology used by AEMO and the OECC for the energy analysis have resulted in different perspectives on the energy saved (i.e., for the grid or for the participant). AEMO's analysis is presented as it was the most recent analysis and takes a system-wide perspective.

— As the smart meters installed monitored the net energy imported from the grid rather than measuring the total generation and total consumption, assumptions were made on the amount of energy generated by the solar panels.

1.4 This report

The report addresses the evaluation questions identified in Box 1.1. The structure of the report and the evaluation questions addressed by each chapter is provided in Table 1.2.

Table 1.2 Evaluation questions addressed by each report chapter

Report chapter	Evaluation questions
Chapter 2: Knowledge, attitude and practice	A.5. What motivators were relevant for customer uptake of SLIH? What barriers did the program remove for participants? D. To what extent have program participants changed their electricity consumption practices in accordance with the information they received to utilise their solar system and maximise their electricity bill savings? E.1. To what extent has the trial improved household living conditions through non-energy benefits including, for example, reduced financial stress or improved thermal comfort?
Chapter 3: Energy, bills and emissions	B. To what extent has the program increased renewable energy generation? *A.* To what extent are electricity bill savings achieved by participating households? Which participants benefit the most and how can savings be optimised in future programs? C. To what extent has the program reduced GHG emissions? A.4. What is the net financial impact of the program on participants? G. To what extent have the internal LIHR processes removed the risk of potential double-dipping between this program and the LIHR? A.3. What impact (if any) did the program have on the network?
Chapter 4: Performance and quality	E. What, if any, unintended impacts have participants and suppliers experienced? A.1. How did network congestion/ restrictions impact participant savings? A.2. How did system quality and performance impact these savings?

Report chapter	Evaluation questions
	F. How did the quality and performance of the solar systems installed, compare to non-program installations?
Chapter 5: Key findings and recommendations	All KEQs
Appendix A: Stakeholder engagement	Not applicable
Appendix B: Supporting information	Not applicable

Source: ACIL Allen

Knowledge, attitude and practice 2

This chapter addresses the factors influencing customer uptake of the SLIH Trial, and changes to participant's electricity consumption practices and household living conditions occurring due to their participation in the SLIH Trial.

2.1 Factors influencing participant uptake of the SLIH Trial

A.5. What motivators were relevant for customer uptake of SLIH? What barriers did the program remove for participants?

Participant uptake is influenced by their awareness, eligibility, barriers and motivators. This section discusses these factors.

2.1.1 Awareness of the SLIH Trial

The NSW Government and installers played roles in promoting the program and raising awareness among the intended participants.

Awareness raising by the NSW Government

Substantial awareness raising activities were not undertaken before or during the launch of the program, as it was expected that the SLIH Trial would attract high public interest and uptake in all regions.

The Department engaged an external marketing agency and, later on, a media buying agency. The advice from the marketing agency included to establish a Facebook account for the NSW Government to communicate with potential participants in eligible regions; develop a participant user guide in plain language; and to create an installation guide. However, the promotional activities were initially limited in terms of scale and the channels used. For example, the use of a Facebook account as the primary mechanism to promote the program meant that many potential participants (i.e., anybody who does not use this platform) were not reached. The activities undertaken by the marketing agency were not considered by the Department to drive strong uptake of the SLIH Trial.

In 2021, the media buying agency developed a strategy on how to best boost uptake under the SLIH Trial. From this strategy, 14 print advertisements were created and published to advertise the SLIH Trial. Separately, the program team engaged Service NSW to include 'distraction screens' at their centres to further promote the Trial to potential applicants, and LinkedIn posts were circulated by the program team and the Department to promote the Trial.

In recent times, the NSW Government has sought to connect with community groups and consumer organisations to raise awareness of the expanded program. The NSW Government is also actively following up with applicants that have begun, but not completed, the application process.

Potential participants could have been identified through their PCC and/or DVA Gold Card status. However, these contact details are held by Services Australia and the Department of Veterans'

Affairs, respectively, and are not accessible to the NSW Government due to privacy requirements. Further, Service NSW has been unable to promote the program specifically to the eligible regions (as opposed to the whole state) due to platform limitations. This has limited the extent to which the NSW Government could identify, access and raise awareness amongst the intended participants.

Awareness raising by installers

The NSW Government held regular meetings with installers to encourage them to raise awareness of the Trial.

In the absence of a concerted promotional campaign by the NSW Government, promotion has largely been driven by installers, who have engaged with potential participants through local councils' newsletters and social media in eligible regions, and in one instance, by emailing existing customers. Internal assessment by the NSW Government indicates that promotion by installers in local newspapers has been the most effective method for engaging with potential participants. However, there are no contractual obligations between the NSW Government and installers requiring the installer to promote the Trial in their area.

The North Coast was the most successful region in terms of uptake. This corresponds with the more regular delivery of communications and promotional material by the local installer which presumably drove greater levels of interest, leading to the higher level of uptake in this region relative to other regions (see Table 2.1). However, in general, stakeholder consultation for this evaluation identified low awareness among the target audience for this program. This was perceived to be a result of limited promotion by the NSW Government and installers, and the challenges with reaching the target audience.

Table 2.1 Uptake of the SLIH Trial by region

Region	Actual installations	4 year target installations	Target shortfall	Proportion of target achieved
North Coast	561	700	139	80%
South Coast	182	350	168	52%
Illawarra-Shoalhaven	263	650	387	40%
Central Coast	130	650	520	20%
Sydney South	75	650	575	12%
Total	**1,211**	**3,000**	**1,789**	**40%**

Note: Participant location data reflects 31 December 2021 figures.
Source: SLIH Trial program data

The SLIH Trial target audience (PCC and DVA Gold Card holders) is generally considered more vulnerable and susceptible to marketing approaches.[18] As such, installers were required to not use pressure sales tactics (e.g., door to door sales and cold calling) and were required to have all marketing materials approved by the NSW Government before use.

On balance, the lack of promotion has likely resulted in low awareness among the target audience and a lower than expected number of applications for the program. It also impacts the program

[18] Australian Competition and Consumer Commission (2019). *Vulnerable consumers lose record amount to scammers*. Accessed 4 May 2022: https://www.accc.gov.au/media-release/vulnerable-consumers-lose-record-amount-to-scammers.
Bainbridge, A. & Kent, L. (2021). *Vulnerable Australians falling victim to high-pressure solar panel sales tactics, amid calls to ban door-knocking*. Accessed 4 May 2022: https://www.abc.net.au/news/2021-10-13/solar-systems-sold-to-vulnerable-pensioners/100494892.
Australian Banking Association (2019). *Safe & Savvy A guide to help older people avoid abuse, scams and fraud*. Sydney: Commonwealth Bank of Australia.

participants, with uptake likely to be higher among households that had already been exploring solar system installations compared with those that had not previously considered solar system installations. Further, there is no contractual obligation on the installers to raise awareness of the SLIH Trial, and installers have promoted the SLIH Trial to varying extents. This has limited the extent to which the SLIH Trial has met its installation targets (see section 1.2).

Key Finding 1 Awareness of the SLIH Trial

The Department assumed uptake would be strong and awareness raising activities would not be needed. This strong awareness did not eventuate, yet was required for uptake.

The NSW Government and installers undertook limited awareness raising activities, but did not necessarily have effective channels for communicating with stakeholders.

Awareness among the target audience is likely low, which in part explains the low uptake of the SLIH Trial relative to the target number of installations.

Source: ACIL Allen

2.1.2 Eligibility for the SLIH Trial

Once an applicant lodges an application for the SLIH Trial, there are two eligibility assessment stages:

1. the initial application and House Suitability Assessment
2. the full application (see section 1.2.1).

A total of 3,222 applications were received from the start of the SLIH Trial to 31 December 2021. Of these applications, 428 (13 per cent) were deemed ineligible, 517 (16 per cent) were declined and 86 (2 per cent) were withdrawn by the applicant. Applicants were most commonly declined and ineligible due to issues identified during the initial review (97) and the House Suitability Assessment (341).

While information on ineligibility was not available from program data, stakeholders consulted for the evaluation noted that applicants were often deemed ineligible during the initial application stage as they did not fulfill the eligibility criteria for the program (e.g., they did not have the correct concession card, own their own home, receive the LIHR, live in an eligible region). Applicants were also declined during the house suitability assessment stage due to unsuitable roofs (e.g., shading from trees, poor roof orientation towards the sun, roof complexities) and wiring. This has limited the uptake of the program.

Participants must receive the LIHR and be willing to forgo this for 10 years to be eligible for the SLIH Trial. During consultations, it became evident that there were some households interested in the scheme even though they were technically ineligible, given they were not in receipt of the LIHR (although they probably met the LIHR eligibility criteria). These households were advised they would need to apply for (and be granted) the LIHR in order to meet the SLIH Trial eligibility criteria. While this likely led to delays in their applying for the program, it does not directly prevent this cohort of applicants ultimately engaging with the SLIH Trial should they wish to do so.

Greater awareness and participation in the support schemes would likely streamline the eligibility review and SLIH Trial application process for both potential participants and the NSW Government.

The SLIH Trial specifically targeted those holding a PCC or DVA Gold Card and owning one's home. While this is sensible given the need to forgo the LIHR for 10 years, many households in need of support (i.e., those renting, in apartments or social housing and those on other concession cards, such as the Health Care Card) are not eligible for the program. There is an opportunity for future programs to target those most at need. On the other hand, the Government provides an array of support mechanisms for those in need and it is appropriate that support is offered in a way

that is best tailored to the needs of the recipient. Accordingly, the SLIH Trial should not be expected to meet every need.

Key Finding 2 Eligibility for the SLIH Trial

Almost a third of applicants were declined or deemed ineligible during the administrative review and House Suitability Assessment.

SLIH Trial application and eligibility review processes could be streamlined if potential applicants had a better awareness of the Government's energy bill support opportunities (including LIHR).

The eligibility criteria limit the extent to which the program targets those most at need (although they may be eligible for assistance through other schemes).

Source: ACIL Allen

2.1.3 Barriers and motivators to uptake of the SLIH Trial

A.5 What motivators were relevant for customer uptake of SLIH? What barriers did the program remove for participants?

The SLIH Trial aims to address barriers to the uptake of solar systems, including high up-front capital costs which can be prohibitive for low-income households.[19] By providing free solar systems, the SLIH Trial was expected to encourage participation by households that would not otherwise be able to afford to install solar systems. At the time of designing and implementing the SLIH Trial, this assumption had not been tested and verified in an Australian context.[20]

During stakeholder consultations, one installer considered that the primary motivation for participant uptake was financial, as it removed the initial up-front cost for participants. Participants considered that environmental (as well as financial and social and community) factors strongly contributed to their motivations for installing solar, as the SLIH Trial allowed them to contribute to positive environmental outcomes (e.g., reduced GHG emissions and reduced impact on climate change), make the necessary transition to renewable energy, and participate in climate change action.

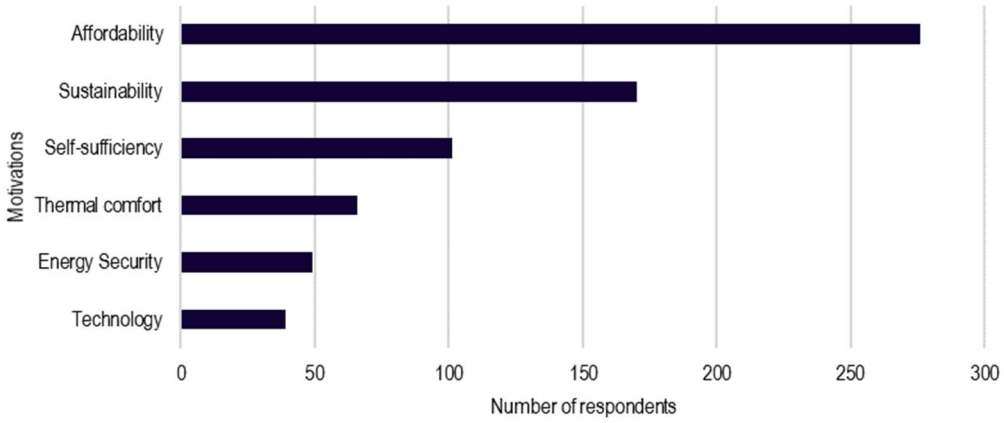
This is supported by data from the Department's 1-year post-installation survey of SLIH participants (see Figure 2.1). This shows that the respondents' most common motivations for installing a solar system are affordability (39 per cent, 276 responses), followed by sustainability (24 per cent, 170 responses) and self-sufficiency (14 per cent, 101 responses).

Participants also commented on the barriers to uptake of solar PV (including some with prior experience from previous houses). The recent decline in feed-in tariffs for solar energy, leading to a longer payback period to recoup the capital costs, has made installing solar systems on their current house unaffordable without the SLIH Trial, as with low feed-in tariffs, payback is achieved primarily through self-consumption of the energy generated.

[19] Australian Council of Social Service and Brotherhood of St Laurence (2019). *Affordable, clean energy for people on low incomes*. Sydney. Available at: https://www.acoss.org.au/wp-content/uploads/2019/02/FINAL-Report-Affordable-clean-energy-for-people-on-low-incomes_web.pdf, accessed 4 May 2022.

[20] Department of Planning, Industry and Environment (2019). Op. cit.

Figure 2.1 Respondents' motivations for installing solar power system



Note: Respondents could select multiple answers.

Source: ACIL Allen analysis of Department data from the 1-year post-installation survey, 2022.

As noted in section 1.2, higher costs may be incurred if issues are identified with the meter board or wiring of the house. Suitable wiring and meter boards are a pre-requisite to participation in the Trial. The NSW Government provided subsidies of up to $1,200 to cover the cost of necessary upgrades. The cost of these types of works generally range between $500 to $2,000,[21] but installers have indicated that it could be as high as $10,000 or greater. These high costs, together with the burden of arranging such upgrades, are a barrier to uptake of the program. This was confirmed by one retailer consulted, who commented that the high price of addressing wiring issues was prohibitive to households.

Participation in the SLIH Trial requires participants to manage the perceived uncertainty that the savings from the solar system may or may not be greater than the LIHR. As no minimum benefit is guaranteed, some stakeholders considered that the perceived uncertainty of losing the LIHR can be too large for some vulnerable groups and that this was impacting their uptake. In exceptional circumstances, participants could reapply to have the LIHR reinstated.

However, it is unclear how widely this was known among potential participants and as such, the perceptions of uncertainty may have discouraged uptake. A guaranteed minimum saving of $285 per year (excluding GST, equal to the LIHR) was suggested by stakeholders as a means to provide some certainty and provide opportunities for these potential applicants to benefit from the SLIH Trial. This approach is not supported as it could encourage poor energy use behaviours given a guaranteed saving. As an alternative the findings and outcomes of the SLIH Trial should be strongly promoted given they clearly establish a strong evidence base as to the level of savings achievable.

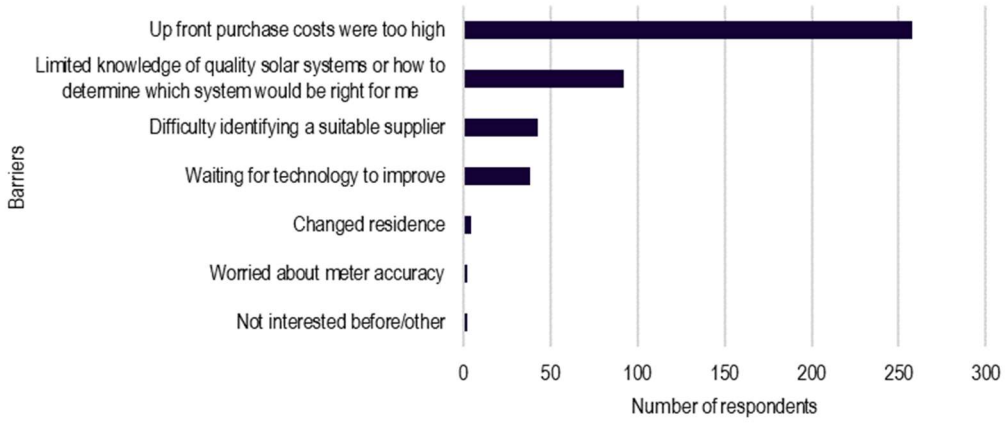
The 1-year post-installation survey data (see Figure 2.2) confirms that the primary barrier for respondents is the high up-front purchase costs (59 per cent, 258 responses). This is followed by a limited knowledge of quality solar systems and their suitability (21 per cent, 92 responses), difficulty identifying a suitable supplier (10 per cent, 43 responses) and waiting for improvements in technology (9 per cent, 38 responses).

However, many participants upsized their solar systems to larger capacity installations (see section 3.2.1) and a significant number indicated they may have installed solar systems without the

Mullane, J. (2022). *Fuse Boxes and Switchboards Explained*. Accessed 12 July 2022: https://www.canstarblue.com.au/home-garden/fuse-box-switchboard/.

program (see section 3.1). As such, there are some participants that did not face financial barriers to installing a solar system.

Figure 2.2 Respondents' barriers to installing solar system before the SLIH Trial

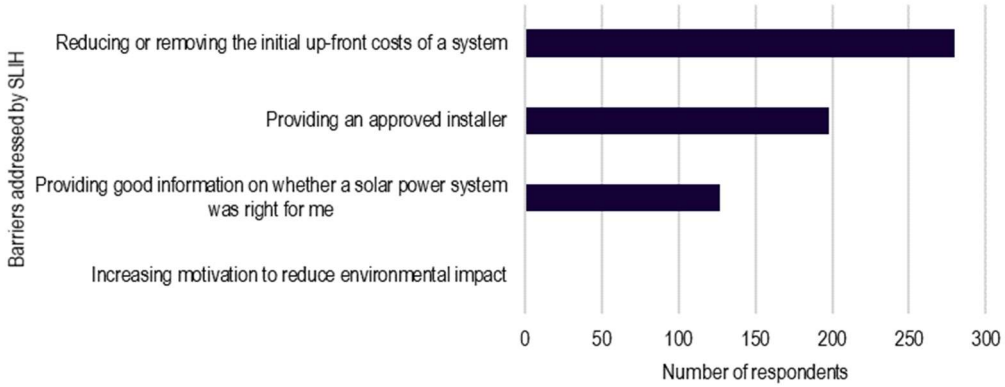


Note: Respondents could select multiple answers.

Source: ACIL Allen analysis of Department data from the 1-year post-installation survey, 2022.

Respondents considered that the SLIH Trial was effective in addressing these barriers (see Figure 2.3). In particular, barriers related to reducing or removing the initial up-front costs of a system (46 per cent, 280 responses), providing an approved installer (33 per cent, 198 responses) and providing good information on whether a solar power system was right for me (21 per cent, 127 responses) were effectively addressed by the Trial.

Figure 2.3 Respondents' barriers addressed by the SLIH Trial



Note: Respondents could select multiple answers.

Source: ACIL Allen analysis of Department data from the 1-year post-installation survey, 2022.

Key Finding 3 Barriers and motivators to uptake of the SLIH Trial

The primary motivators for installing solar systems are affordability and environmental outcomes.

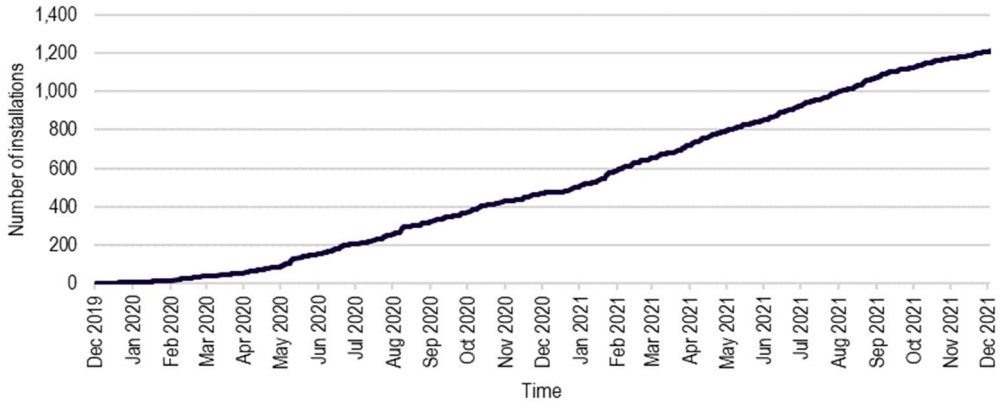
The SLIH Trial has been successful in removing barriers to installation, in particular the high up front purchase costs.

Source: ACIL Allen

2.1.4 Uptake of the SLIH Trial

One of the SLIH Trial objectives is to increase the number of solar installations and amount of distributed renewable energy generation across NSW. Program data shows that, as of end of December 2021 (a little over two years from the launch of the Trial), the total number of participants in the SLIH Trial whose solar systems were operational was 1,211. The Department had set a target for the Trial of 3,000 installations in four years. On a pro-rata basis, taking account of the shorter time period, and allowing for an initial start-up period (see Figure 2.4), overall installation numbers were by and large on-track to meet the four-year target.

Figure 2.4 Cumulative number of installed rooftop solar PV systems between December 2019 and December 2021 as part of the SLIH Trial



Source: Department SLIH Trial Program Data as at 31/12/2021

The Department also set installation targets for each installer for each region, which were incorporated into its contracts with installers (see Table 2.1). Given these are four-year targets, they have not yet been met (as would be expected). The largest number of installations have been completed in the North Coast region (49 per cent, 561 installations), followed by Illawarra-Shoalhaven (23 per cent, 263 installations) and the South Coast (16 per cent, 182 installations).

In terms of installer performance against the targets, the North Coast region performed strongest achieving 80 per cent of the target installations. It is well on-track to exceed its target. The South Coast (52 per cent) and Illawarra-Shoalhaven regions (40 per cent) are performing well and should be able to deliver against their respective targets. The remaining two regions (Central Coast and Sydney South) are lagging and unlikely to deliver against their respective targets. As noted in section 2.1.1, the North Coast region's strong performance may be a result of more concerted promotional activities undertaken in that area.

As noted in section 2.1.1, the low uptake is largely driven by poor awareness of the program. Anecdotally, the COVID-19 pandemic also reduced participants' willingness to install, as this required face to face interaction with installers. Uptake later increased in 2021 (see section 3.1 and Figure 3.1).

Participants had the opportunity during the application process to select their inverter and the size of their solar system. Figure 2.5 shows that participants have installed a range of solar system sizes. The vast majority of installations are above the free 3 kW solar system size provided by the NSW Government (96.5 per cent). About half of the installations (53 per cent) have a capacity of less than or equal to 3.5 kW (641 of 1,211 installations). This is likely because solar systems sized 3 kW and under are free under the SLIH Trial (as overviewed in section 1.2).

A large number of participants also selected to install upsized solar systems (i.e., above the free 3 kW system) between 6.0 and 7.0 kW (29 per cent, 352 installations), which is a commonly

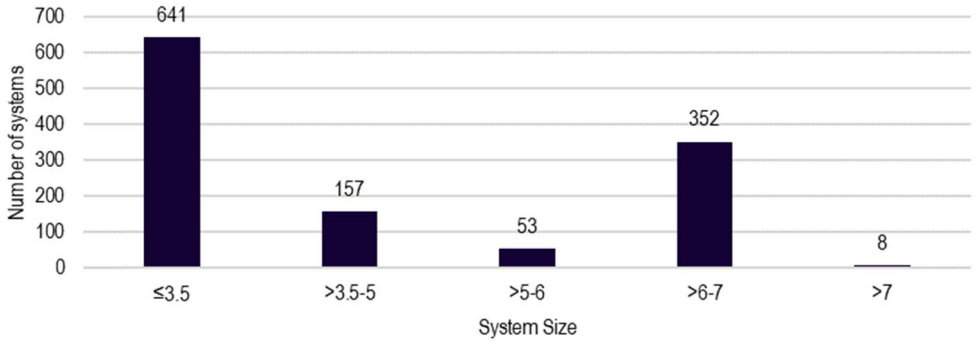
installed capacity for rooftop solar systems (i.e., beyond the Trial). For example, the average installed capacity in Australia in 2021 was 7.0-8.0 kW.[22] This has been progressively increasing. However, as further discussed in section 3.2.4 and 4.2.1, some solar systems were curtailed in some areas, which led to reduced capacity to export surplus energy to the grid and therefore generate income through feed-in tariffs. For example, the export limit on the Essential Energy network was 3 kW in regional areas and 5 kW in non-regional areas.

The larger capacity system provides the potential for participants to generate more electricity. Based on the 1-year post-installation survey, most of the participants opting for a larger system size did so because they considered it would better meet their household energy needs (58 per cent, 104 responses) or because they are planning for future changes in energy prices or solar feed-in tariffs (33 per cent, 58 responses).

Installers were not allowed to actively offer or propose an upsizing option to applicants. Instead, participants are required to ask. This approach was adopted to reduce the likelihood that applicants would experience pressure sales tactics from installers (see section 2.1.1). However, this arrangement could have also led to unintended outcomes, indirectly restricting participant options, with one installer noting that some participants said they would have installed a bigger system if they were aware of this option. This comment was also made by one participant.

At a later stage in the SLIH Trial, installers started to offer upsizing as an option to applicants. According to one installer, this was due to more freedom being afforded by the Department, in response to complaints from participants that would have opted for a larger system had they been aware of the option. This enabled installers to actively offer an upsizing option.

Figure 2.5 SLIH Trial uptake by system size



Note: System size data is current on 31 December 2021.
Source: SLIH Trial program data

[22] Clean Energy Regulator (n.d.). *Residential solar PV installation trends*. Accessed 13 May 2022: http://www.cleanenergyregulator.gov.au/About/Pages/Accountability%20and%20reporting/Administrative%20Reports/The%20Renewable%20Energy%20Target%202019%20Administrative%20Report/Residential%20solar%20PV%20installation%20trends.aspx.

Key Finding 4 Uptake of the SLIH Trial

The SLIH Trial is largely on track to meet its installation targets, noting that it has only been operating for just over two years of the four-year period initially scheduled for the Trial. The North Coast performed most strongly of the regions and is on track to exceed its target.

More than half of the participants installed a 3 kW or smaller system, which is free under the SLIH Trial. Larger systems are commonly installed to better meet participants current or future energy needs.

Restricting installers' ability to promote an upsizing option was a double-edged sword. This limited pressure sales tactics, but may have prevented participants from getting a solar system that best met their needs.

Source: ACIL Allen

2.2 Participant changes in electricity consumption practices

D. To what extent have program participants changed their electricity consumption practices in accordance with the information they received to utilise their solar system and maximise their electricity bill savings?

This section discusses how the program has set the foundations for changes in electricity consumption practices, and the resulting knowledge and behaviour changes.

2.2.1 Setting the foundations for changing electricity consumption practices

The SLIH Trial has set the foundations for changing electricity consumption practices through the distribution of user guides, follow-up by installers, and the use of appropriate apps and monitoring systems (linked to smart meters/inverters), which allows participants to access real-time monitoring and consumption data.

User guides

To ensure households maximise their benefits from the solar system, all participating households received a user guide when they began participating in the SLIH Trial.[23] The guide outlines how the solar system works, how to maximise its use and how to undertake ongoing maintenance. This information is also available on the SLIH Trial website.

The user guide suggests the following practices to maximise the benefits of the solar systems:[24]

- use appliances between 10 am and 3 pm
- use a delayed start for dishwasher and washing machine to let it run during these times
- limit electricity use during cloudy and rainy days
- avoid using the dryer when you can
- use timers to turn appliances on and off at pre-set times.

The user guide also provides suggestions on maintaining the solar system to ensure it was working effectively and maximising the energy generated. This includes monitoring the inverter, checking the roof surroundings, getting the solar system cleaned and having maintenance checks done.[25]

Stakeholders did not comment on the user guide during consultations or through the 1-year post-installation survey. As such, it is not possible to comment on its usefulness for participants.

[23] Department of Planning, Industry and Environment (2019). *User guide: Solar for Low Income Households Trial*. Sydney: NSW Government.

[24] Ibid.

[25] Ibid.

Information provided by installers

Most participants consulted commented that they had been offered information by their installer during the installation process as to how best to use their solar system.

Installers then engaged, and followed up, with participants using a range of approaches. All installers advised their customers or potential customers that the program is available and supported them to complete the application process. Installers provided information on the best solar system options and how to operate the system during the assessment phase. Two installers conducted the installations on approved households themselves, while one used the services of subcontractors to perform site inspections and installations.

Following installation, two installers educate participants on how solar works, how to read their inverters, and how to manage their systems. They then entrusted the participants to do their own research on how to best manage the system. One installer provided ongoing support and advice on how participants can manage and maintain their systems, and maximise their savings. This includes support to review their electricity bills to identify solutions for maximising their savings.

One installer suggested that there was the need for a post-installation kit to inform participants on how to maximise their savings. Another installer suggested the NSW Government should play a stronger role in following up with participants to ensure the initial education has been embedded.

Smart meters

Some participants did not have a smart meter installed prior to participating in the SLIH Trial. They were required to have one fitted as part of the solar system installation to access the relevant tariffs (see section 1.2). There would be value in ensuring that smart meters installed in conjunction with the SLIH Trial have at least two elements to future proof the metering installation (to facilitate future battery installation and enhance user knowledge).

Since December 2017 retailers have been responsible for installing smart meters for new connections or when replacing faulty meters.[26] Retailers take different approaches to recover the cost of the smart meters (typically $500-$600). Some retailers charge their customers the capital cost of the smart meter (including installation) as a lump sum on their electricity bill (uncommon in NSW), others charge customers a monthly fee or make it part of electricity usage charges. Retailers are required to disclose the upfront costs for smart meters.[27]

A request to install a smart meter (if not already in place) must be initiated by the SLIH Trial participant as only they have the legal authority to initiate such a request of their energy retailer. If there is an existing smart meter, this will need to be recoded, which also requires a metering coordinator to attend the household. Furthermore, should a participant pre-emptively request a smart meter installation, and the metering coordinator needs to attend the house multiple times, they will require payment for their services.

The SLIH Trial approved installers are required to support and assist participants through the smart meter installation process and to liaise with retailers. Where a new meter is required to match the solar panels, the cost of this is typically not charged to the accountholder in NSW (it is a general cost to the retail business). However, in circumstances where an additional indirect cost is levied for a smart meter, this may have been a barrier to uptake of the program.

While installers are required to 'assist' and 'coordinate', responsibility for getting the smart meter installed ultimately rests with the household. Anecdotal evidence from consultations suggests that

[26] Australian Energy Market Commission (n.d.). *Metering*. Accessed 18 May 2022: https://www.aemc.gov.au/energy-system/electricity/electricity-system/metering.

[27] Australian Energy Regulator (n.d.). *Smart meters*. Accessed 27 May 2022. https://www.aer.gov.au/consumers/my-energy-service/smart-meters

some participants found this process challenging, with potential additional ('hidden') costs that were not evident upfront. Greater awareness of the possible need to install a smart meter (and its cost) would have enhanced the outcomes of the SLIH Trial. There would be value in the NSW Government working with installers to develop ways to ensure that participants are not burdened with organising installation of smart meters, with installers required to take a more active role in facilitating installation.

Inverter smart monitoring system

Inverters are installed as an integral component of any solar system, converting the direct current (DC) electricity generated by the solar panel, to alternating current (AC) electricity, which is used by the grid. They provide the interface between the PV panels and the electricity system. The inverter installation was accompanied by an inverter smart monitoring system. An inverter smart monitoring system is a computer or smartphone application that provides information on the amount of energy produced by a household's solar panels, the amount that is consumed in their home, and the amount exported to the grid.

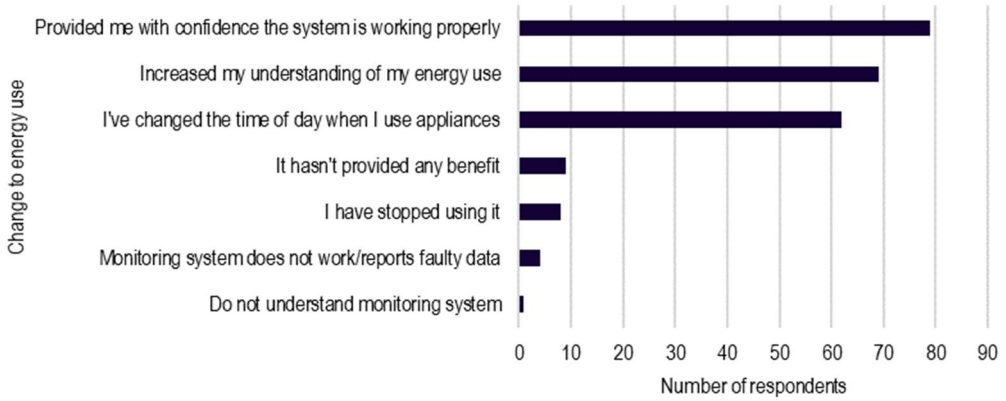
The 1-year post-installation survey shows a significant knowledge gap among participants, with 20 per cent of respondents unsure whether or not an inverter was installed (presumably they had not been adequately advised by their installer), with a further five per cent considering that they did not have an inverter installed. As the survey did not request specific information on respondent installers, it is not possible to determine if this information failure relates to a specific installer or is more general.

Of the 75 per cent of respondents that knew they had an inverter installed, 56 per cent had been supported by their installer to install the solar performance monitoring system application on their phones. Respondents that did not have a monitoring system installed on their computer or mobile phone considered that this was because they were not offered one (16 respondents) or were unclear as to the benefits of the monitoring system and therefore did not consider that they needed to have one (13 respondents).

Many respondents were checking their monitoring system once a week (20 per cent) or a few times a week (25 per cent). Eleven per cent of respondents indicated they check their monitoring system multiple times a day. However, a third of respondents (36 per cent) were not interested in using the application and do not regularly check it, and a small number of participants found the application challenging to use or were not able to use it (e.g., due to issues with internet access).

Among respondents with monitoring systems, 93 per cent agreed that it was very, quite or somewhat useful to monitor their use. As shown in Figure 2.6, respondents considered that the monitoring system provided them with confidence that their system was working properly (34 per cent), and was increasing their understanding of their energy use (30 per cent).

Figure 2.6 How monitoring systems has affected respondents' energy use



Source: ACIL Allen analysis of Department data from the 1-year post-installation survey, 2022.

On balance, there is value in improving a participant's knowledge and understanding of their solar system and inverter, how their inverter smart monitoring system works, and how they can generate the most benefit from it. This would better support participants to get the most benefit from their solar system (i.e. where participants could amend their behaviours or improve their energy use to generate more energy benefits).

Stakeholders made several suggestions on how this could be achieved, including follow-up engagement with participants, and 1-3 month post-installation and annual service calls. At home monitoring systems could also be useful in supporting participant engagement with, and understanding of, their system.

Key Finding 5 Setting the foundations for changing electricity consumption practices

User guides, installers and monitoring systems set the foundations for changing consumption practices.

The extent to which installers followed up and sought to empower participants to make the most of their solar systems varied.

While 75 per cent of households understood that they had an inverter installed as part of the solar system. 25 per cent of respondents either did not know whether they had an inverter installed or considered that they did not have an inverter installed. Given inverters are an integral component of the solar system, this indicates a lack of understanding by a significant proportion of SLIH Trial participants of how their system operates (and how to monitor it to achieve best use).

Only half of participants use the associated inverter smart monitoring systems, although almost all of those that did so find this useful for monitoring their consumption.

There is an opportunity to improve a participant's knowledge and understanding of what solar system and inverter they have installed, how their system works and how it can generate the most benefit.

Source: ACIL Allen

2.2.2 Knowledge and behavioural changes

To generate the most benefit from the solar system, participants must know and understand how to use their systems and change their behaviours to reflect this knowledge.

Knowledge and understanding of energy practices

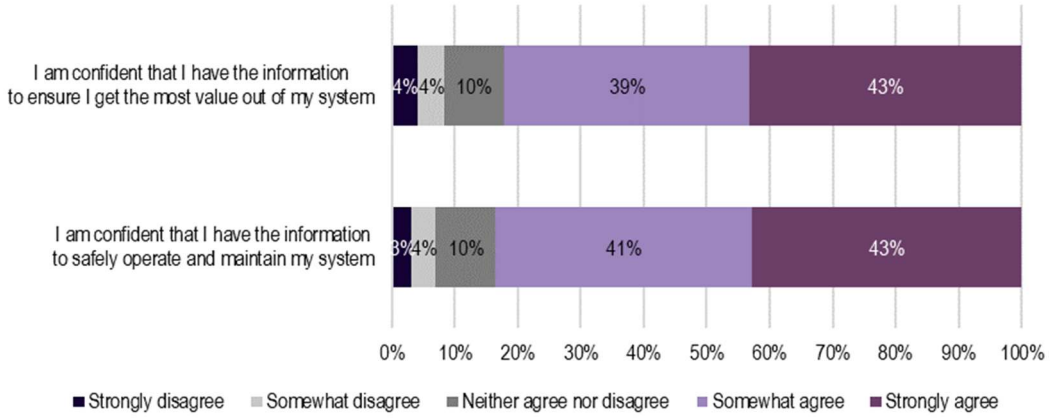
Participants consulted for the evaluation had mixed views on whether they received the information they needed to operate, maintain and get the most out of their system. This varied by installer, with

the majority of cases experiencing no follow up support. Participants who engaged with suppliers with local networks generally received more support.

The Department's surveys of participants pre-installation, initial post-installation and 1-year post-installation provide insights into participants' understanding of the practices that will best utilise their solar systems over time (see section 1.3.3). It is important to note that the surveys had distinct groups of respondents and response numbers, and are not a longitudinal study of behavioural change over time. Data was also not collected consistently across the surveys.

The 1-year post-installation survey shows that most respondents strongly or somewhat agree that they have the information they need to safely operate and maintain their system (84 per cent) and to get the most value out of their system (82 per cent). This is notable considering that 25 per cent of respondents do not know or do not consider that they have smart inverters installed (see section 2.2.1). This could reflect that respondents' knowledge of the optimal energy practices required to best use the solar system has come from sources of information other than their smart inverter. Further, respondents may not be able to quantitatively measure their use, for example, through a smart inverter monitoring system, as only 42 per cent of respondents have monitoring systems installed.

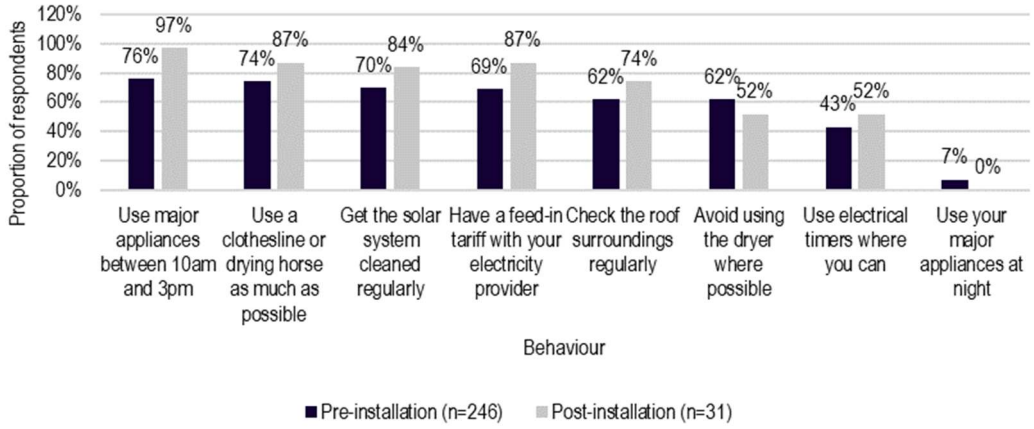
Figure 2.7 Respondents' changes in energy behaviour 1-year post-installation



Source: ACIL Allen analysis of Department data from the 1-year post-installation survey, 2022.

This understanding of energy saving practices has improved across most questions from the pre-installation to post-installation survey (see Figure 2.8). In particular, the proportion of respondents aware of the need to use major appliances between 10 am and 3 pm increased from 76 to 97 per cent, and the proportion aware of air drying their clothes instead of using a dryer increased from 74 to 87 per cent. Respondents of the post-installation survey were also more aware of the necessary actions to take in terms of maintenance.

Figure 2.8 Pre-installation and post-installation survey respondents' knowledge of energy practices



Source: Internal Departmental analysis, 2020.

Participant behaviour changes

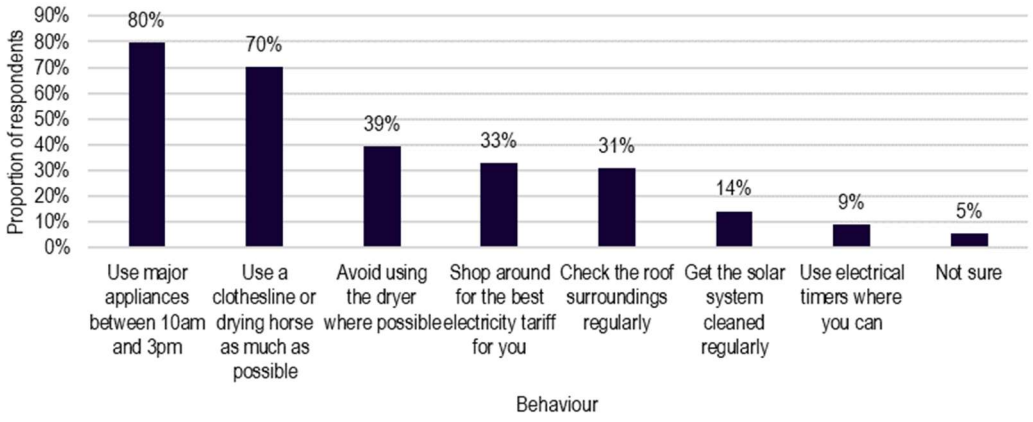
During consultations, participants identified that they have changed the way they use energy, seeking to use electrical appliances more during the day (e.g., washing machines, dishwashers). Participants reported that these changes were common sense and that they did not find it difficult to adjust their behaviour. Some participants had installed solar systems on previous homes and understood how the solar systems generated energy and how they should modify their behaviour to get the most out of their system. Some were also using their solar energy to support better lifestyle choices, using more energy on heating and cooling to improve comfort.

Participants also changed their behaviours to varying degrees, with some using less energy, others unchanged and some using more energy than before installation. This is reflected in the survey results.

The 1-year post-installation survey shows that most participants have made positive changes to their behaviour following installation of their solar system in terms of use of their major appliances between 10 am – 3 pm (80 per cent) and using a clothesline or drying horse as much as possible (70 per cent). This could reflect participants' understanding of how to maximise the benefits of their solar systems.

A smaller proportion of respondents are avoiding using their dryer where possible (39 per cent), cleaning their system regularly (14 per cent) (noting that regular cleaning may not be needed within the timeframe the survey was conducted), checking the roof surroundings (39 per cent) and shopping for the best electricity tariff (33 per cent). This suggests there is more benefit that respondents could be generating from their solar systems. These findings also indicate that there were limitations to the survey design, as using a clothesline or drying horse as much as possible and avoiding using their dryer where possible are similar statements, yet generate large differences in respondents' behaviours (70 and 39 per cent, respectively). Further, contextual factors (such as rainy or bushfire weather conditions) may affect the extent to which respondents consider it 'possible' to use clotheslines or avoid using the dryer.

Figure 2.9 1-year post-installation survey respondents changes in energy behaviour



Source: ACIL Allen analysis of Department data from the 1-year post-installation survey, 2022.

The impact of the COVID-19 pandemic

The COVID-19 pandemic had a large impact on the use of energy. Energy consumption fell across Australia by two per cent in the second quarter of 2020 relative to the previous year, with residential consumption increasing significantly and business consumption decreasing.[28]

The 1-year post-installation survey data shows that 72 per cent of respondents spent more time at home as a result of the COVID-19 pandemic, yet only 34 per cent of survey respondents self-reported that they were using more energy, with just 25 per cent using their heating and/or cooling appliances more. This may reflect the mild summers and winters during 2020-21, given the prevailing La Niña weather pattern. Further, 42 per cent of respondents had tried to save money generally during the COVID-19 pandemic, with 48 per cent unchanged.

This data suggests that, although the COVID-19 pandemic has influenced where people are spending their time, the pandemic did not have an impact on the energy or appliances used by half of the respondents.

Key Finding 6 Knowledge and behaviour changes

Most respondents consider they have the information they need to safely operate, maintain and get the most value out of their system. This has improved over time.

Participants have largely changed the way they use their energy (to effect savings), i.e. more commonly using energy during the day, or using less energy than before installation.

Some were also using their solar energy to support better lifestyle choices, using more energy to improve thermal comfort.

The COVID-19 pandemic has led most participants to spend more time at home. Yet only some are using more energy or heating/cooling appliances (potentially due to mild weather conditions).

Source: ACIL Allen

[28] Australian Competition and Consumer Commission (2020). *Electricity prices fall and COVID spikes residential demand*. Accessed 5 May 2022: https://www.accc.gov.au/media-release/electricity-prices-fall-and-covid-spikes-residential-demand.

2.3 Changes to participants' household living conditions

E.1. To what extent has the trial improved household living conditions through non-energy benefits including, for example, reduced financial stress or improved thermal comfort?

Participants have experienced a range of changes to their household living conditions. These relate primarily to reduced financial stress and increased thermal comfort.

The target audience for the SLIH Trial commonly underuse electricity (because they cannot afford to use as much as they would like). The Australia Institute's 2018 report on electricity use in low income households[29] shows that the majority of households in the lowest household income bracket[30] have below average electricity consumption. This is often due to the cost of electricity, and the need to balance limited resources on electricity and other household expenses, such as food. This can have a significant negative impact on wellbeing, causing stress and anxiety around energy use and bill payment.[31] This can have longer term impacts on reducing health outcomes, leading to increased health costs to households and the public healthcare system. One industry stakeholder considered that there is an opportunity for the SLIH Trial to include a focus on health and wellbeing of participants.

The positive impact of the SLIH Trial on wellbeing has been evident in the consultations and survey data. For example, one participant consulted for this evaluation has a chronic health condition that is impacted by temperature. Since installation of the solar system, they have been able to use reverse cycle air-conditioning more frequently, which has made it more comfortable for them to be in their living room (addressing a pattern of underusage of energy prior to installation). Another participant only used heating in 'extreme conditions', but following installation felt they were able to use heating when needed to improve their comfort, potentially leading to improved health and other positive impacts.

Some participants reported during consultation that receiving lower energy bills had reduced the stress and anxiety they experience over the cost of energy. Other participants were simply satisfied with the savings they were making on their energy bills.

The 1-year post-installation survey data supports the information from the consultation and shows that 68 per cent of respondents were less stressed about paying electricity bills after installation. During consultation, two of the five participants mentioned not being stressed about their electricity bills either before or after installation. Interestingly, the survey shows that five per cent of respondents were more stressed. Participants identified that they were more stressed for a range of reasons, including increased energy bills, perceived poorer financial outcomes relative to the LIHR, disappointment with minimal savings achieved among a small proportion of participants (a total of 20 respondents, or 48 per cent of those experiencing negative impacts following installation), or increased uncertainty due to their new reliance on the sun to reduce their costs and uncertainty around reduced feed-in tariffs.

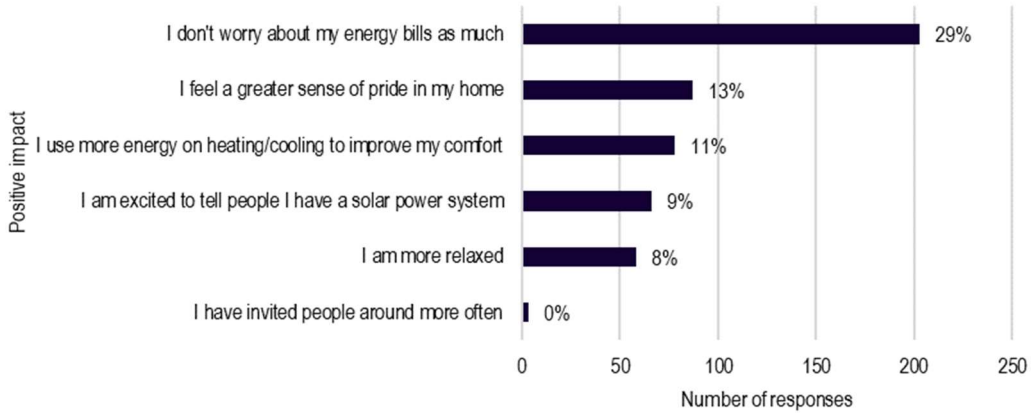
When asked about the positive impacts they had experienced as a result of the new solar power system (see Figure 2.10), respondents commonly mentioned not worrying about their energy bills as much (29 per cent), feeling a greater sense of pride in their home and using more heating and cooling to improve their comfort.

[29] Saddler, H. (2018). *How low income households use electricity*. Canberra: The Australia Institute.

[30] Quartile or quintile, i.e., 75 to 80 per cent of incomes. The data available for analysis varies by jurisdiction across Australia.

[31] Australian Council of Social Services, the Brotherhood of Saint Laurence & The Climate Institute (2017). *Empowering disadvantaged households to access affordable, clean energy*.

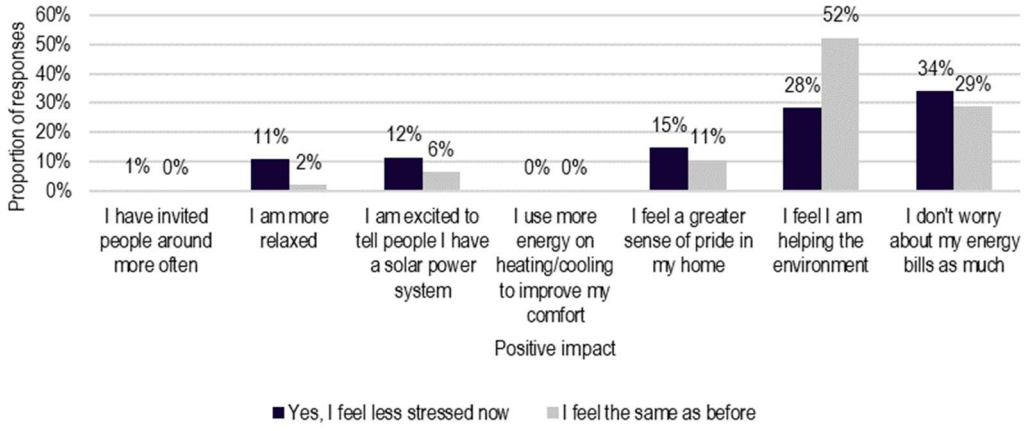
Figure 2.10 Positive impact on respondents' lives as a result of the new solar power system



Source: ACIL Allen analysis of Department data from the 1-year post-installation survey, 2022.

When participants are grouped into those that were and were not experiencing more bill stress prior to installation (see Figure 2.11), those that were experiencing more bill stress prior to installation were more likely to identify that the installation led them to worry less about their energy bills (34 per cent) and feel more relaxed (11 per cent). Participants that had not experienced differences in bill stress since installation more commonly identify that they feel they are helping the environment (52 per cent).

Figure 2.11 Positive impact on respondents' lives as a result of the new solar power system by bill stress



Note: Yes, I feel less stressed now: n=512 responses, I feel the same as before: n=94 responses.
Source: ACIL Allen analysis of Department data from the 1-year post-installation survey, 2022.

Key Finding 7 Changes to participants' household living conditions

The Trial resulted in significant changes to household living conditions, delivering reduced financial stress and worry about paying their energy bills, a sense of pride in their home, and use of heating and cooling to improve thermal comfort.

Source: ACIL Allen

3 Energy, bills and emissions

This chapter addresses the extent to which the SLIH Trial has achieved energy, bill and emissions savings.

3.1 Impact of the program on renewable energy generation

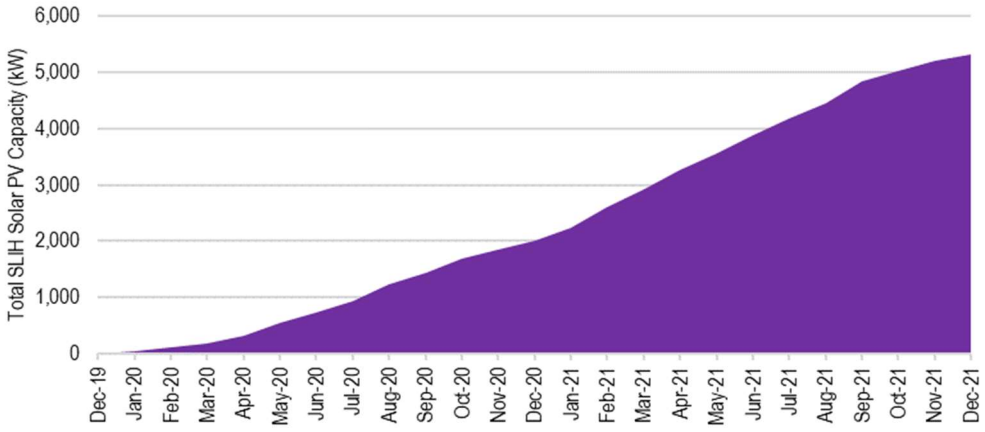
B. To what extent has the program increased renewable energy generation?

Before examining the impact of the SLIH Trial on energy, bill and emissions savings, this section looks at the overall impact of the program on renewable energy generation.

One of the objectives of the SLIH Trial was to increase the generation of distributed renewable energy across NSW. Figure 3.1 shows the cumulative solar PV capacity installed as part of the SLIH Trial from December 2019 until the end of December 2021. The chart shows that there has been a steady increase in the capacity installed over this time, leading to a total of over 5,300 kW of installed solar PV capacity.

The SLIH Trial has generated a total of 7.3 MWh of renewable energy.

Figure 3.1 Cumulative installed rooftop solar PV capacity between December 2019 and December 2021 as part of the SLIH Trial (kW)



Source: Department SLIH Trial Program Data as at 31/12/2021

As the SLIH Trial is targeted at low-income households, 59 per cent of participants identified the high up-front purchase costs as a barrier to installing solar systems (see section 2.1.3). As such, the majority of survey respondents (62 per cent) were very or somewhat unlikely to have installed the solar system without the SLIH Trial. The SLIH Trial removed this barrier (as well as other barriers) for many of the 1-year post installation survey respondents. A total of 31 per cent consider that they would have installed without the program (noting that there is no guarantee of this

occurring). These participants more commonly upsized their systems (85 per cent upsized compared with 63 per cent among those unlikely to install without the program) and likely had more financial resources available to install without the program. The SLIH Trial probably brought forward the timing of their installation and potentially enabled them to install larger systems. As such, these participants may still have contributed more to NSW's increased renewable energy capacity than would have occurred without the SLIH Trial.

These results suggest that the SLIH Trial has increased renewable generation in NSW more so than would have occurred without the SLIH Trial, by providing people with the opportunity to install a solar system where they would not otherwise have been able to.

Interestingly, the survey also showed that 31 per cent of respondents would have installed a solar system without the SLIH Trial. It is unclear if these respondents opted for an upsized solar system with the SLIH Trial, or if the SLIH Trial with its approved installers provide the impetus to proceed with installation (which otherwise may have stalled). Regardless of the circumstances, participation in the SLIH Trial resulted in an immediate increase in renewable generation.

Accordingly, there is a group of participants that were less constrained with regard to installing a solar system, but who benefited from the support (financial and otherwise) provided by the SLIH Trial. This may create an unnecessary burden for Government in terms of funding these additional installations, noting that as the participants are still required to forgo the LIHR, they do not add a substantial financial burden (it is unclear whether these participants received the LIHR prior to initially applying for the SLIH Trial).

Key Finding 8 Impact of the program on renewable energy generation

The SLIH Trial increased the renewable energy capacity in NSW by over 5,300 kW.

Survey data suggests that a majority of SLIH Trial participants would not have installed their solar system without the SLIH Trial.

Source: ACIL Allen

3.2 Impact of the program on energy benefits, GHG and electricity bill savings

A. To what extent are electricity bill savings achieved by participating households? Which participants benefit the most and how can savings be optimised in future programs?

This section discusses the impact of the SLIH Trial on energy benefits, avoided GHG emissions (carbon dioxide equivalents (CO_2-e)) and electricity bill savings. When discussing the savings achieved by participants, it is important to note that these savings will be heavily impacted by the personal circumstances of each participant, such as electricity usage, knowledge and understanding of the solar system (see section 2.2.2), as well as locational differences, as detailed below.

The SLIH Trial ran in a select number of postcodes. The Central Coast and Sydney South are largely metropolitan areas, whereas the rest of the regions – the North Coast, South Coast and Illawarra-Shoalhaven – are regional areas.

The regions have different distribution network service providers. The Central Coast and Sydney South are located largely in the Ausgrid network. The North Coast and South Coast are part of the Essential Energy network. Illawarra-Shoalhaven is part of the Endeavour Energy network. Some of these distribution networks experience more network congestion than others, hence export limits in the various networks differ.

In addition, participants are contracted to different energy retailers and therefore receive different feed-in tariffs for their solar exports.

In this chapter we present our assessment of AEMO's energy benefits, bill and emission savings based on a sample of 98 participants (see section 1.3.3). The sample includes participants of all five regions and all three distribution network service providers (the exact nature of the participants is not known as individual household details are not accessible, given privacy considerations).

3.2.1 Impact of the SLIH Trial on energy imported from the grid

Table 3.1 shows the annual average energy benefits, and the minimum and maximum energy benefits, that have been calculated using AEMO's sample. For the purposes of this section, the 'energy benefits' are defined as a reduction in energy that is imported from the grid.

On average, sampled participants have reduced the energy that is imported from the grid by almost 4,900 kWh between 1 March 2021 and 28 February 2022. The annual energy benefits range between a minimum of -2,343 kWh (that is, an increase in energy imported from the grid) and a maximum of 12,556 kWh. Assuming the sample is representative for the 12-month period analysed for all participants in the SLIH Trial, the total energy benefits of the SLIH Trial were 5,930 MWh per annum.

For context, the average household electricity consumption per annum ranges between 5,000-7,200 kWh.[32]

The increases in energy imported from the grid in AEMO's sample can be caused by several underlying issues. Firstly, the increase in energy imported from the grid could indicate that a household has used most of its electricity outside of daylight hours, potentially using more energy relative to pre-installation. For example, the largest case of an increase in energy use was caused by the house not being occupied for a number of months during the pre-installation period.

This increase in energy imported from the grid could be a positive impact of the program (i.e., if participants underused electricity prior to installation) or a negative impact (i.e., if participants are using energy inefficiently - see section 2.3). Possible underuse of electricity by low income households was mentioned by several stakeholders as a reason why the installation of a solar system does not always translate into bill savings. That is the potential for savings from solar induces them to use more energy to improve their quality of life (see section 2.3).

Secondly, an increase in energy imported from the grid could also suggest that some participants may have a poor understanding of how to best use their solar system to generate the most benefit (as discussed in section 2.2).

Finally, an increase in energy imported from the grid could be a result of lower than expected or no output from the solar system. In March 2022 the Department analysed a sample of participants to investigate the impact of performance issues with solar systems in the SLIH Trial. This identified that, of the 86 solar systems in the sample, a total of 29 solar systems had experienced reduced metered export. This had a range of causes, namely system failure, export limits, delayed system activation or export curtailment. Section 4.2.1 discusses these issues in more depth. While this analysis focused on the reduction in metered export, a system failure would also affect grid demand by the households. This in turn would result in an increase in energy use from the grid.

[32] Frontier Economics (2020). *Residential energy consumption benchmarks. Final report for the Australian Energy Regulator*. Australia: Frontier Economics.

Table 3.1 Statistical summary of energy benefits in kWh

Statistical measures	Energy benefits (kWh)
Annual average energy benefits	4,897
Minimum annual energy benefits	-2,343
Maximum annual energy benefits	12,556
Standard deviation	2,439

Note: sample size = 98. Sample taken between 1 March 2021 and 28 February 2022.
Source: AEMO

Section 2.1.4 showed that a large number of SLIH Trial participants upsized their solar systems from the NSW Government's free 3 kW solar system to larger capacity models (mostly between 6 and 7 kW). Table 3.2 shows the difference in energy benefits between systems that are smaller and larger than 3.5 kW. The analysis shows that solar systems larger than 3.5 kW generate almost twice as much energy benefits as solar systems smaller than 3.5 kW (7,000 and 3,800 kWh, respectively).

Table 3.2 Annual energy benefits (kWh) by solar system size

Solar system size	Annual energy benefits of solar systems (kWh)
Less than 3.5 kW	3,794
Greater than 3.5 kW	6,974

Note: sample size = 98. Sample taken between 1 March 2021 and 28 February 2022.
Source: AEMO

Key Finding 9 Impact of the SLIH Trial on energy benefits

Most participants in the SLIH Trial saved energy, particularly those with an upsized solar system (i.e., those larger than 3.5 kW had almost twice as much energy benefits).

A small number of participants imported more energy from the grid, potentially from increased energy use, due to system faults or use at night.

Source: ACIL Allen

3.2.2 Impact of the SLIH Trial on GHG emissions

C. To what extent has the program reduced GHG emissions?

One of the SLIH Trial objectives is to reduce GHG emissions. AEMO used the same sample of 98 participants to analyse the impact of installations on GHG emission savings. Table 3.3 provides a summary of GHG emissions savings. The average annual savings across all sampled participants was 3,137 kg CO_2-e. Assuming the sample is representative of all participants in the SLIH Trial and for the 12-month period analysed, the total GHG emissions avoided by SLIH Trial participants were 3,799 tonnes per annum. In comparison, the average household generates more than 18 tonnes of GHG per year (ranging from 3-30 tonnes depending on location and lifestyle).[33] As such, the SLIH Trial has had a small impact on the total GHG savings in NSW.

However, as for the energy savings (see section 3.2.1), some households increased their GHG emissions, with a maximum annual increase (minimum annual savings) of -1,675 kg CO_2-e. The maximum annual savings were 8,038 kg CO_2-e across all systems.

[33] Australian Greenhouse Calculator (n.d.). Op. cit.

Increases in GHG emissions is likely to occur as a result of overnight use of power when the generation of electricity is mostly coal-based. The causes of increased use of overnight power are discussed in section 3.2.1. This is only the case for 5 of the 64 participants.

As discussed for energy savings in section 3.2.21, the average annual GHG emissions savings for a system greater than 3.5 kW were almost twice the amount of savings achieved amongst participants with a solar system less than 3.5 kW. As indicated in Figure 2.5, half of the installations have a capacity of less than or equal to 3.5 kW, while 30 per cent of installations are approximately twice the size. The size differential and the capacity to displace a larger proportion of grid-generated electricity most likely explains the difference in GHG emissions savings. However, it could also arise if participants with different sized solar systems have a different range of energy use behaviours before and after installation of their solar system, leading to contrasting GHG emission savings.

Table 3.3 Statistical summary of GHG emissions savings (kg CO_2-e) by solar system size

Statistical measures	All solar systems	Solar systems less than 3.5 kW	Solar systems greater than 3.5 kW
Average annual savings	3,137	2,421	4,485
Minimum annual savings	-1,675	-1,675	229
Maximum annual savings	8,038	4,778	8,038
Standard deviation	1,631	1,070	1,663
Sample size	98	64	34

Note: Sample taken between 1 March 2021 and 28 February 2022.
Source: AEMO

Key Finding 10 Impact of the SLIH Trial on GHG emissions

The SLIH Trial generated 3,799 tonnes of annual GHG emissions savings. These were higher for sampled participants that had upsized their solar systems to solar systems larger than 3.5 kW.

A small number of participants increased GHG emissions due to an increase in the amount of energy imported from the grid.

Source: ACIL Allen

3.2.3 Impact of the SLIH Trial on electricity bill savings

When low-income households receive the LIHR, their electricity bill is reduced by $285 per year (excluding GST). The SLIH Trial therefore aims to reduce participating households' electricity bills by more than the annual LIHR amount (i.e., by more than $285 per year, excluding GST). The Department's target for participants' bill savings is up to $600 per annum (excluding GST), or twice the value of the LIHR (see section 1.2).

AEMO analysis presented in Table 3.4 shows that participants achieved average annual bill savings of $799 (including GST) with a flat tariff and $804 (including GST) with a time of use (TOU) tariff. Most bill savings were above the up to $600 (excluding GST) per year target set by the Department.[34] AEMO data confirmed that most of the participants had bill savings greater than $600, since the median of bill savings in AEMO's sample was $751 (including GST) under a TOU tariff.

[34]Department of Planning, Industry and Environment (2020). *SLIH Evaluation Plan*. Sydney: NSW Government.

Some participants had an increase in their electricity bill. The causes of electricity bill increases are consistent with increases in energy imported from the grid, discussed in section 3.2.1.

Table 3.4 Statistical summary of electricity bill savings (including GST) resulting from SLIH Trial

Statistical measures	Flat tariff	TOU tariff
Average annual savings (2021)	$799	$804
Minimum annual savings (2021)	-$649	-$581
Maximum annual savings (2021)	$1,914	$1,864
Standard deviation	$468	$450
Sample size	98	98

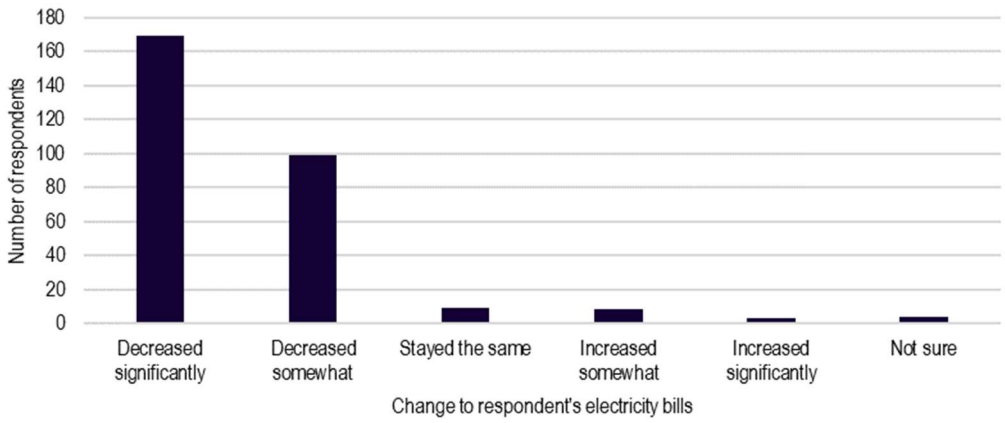
Note: sample size = 98. Sample taken between 1 March 2021 and 28 February 2022.
AEMO analysis is performed for residents on flat tariffs and time of use tariffs.
Source: AEMO

Stakeholders, including participants, agreed during consultations that the SLIH Trial had resulted in electricity bill savings for participants. Participants discussed their energy bill savings, with one commenting that their yearly electricity bill had reduced from $1,800 to $500-$600 on an annual basis (saving $1,200-$1,300), and another from $1,000 to $600 per year (saving $400). Another participant mentioned their bill savings were higher than the rebate.

Participants voiced concerns that the reduced feed-in tariff has reduced the benefit they receive from exporting energy to the grid. This reduces their ability to save on their electricity bills. It also means that some participants who had installed solar systems on previous homes, could no longer afford to do so without the SLIH Trial as it was no longer economically viable as a standalone initiative without some form of assistance (see section 2.1.3). The increasingly lower feed-in tariffs will result in a higher pay-back time for participants who opted to upsize their system.

Bill savings from the 1-year post installation survey align with the consultation findings. Respondents were asked about the changes in their electricity bills since the installation. Figure 3.2 shows that 92 per cent of respondents considered their electricity bills had decreased since installation. A small number of respondents indicated their electricity bills stayed the same (9 respondents) or increased (11 respondents). Further, 85 per cent of respondents said their expectations had been met in terms of bill reductions.

Figure 3.2 Responses to the survey question on the differences to electricity bills since installing solar power system



Source: 1-year post installation survey

Key Finding 11 Impact of the SLIH Trial on electricity bill savings

A majority of SLIH Trial participants had bill savings higher than the LIHR and the target set by the Department ($600 per year).

Falling feed-in tariffs reduce the perceived and actual benefits participants receive (they no longer generate the same income from exporting the same amount of electricity). The program (and any extension) needs to focus on the benefits participants can derive from using the energy their systems produce (rather than relying on variable feed-in tariffs for revenue generation).

A small number of participants received increased electricity bills, potentially from increased energy use.

Source: ACIL Allen

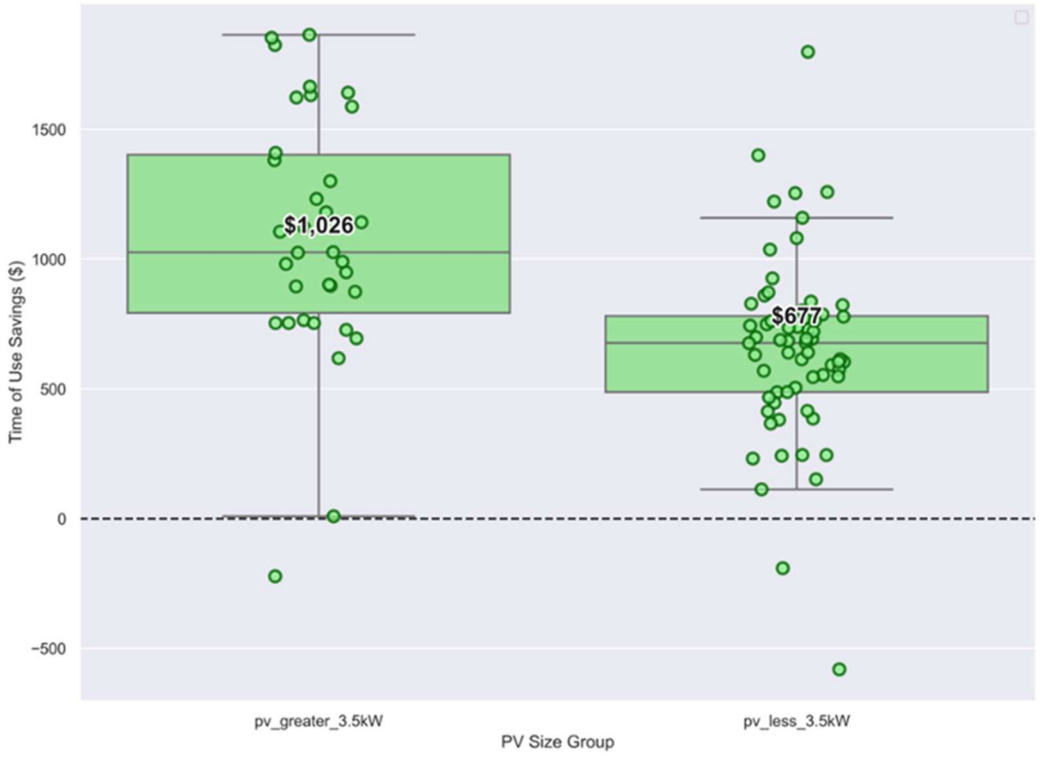
3.2.4 Factors influencing which participants benefit the most

AEMO analysed the impact of household size, region and distribution network on electricity bill savings to identify factors that are influencing which participants benefit the most.

Influence of solar system size on electricity bill savings

Figure 3.3 shows the distribution of bill savings by solar system size. There is a distinct difference in electricity bill savings between participants with solar systems smaller than 3.5 kW and those with larger systems. A majority of households with solar systems greater than 3.5 kW achieved bill savings greater than $600 (excluding GST), since the median bill savings based on a TOU tariff for participants with solar systems greater than 3.5kW was $1,026 (including GST).

Figure 3.3 Boxplots with bill savings based on a TOU tariff by PV system size



Source: AEMO

Of the households with solar systems greater than 3.5 kW, one household had an increase in their electricity bill, while among households with solar systems smaller than 3.5 kW, two households had electricity bill increases. As discussed in section 3.2.1, these bill increases are likely either due

to technical issues, curtailment or prior underuse of electricity. The average bill savings for participants were (including GST):

— solar system greater than 3.5 kW: $1,087 based on a TOU tariff and $1,095 on a flat tariff

— solar system smaller than 3.5 kW was $653 based on a TOU tariff and $642 on a flat tariff.

Households with a larger solar system generated higher bill savings regardless of the feed-in tariff benefits being less financially valuable than the self-consumption benefits.

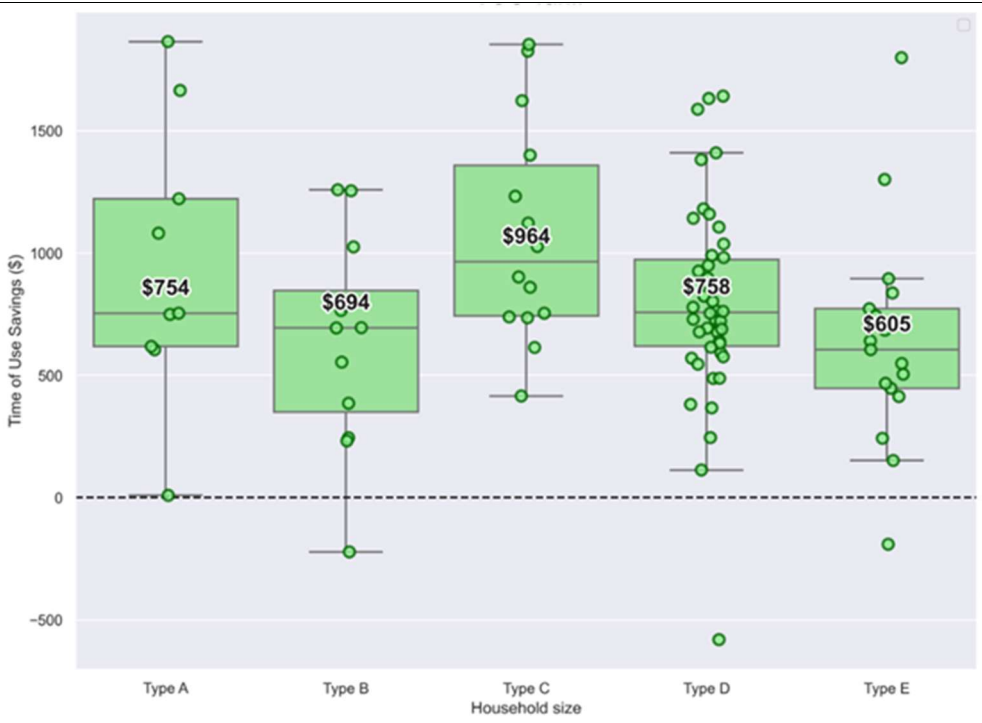
This aligns with stakeholder's perceptions of the SLIH Trial, with all stakeholders agreeing that if participants could afford to pay to upsize their solar system, they would be able to make more bill savings. However, while the majority of participants upsized their system, not all were aware of the option to do so, and some missed out on this opportunity (see section 2.1.4).

Though the outcomes of AEMO's data analysis and the 1-year post installation survey results suggest that upsized solar systems result in higher energy and bill savings for participants, this requires participants to take on extra costs to upsize their solar system. With falling feed-in tariffs, the payback time might increase in the longer-term. Added to that, upgrading solar systems will also increase the total amount of solar PV capacity installed under the SLIH Trial. This will put more pressure on the network, particularly in weaker areas of the grid. In areas that are already experiencing minimum demand, the additional solar export coming from an upsized solar system may lead to curtailment. This in turn could lower the long-term energy and bill savings. These issues need to be considered as the SLIH program scales.

Influence of household size on electricity bill savings

Figure 3.4 provides an overview of the difference in bill savings among different household sizes. The sample data shows no significant difference in bill savings between different household sizes. The calculated annual average bill savings (using a TOU tariff) of a household with four persons (Type B) is equal to the average annual bill savings of a single person household (Type E).

Figure 3.4 Boxplots with bill savings based on a TOU tariff by household size



Note: Type A: 5 or more people in the house, Type B: 4 persons, Type C: 3 persons, Type D: 2 persons, Type E: 1 person.
Source: AEMO

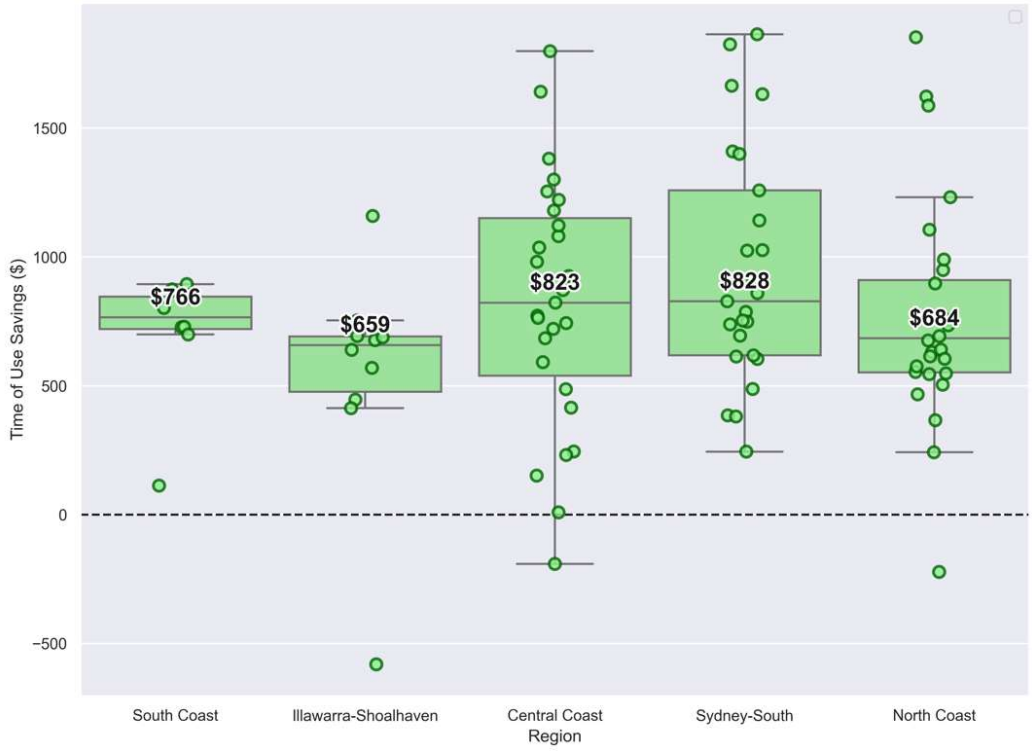
Household Type D, which represents a household of two persons, has the largest number of solar systems installed. This is not surprising given that one of the eligibility criteria for the program is holding a PCC or DVA card. The sample is therefore skewed towards type D households, which also makes it challenging to compare bill savings between household types. From the data available across the remaining household types, it appears that household Type C, those with three persons, had the highest bill savings and household Types B and E, those with four and one person, respectively, had the lowest savings.

Consultations with stakeholders revealed that an assessment of a participant's household size is not part of the application assessment phase. Several stakeholders considered that this was an important factor that influenced a household's energy usage and should be part of the assessment.

Influence of region on electricity bill savings

AEMO's analysis of electricity bill savings based on region is presented in Figure 3.5. This shows that participants in Sydney South have the highest bill savings with an average annual bill saving of $956 (including GST) based on a TOU tariff. This is followed by participants in the Central Coast region with an average bill saving of $824. Participants in the Illawarra-Shoalhaven region had the lowest average bill savings ($546 (including GST)). The difference in bill savings between regions is influenced by the distribution of participants, as well as the presence of outliers. A participant in the Illawarra-Shoalhaven region has the largest negative outlier of -$581 (including GST).

Figure 3.5 Boxplots with bill savings based on a TOU tariff by region



Source: AEMO

When examining the distribution of participants across the regions, we find that the North Coast has the most participants (28), followed by Central Coast (27) and Sydney South (25). Illawarra-Shoalhaven has only 10 participants and the South Coast just 8 participants.

Participants in the Sydney South and Central Coast regions seem to have benefited more from the SLIH Trial than participants in the other regions. The Sydney South and Central Coast regions had a higher proportion of systems larger than 3.5 kW installed. This has likely contributed to their

improved savings relative to other regions (see Table 3.5). Further, as noted in section 3.2, both the Sydney South and Central Coast regions are located largely in the Ausgrid network. During consultations, two installers mentioned that network issues occur more often in regional areas. This was confirmed by a difference in export limits mentioned in consultations with Ausgrid (10 kW) and Essential Energy (3 kW in regional and 5 kW in non-regional areas). This could be one of the reasons why the SLIH Trial installations in these regions are benefitting more from the SLIH Trial.

Another possible reason for the higher bill savings for participants in the Sydney South and the Central Coast regions could be the proportion of installed upsized systems in these areas. As shown in Figure 3.3, participants with solar systems greater than 3.5 kW had higher bill savings.

While AEMO analysis of bill savings was not available by region and by solar system size, Table 3.5 provides an overview of the number of installations up to 3.5 kW and the number of installations above 3.5 kW by region. This shows that most of the installations occur on the North Coast and 41 per cent of these are upsized systems. The proportion of upsizes ranges between 41 per cent for participants in the Illawarra-Shoalhaven region and 45 per cent for participants in the Central Coast region.

The proportion of installed upsized systems is therefore relatively equal among all regions and does not seem to have a great influence on the difference in bill savings between the regions. It is unknown whether the AEMO sample reflects this same distribution.

Table 3.5 Number of installations by system size and region

Solar system size	South Coast	Illawarra Shoalhaven	Central Coast	Sydney South	North Coast
Smaller than 3.5 kW	108	150	71	39	331
Larger than 3.5 kW	74	113	59	36	230
% larger than 3.5 kW	41%	43%	45%	48%	41%

Source: NSW Government tracking list of SLIH Trial installations

Interestingly, both the Sydney South and Central Coast regions are located largely in the Ausgrid network. The impact of the distribution networks on bill savings is discussed further below.

Influence of distribution network on electricity bill savings

Solar systems installed as part of the SLIH Trial are part of three different distribution networks. Figure 3.6 shows the geographical location of the networks. The Ausgrid network covers large parts of metropolitan Sydney. Essential Energy covers most of regional NSW and Endeavour Energy covers regional areas as well as suburban areas. The location of these distribution networks are important.

Figure 3.6 Electricity distribution network service providers in New South Wales

Source: Ausgrid (July 2020), Ausgrid Debt Investor Presentation, https://links.sgx.com/FileOpen/Ausgrid%20Debt%20Investor%20Presentation%2020200727.ashx?App=Announcement&FileID=625039

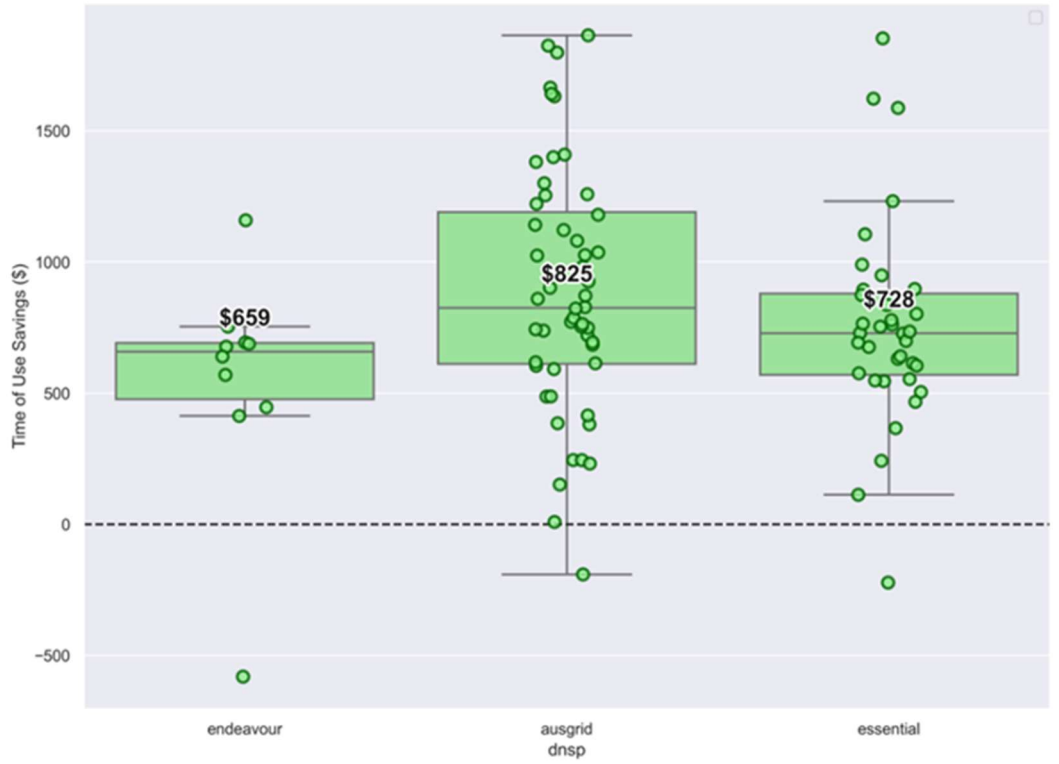
Figure 3.7 shows the average electricity bill savings by distribution network. Bill savings are the highest for participants in the Ausgrid network, with average annual bill savings of $887 (including GST) based on a TOU tariff.

Participants in the Endeavour Energy network had the lowest annual average bill savings at $546 (including GST) based on a TOU tariff. Participants in the Endeavour Energy network seem to have benefitted less from the SLIH Trial than participants in the other two distribution networks. This may be due to a combination of factors, including Endeavour Energy's lower network costs (so there is less money to be saved) and the fact that it covers more densely populated areas than the Essential Energy network. The Endeavour Energy network also includes the largest negative outlier of the sample, at -$581 (including GST). This may impact the sample and skew the benefit achieved by SLIH Trial participants in the Endeavour Energy network.

Additionally, the Endeavour Energy network had a smaller number of systems (ten), compared to Essential Energy (36) and Ausgrid (52) as part of the sample size.

The bill savings by network service provider in this sample may have been impacted by the negative outliers, and differences in the number of solar systems and participants' knowledge and behaviours.

Figure 3.7 Boxplots with bill savings based on a TOU tariff by distribution network



Source: AEMO

There are two network issues that may impact the electricity bill savings by network service provider – one relates to export limits and the other relates to solar systems tripping due to voltage issues.

During consultations stakeholders mentioned that export curtailment occurs more in regional areas than in metropolitan areas. It is therefore no surprise that the export limit in the Ausgrid area is higher (10 kW), than the export limit in the Essential Energy areas (3 kW in regional and 5 kW in non-regional areas). Additionally, voltage issues are more likely to occur in regional areas than urban areas.

The differences between the network distribution providers are discussed in more detail in section 4.2.1.

Other factors influencing electricity bill savings

Stakeholders identified other factors that influence electricity bill savings.

Participants who can afford additional investments in technologies were benefitting more. For example, as discussed in section 2.2.1, smart meters inform participants about their energy generation and usage. This provides them with the opportunity to change their behaviour to get the most out of their system. Those that cannot or do not monitor their energy usage using a smart meter or other application do not have this same opportunity. The SLIH Trial also provides participants with the opportunity to benefit from other technological investments in the future, for example, installing a battery.

Participants who can afford to maintain and repair their solar systems are more likely to have optimally functioning systems, and get the most out of their system. A key risk of the SLIH Trial is that the effectiveness of the solar system could reduce or the solar system could break down before the end of the 10-year life span of the program. If this occurs, participants could encounter

higher electricity bills, yet would have the right to re-apply for the LIHR due to extenuating circumstances. The 10-year whole of system warranty for the solar systems should provide coverage for these participants, however, participants could miss out on benefits during the claim and repair period.

Key Finding 12 Factors influencing which participants benefit the most

Electricity bill savings are higher among participants with solar systems greater than 3.5 kW and those located in the Sydney South and Central-Coast regions, both part of the Ausgrid network.

There is no significant difference in electricity bill savings between different household sizes.

Savings are also impacted by the ability to monitor usage and the extent to which the systems are maintained and repaired over time.

Source: ACIL Allen

3.2.5 Optimising savings in future programs

Stakeholders identified a number of ways in which savings could be optimised in future programs, including:

- making applicants aware that they have an option to upsize the system
- calculating the possible benefits during the application stage to allow for better informed decision making by participants
- educating participants on housing efficiency (e.g., window and door seals, insulation, and using electricity rather than gas appliances) so that they can pre-heat their homes during daylight hours and reduce the use of grid-sourced electricity
- provide a minimum guaranteed financial benefit to participants to remove the risk that a participant's savings are lower than the LIHR.

While most of these are sound suggestions that could be explored, we would caution against providing a minimum guaranteed financial benefit to participants. There is a significant moral hazard associated with this approach – it provides an incentive for participants to not change their behaviour to maximise benefits from their solar system or to maintain and repair their solar system over time.

Key Finding 13 Optimised savings in future programs

Savings could be optimised in future programs through a range of approaches (i.e., upsizing, better information on benefits and maximising these).

Source: ACIL Allen

3.3 Financial impact of the program on participants

A.4. What is the net financial impact of the program on participants?

As outlined in section 1.2, SLIH Trial participants are offered a solar system with a capacity of 3 kW or less, fully installed at no cost. This does not include the cost of a smart meter if required (which is paid for by the retailer, and recovered from customers, e.g., as a lump sum on their electricity bill, a monthly fee or as part of electricity usage charges). A subsidy of up to $1,200 was made available for a replacement meter board. The cost of any associated electrical upgrades is not covered, and could be a barrier to uptake (see section 2.1.3).

In return, participants are required to forgo 10 years of the LIHR, valued at $2,850 ($285 per annum excluding GST). This aligns with one of the SLIH Trial objectives to reduce the NSW Government's energy rebate liability. In return, participants are expected to generate a minimum of

$2,850 (excluding GST) in electricity bill savings. This is the participants' break-even point[35] from installing the solar system. Any value generated above this is the net benefit.

Participants with solar systems greater than 3 kW have paid an additional cost to upsize their system – this additional cost is factored into the calculation of payback periods. The payback period represents the number of years it takes participants to recuperate the cost of their solar system upsize through electricity bill savings. Included in the payback period calculation is the loss of the yearly LIHR ($285 excluding GST). The net benefit for households that opted for an upsized system is based on the total rebate cost of $2,850 (excluding GST) plus the additional cost to upsize.

Table 3.6 provides the average electricity bill savings generated by participants for different ranges of solar system sizes. The sample did not have enough data to calculate the net benefit of solar systems greater than 7 kW. The calculation of the payback period only includes savings above $285 (excluding GST, or $313.50 including GST) of LIHR, since participants lose the LIHR by participating in the SLIH Trial.

Table 3.6 Net benefit and payback period of SLIH Trial solar systems, by solar system size

System size (kW)	Number of solar systems	Average bill savings ($ inc. GST)	Net Benefit (%)	Payback period (years)
All	74	$860	22%	-
Less than or equal to 3.5	33	$619	22%	-
Greater than 3.5 - 5	9	$828	22%	2.07
Greater than 5 - 6	8	$906	19%	3.12
Greater than 6 - 7	24	$1,190	25%	2.53

Note: Only includes sample data with sufficient information for this calculation. Payback period for upsized systems is calculated by dividing the cost of the upsize by total yearly savings. The total yearly savings has been reduced by $285 (excluding GST), which is the value of the yearly LIHR. The sample size for systems between 5-6 kW is small - this may impact results (and account for drop in benefit compared to systems greater than 6 kW).

Source: OECC analysis

The OECC's analysis shows that the net benefit is positive for all solar system sizes. Solar systems greater than 6 kW have the greatest net benefit of 25 per cent and the highest bill savings, $1,190 (including GST). The payback period for solar systems greater than 6 kW is also slightly shorter than for solar systems between 5-6 kW.

Solar systems between 5 to 6 kW have the lowest net benefit of 19 per cent. This size results in higher bill savings than the base solar systems. However, for this solar system size the increase in bill savings is proportionally not as large as the increase in the cost of the upsize. Hence, the longer payback time.

These findings could inform future system sizes offered as part of the program, with the greatest net benefits and shortest payback period achieved for participants with 3.5-5 kW solar systems relative to 5-6 and 6-7 kW solar system sizes (noting that a payback period was not calculated for participants with solar systems of 3.5kW, with solar systems of 3 kW or less provided for free). There would likely be a trade-off between the number of participants that could be supported through the program and the optimal benefit that could be achieved by each individual participant.

[35] That is, the point where total revenue from the installation equals the total costs.

Key Finding 14 Financial impact of the program on participants

The average net benefit for participants is 22 per cent for all solar systems

Participants with systems between 3.5 and 5 kW take on average 2.07 years to recover the cost of their system. This is the lowest payback time of all upsized solar systems. This could inform future decisions around sizing of solar system installations.

Source: ACIL Allen

3.4 Participant's transition from LIHR to the Trial

G. To what extent have the internal LIHR processes removed the risk of potential double-dipping between this program and the LIHR?

The NSW Government provides energy retailers with the total annual value of the LIHR for each eligible customer. This occurs in aggregate for all of the energy retailer's customers. The value of the LIHR is then deducted from a customer's energy bill by the energy retailer. When a customer has been accepted as an SLIH Trial participant, the NSW Government informs the retailer. However, the NSW Government relies on the customer advising if they change retailers. The NSW Government also requests that the retailer halt payment of the LIHR. Information on individual LIHR recipients is held by Service NSW (given privacy considerations).

Some participants may continue to receive the LIHR after installing a solar system through the SLIH Trial. This is known as 'double dipping'.

Double dipping is not perceived to be widespread or significant, with most known cases of double dipping considered unintentional. Consultations with participants showed that several participants received the LIHR for a short period after the installation of their solar system before they notified their retailer that it should be stopped. This is because the Department notifies retailers to halt payment of the LIHR rebate on a quarterly basis.

The responsibility to check for double dipping currently rests with the energy retailer. This potential gap could be addressed by including the SLIH Trial in the NSW Social programs for Energy Code.[36] This Code sets out how retailers must assist in delivering government energy assistance and how to claim reimbursements. According to the Department, there is an opportunity for Service NSW to link data from the LIHR (which Service NSW currently holds) and the SLIH Trial. Under this scenario, new SLIH Trial applicants would need to provide approval to Service NSW to access their SLIH Trial information.

Key Finding 15 Participant's transition from LIHR to the Trial

Double-dipping, whereby the LIHR continues to be received by a SLIH Trial household is expected to be a small-scale issue.

Responsibility rests with the NSW Government to inform the retailer and on the participant to advise if they change energy retailer and if the energy rebate benefits are reinstated.

Including the SLIH Trial in the NSW Social programs for Energy Code could ensure that Service NSW has visibility over both the LIHR and the SLIH Trial, and could prevent instances of double dipping.

Source: ACIL Allen

[36] New South Wales Government (n.d.), *Social Programs for Energy Code,* Accessed 13 May 2022, https://www.energy.nsw.gov.au/government-and-regulation/legislative-and-regulatory-requirements/social-programs-energy-code#-retailer-reporting-requirements-

3.5 Impact of the program on the network

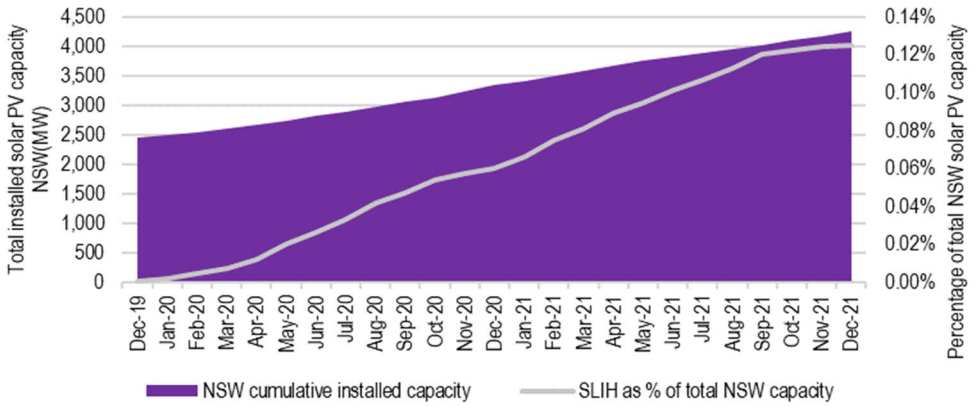
A.3. What impact (if any) did the program have on the network?

As discussed in section 3.1, the total solar PV capacity installed as part of the SLIH Trial was 5.3 MW. This section examines the impact of this solar capacity on the networks in NSW.

To understand the impact of the SLIH Trial, it is important to look at the number of installations in the context of the total number of solar installations in NSW. The Clean Energy Regulator (CER) provided monthly data on small-scale solar installations in the National Electricity Market (NEM) up to the end of December 2021. Figure 3.8 shows that a total of 1,880 MW of small-scale solar capacity was installed in NSW between December 2019 and the end of December 2021. The total capacity of solar systems installed under the SLIH Trial during that period was 5.3 MW. This represents 0.13 per cent of the total NSW rooftop solar capacity installed during that period.

This potentially overestimates the additionality delivered through the SLIH Trial, given a proportion of survey respondents indicated they would have proceeded to install their solar systems without government assistance (noted that this is not guaranteed to eventuate).

Figure 3.8 Total installed rooftop solar system capacity in NSW (MW) and the contribution of SLIH Trial rooftop solar PV systems as a percentage of total NSW capacity (%)



Source: Clean Energy Regulator *(n.d.) Postcode data for small-scale installations,* Accessed 20 May 2022 http://www.cleanenergyregulator.gov.au/RET/Forms-and-resources/Postcode-data-for-small-scale-installations

NSW Government program data on the total number of SLIH Trial installations

The impact at a regional level is slightly more pronounced. Table 3.7 shows that across the participating regions the increase in solar system capacity varied between 0.2 and 1.4 per cent of total solar system capacity in these areas. The South Coast has the highest proportion of capacity from the SLIH Trial (1.4 per cent). Even though most of the state's solar system capacity is installed in the North Coast, the SLIH Trial solar system capacity as a proportion of the total installations in this region is only 0.5 per cent.

Table 3.7 Comparison of total and SLIH Trial solar system capacity by region

	South Coast	Illawarra Shoalhaven	Central Coast	Greater Sydney	North Coast
Total SLIH solar capacity (kW)	891.48	1135.76	521.56	326.86	2446.57
SLIH solar installations as % of total regional solar capacity	1.37%	0.48%	0.27%	0.19%	0.46%

Note: In the calculation for NSW installations only postcodes are included where SLIH solar systems have been installed.

Clean Energy Regulator *(n.d.) Postcode data for small-scale installations,* Accessed 22 May2022 http://www.cleanenergyregulator.gov.au/RET/Forms-and-resources/Postcode-data-for-small-scale-installations

NSW Government program data on the total number of SLIH Trial installations.

Source: NSW Government SLIH Trial program data

These figures indicate that the total installed capacity of the SLIH Trial is a fraction of the total solar PV capacity in NSW. However, the SLIH Trial only includes five regions in NSW and the uptake targets have not been met. While the installation of solar systems has had an impact on the network, the incremental impact of the SLIH Trial on the network issues is marginal.

As the SLIH program scales up across NSW, it will have a more material impact on the network. An expansion of the project will put particular pressure on areas of the distribution network that are already dealing with network issues, particularly on the Essential Energy network. The benefit of energy and bill savings for participants, as well as emissions savings and future energy security, will then have to be weighed against the extra costs associated with increasing the network hosting capacity and the redistribution of network costs from solar owners to non-solar owners.[37]

During consultations, stakeholders presented mixed views on whether the SLIH Trial had impacted the wider solar PV market in NSW. Most stakeholders considered that the SLIH Trial had not been delivered at a sufficiently large scale to impact on renewable energy generation, the energy network, the total amount of NSW Government funding spent on the LIHR, or the quality and safety of solar installations. The impact of the SLIH Trial has also been affected by network issues (discussed further in section 4.2.1).

In contrast, a small number of stakeholders considered that the SLIH Trial had supported an increased uptake of solar systems and prompted discussions on work health and safety among installers. The stakeholder had collaborated with SafeWork NSW, installers and homeowners to develop case studies on falling from heights and electrical safety risks. These videos were to be distributed around the industry to raise industry awareness of these issues. However, there was concern as to whether the higher levels of auditing, quality assurance and customer support currently provided to customers under the SLIH Trial could be guaranteed by all installation companies as the SLIH program scaled up.

Furthermore, two stakeholders suggested that the program had the potential to impact the market and to lower manufacturing costs if the volume of installations was higher.

Key Finding 16 Impact of the program on the network

During the period of the SLIH Trial, 0.13 per cent of the additional rooftop solar capacity installed in NSW was SLIH Trial installations.

The SLIH Trial has not been delivered at a sufficiently large scale to generate impacts at the network or supply chain level.

Source: ACIL Allen

[37] Network charges are not generally cost reflective. When consumers install solar systems, there is generally a redistribution of costs from solar consumers to non-solar consumers.

Performance and quality 4

This chapter addresses the KEQs related to the performance and quality of the program and solar systems.

4.1 Unintended impacts of the program

E. What, if any, unintended impacts have participants and suppliers experienced?

The SLIH Trial generated a range of unintended impacts, as identified through consultations and survey feedback. It was evident that unintended impacts included both positive outcomes, such as participants feeling they were part of a broader community-based movement to participate in climate change action, as well as negative outcomes, such as unforeseen costs. This section discusses both positive and negative unintended impacts on participants and suppliers.

4.1.1 Impacts for participants

This section overviews the perceived positive impacts of solar systems on participants. The issues discussed below show that the installation of solar systems has not only had a material impact on the life of participants but has also given them a sense of pride and security in terms of generating their own energy now and in the future.

Contributing to climate change action

The SLIH Trial enables low-income households to contribute to the social movement toward climate change action by contributing to renewable energy generation. The survey found that 78 per cent of respondents felt their solar system had reduced their environmental impact. During consultations several participants mentioned that being able to contribute to renewable energy generation was a motivator for applying to the program (see section 2.1.3), and an important benefit that they could not have received without the SLIH Trial.

One participant also mentioned that this made him feel part of the community and part of a climate change movement. As the SLIH Trial focuses on a vulnerable cohort that is often marginalised, it is particularly important that the program assists with building greater social cohesion.

Energy supply and future non-energy benefits

The consultations and survey both identified the importance of a reliable supply of energy. A total of 85 per cent of survey respondents considered that the SLIH Trial had met their expectations for facilitating a reliable supply of energy and 54 per cent (158 respondents) raised the benefit of reduced reliance on energy providers. However, it should be noted that the benefits from solar systems during power outages can only be reaped if participants install a battery system.

During consultations, several participants identified the desire to install a battery in the future, and to potentially own and charge an electric vehicle. Having a solar system installed meant that they

were already one step closer to installing a battery and therefore prepared them to reap potential future benefits.

The survey discussed immediate non-energy benefits and asked respondents if their expectations had been met in terms of accessing new technology. The survey showed mixed results, with the majority of respondents (45 per cent) being unsure. This may point to the need to enhance information and training on systems so participants better understand how to get the best performance from their new technology. 43 per cent of respondents considered that their expectations had been met in terms of accessing new technology.

Besides these intangible positive impacts of the installation of the solar systems, some of the participants also experienced more material negative impacts.

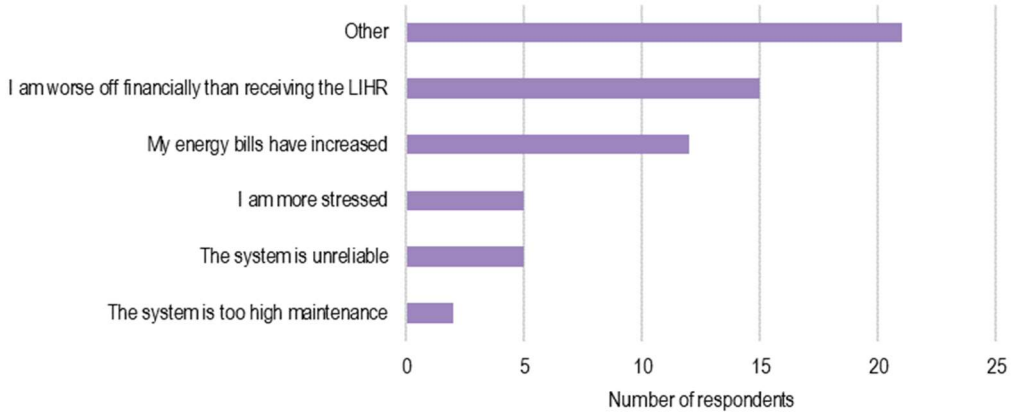
Energy bills have increased for some participants

Survey respondents were asked if they noticed any negative impacts on their life as a result of installing a solar system. A total of 60 responses (negative impacts) were identified by 48 respondents. Figure 4.1 shows that 15 respondents identified that they were worse off financially than receiving the LIHR and 12 said their energy bills had increased. Interestingly, five of the 12 respondents with increased energy bills did not consider that they were worse off financially compared to receiving the LIHR. This may indicate that increased energy bills were less than the value of the LIHR. This supports AEMO's energy bill analysis in section 3.2.3, which also shows that some participants (5 of 98 sampled participants) had bill increases.

Further, nine of the 15 respondents that considered they were worse off financially did not identify that their energy bills had increased. Some of these participants identified additional costs incurred (i.e., associated with installing new smart meters), declining feed-in tariffs and poor energy plans with retailers as reasons for being worse off financially.

A total of 18 respondents identified 23 'other' negative impacts in free text responses. The responses were manually assigned to one or more themes based on the issues identified in the response. These impacts were most commonly being disappointed with minimal savings (four respondents), and decreasing solar feed-in tariffs (three respondents), future potential maintenance costs (three respondents) and that they had installed a system that was too small for their needs (three respondents).

Figure 4.1 Respondents views on negative impacts on their life due to new solar system



Source: ACIL Allen analysis of Department data from the 1-year post-installation survey, 2022.

Figure 4.1 provides some indications as to why people experienced bill increases. When asked why they would be worse off financially than receiving the LIHR, participants commonly identified

decreasing feed-in tariffs as a concern, perceiving that they reduced the financial benefits of the solar system, which could see bills increase over time. This could indicate a lack of knowledge on the main source of benefits from the solar system, which is to self-consume the energy produced by the solar system. This aligns with the comments in sections 2.2.1 and 2.2.2 regarding participant knowledge of how to maximise the benefits from their systems.

Participants also mention that their energy usage has not reduced which could indicate a lack of knowledge on how to optimise their system. This aligns with the comment that participants are dissatisfied with their monitoring system. This could potentially be addressed through greater awareness and understanding of their monitoring system, or through the use of alternate monitoring systems.

Unanticipated costs incurred by participants

The survey also shows that not all respondents were aware of the additional costs for cleaning and maintaining their solar system. This aligns with the comments in sections 2.2.1 and 2.2.2 regarding participant knowledge of how to maximise the benefits from their systems. One of the respondents was surprised by the cost of cleaning the system and would have liked to receive information on how to clean the system themselves. Further, not all survey respondents seemed to be aware of the 10-year whole of system warranty. One respondent expressed concern about future costs of replacement or maintenance. This is an issue that will become particularly relevant as the inverters reach the end of their life after 10 years and the solar panels after 20 years.

Engaging eligible participants

Anecdotal evidence indicates that some households that were not previously receiving the LIHR inquired about the SLIH Trial. They were required to sign up to the LIHR in order to be able to forgo the rebate in exchange for participating in the SLIH Trial. As such, the SLIH Trial engaged eligible households that were otherwise not benefiting from NSW Government energy-related support.

Some participant cohorts not reached due to marketing and application processes

The SLIH Trial was promoted mostly online by the Department, as well as via print media by the installers and through the Seniors Expo, hosted by Service NSW. This may have limited the reach to older members of the public who are less likely to be online (in comparison with younger age groups).[38] Promotional activities could have also been better targeted toward culturally and linguistically diverse communities. As such, a significant portion of eligible households may not have been reached.

Some eligible applicants also did not participate in the SLIH Trial due to challenges with the application process. One of the installers mentioned that incomplete applications often resulted where applicants felt the application process was too difficult.

Finally, applicants were declined due to problems with their roof or the structure of their house. An installer mentioned that 20 per cent of people they visited had shading or structural issues that made them ineligible.

4.1.2 Impacts for installers

The SLIH Trial also resulted in some unintended impacts for suppliers.

[38] Australian Communications and Media Authority (2021). *Communications and media in Australia: The digital lives of older Australians*. Canberra: Commonwealth of Australia

Exclusion of and competition from non-SLIH Trial installers

As noted in section 1.2, the Department sourced suitable installers through an open tender process. A total of 17 complying tenders were submitted, with three successful (the approach adopted effectively precluded smaller local installers from the SLIH Trial). During the negotiation process, a consistent solar system size and 10-year whole of system warranty was agreed for the three tenderers. While this was positive in providing consistency in the Trial's service offering, there was a missed opportunity for additional installers (outside of the SLIH Trial) to identify and engage eligible households.

The installers that were not included in the program were incentivised to not refer eligible households to the SLIH Trial as this would result in a loss of business. This may have prevented households from installing solar systems, or from benefiting from the opportunity to install a free solar system, or to upsize to a larger solar system (due to the lower overall cost of installing a solar system larger than 3 kW under the SLIH Trial). This may have limited the impact of the program.

Unexpected costs of the solar systems and compliance with standards

Two of the three installers mentioned that solar system costs changed over time due to supply chain constraints, the increasing costs of labour, costs associated with providing the 10-year whole of system warranty, and the costs of compliance with safety and electrical standards. However, installers are on a fixed contract with the NSW Government for the cost of solar systems. While installers should have built in provision for movement in some of these cost elements, others (i.e. supply chain tightening) were not foreseen.

Fixed contracts provide certainty of expenditure for the NSW Government and guaranteed income for the installer. They can result in windfall benefit to installers should costs decrease. However, there is the potential for costs to increase, in which case the installer would need to bear this risk and meet the additional costs. Conversely, this represents a positive unintended outcome for the NSW Government.

Unforeseen changes occurred over the course of the SLIH Trial, as prices of solar panels were predicted to go down, but instead increased. Further, installers appeared to underestimate the increased costs required to guarantee the 10-year whole of system warranty, and the costs of compliance with safety and electrical standards.

A further unintended cost was the cost of metering. The SLIH Trial did not generate new costs through the requirement for metering, but merely accelerated the need for these upgrade costs to be incurred. The installers are not qualified to install the meter. Under the National Electricity Rules, the retailers have responsibility for engaging a Metering Coordinator to install smart meters. Origin Energy is the only installer that is also a retailer, and as such, it incurred extra costs of metering upgrades in older areas like Illawarra-Shoalhaven. It should be noted that retailers can later charge these costs to their consumers – whether this is done via a lumpsum and/or via increased electricity usage charges depends on the retailer.[39]

Security standards of the data systems

Another issue that was raised by an installer was the security standard of the systems used by the NSW Government. Survey Monkey was used to exchange application information between the NSW Government and installers. One installer found it hard to get internal approval to use Survey Monkey as their security team did not initially consider the system secure enough to store customer data. The installers also mentioned that the system did not provide the level of detail they needed. These issues are likely to continue as the program scales up and more installers are approved.

[39] Australian Energy Regulator (n.d.). Op. cit.

Key Finding 17 Unintended impacts of the program

The SLIH Trial generated unintended impacts for both participants and suppliers.

Positive impacts included participants contributing to climate change action, potentially benefiting from future non-energy benefits, and

Negative impacts included some participants experiencing increased energy bills and unanticipated costs, some participant cohorts not being reached and approved installers competing with non-approved installers and experiencing unexpected costs.

Source: ACIL Allen

4.2 Factors affecting participant savings

This section discusses the impact of network issues and the quality of solar systems on energy and bill savings of participants in the SLIH Trial.

4.2.1 The impact of network issues

A.1. How did network congestion/ restrictions impact participant savings?

Over the last 10 years, the number of rooftop solar systems in Australia has increased significantly as consumers invest in rooftop solar systems to reduce their energy costs and support renewable energy generation. The growth in rooftop solar systems is making electricity demand more volatile due to its variable nature.[40]

When large numbers of rooftop solar systems generate electricity during the day, this decreases the amount of grid demand in the NEM. As demand levels decrease, it can be more difficult to manage network voltages. Some solar systems will disconnect when they are exposed to power system disturbances,[41] including excess voltage and voltage dips. This section addresses the possible impact of such network issues on the solar generation of SLIH Trial solar system installations, as well as the impacts of limits that are placed on the export of energy.

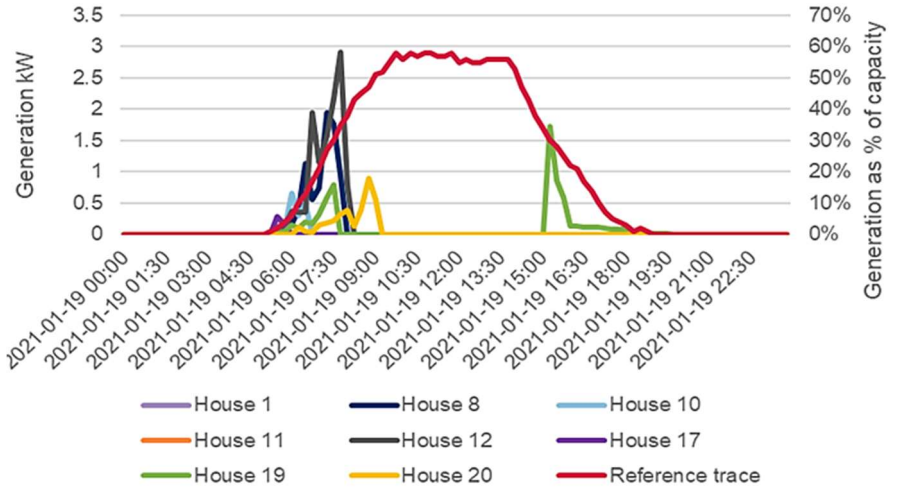
Anecdotal evidence of network issues

At the start of the SLIH Trial, the Department identified some solar systems that were affected by outages. Internal analysis found that eight of the 39 solar systems in the sample had stopped generating energy at times of peak generation. Figure 4.2 shows the energy generation of the eight solar systems by time of day. The chart shows that the solar systems involved are generating energy in the morning, but are switched off for the rest of the day. The red line represents the expected energy generation for these systems.

[40] Australian Energy Regulator (2021). *State of the energy market 2021*. Accessed 8 March 2022: https://www.aer.gov.au/system/files/State%20of%20the%20energy%20market%202021%20-%20Full%20report_1.pdf.

[41] Australian Energy Market Operator (2021). *Factsheet Minimum Operational Demand*. Accessed 8 March 2022: https://www.aemo.com.au/-/media/files/learn/fact-sheets/minimum-operational-demand-factsheet.pdf?la=en.

Figure 4.2 Time of day rooftop energy generation of 8 solar systems of the SLIH program (kW)



Source: OECC analysis of SLIH Trial program data

The Department found a strong correlation between the inverter size and the inverter output. Inverters over 245 volts delivered inverter outputs of zero (i.e., no energy was generated). This indicates that the temporary outage of the solar systems was caused by a high voltage.

To check if these problems were resolved over time, the Department conducted a second round of analysis of 86 participants based on half hourly metered export data from smart meters.

Solar systems that did not perform to the expected standards were categorised according to their level of severity. Five per cent of the solar systems in the sample were impacted severely, meaning they were generating over 1,000 kWh less than expected. Half of these solar systems were impacted by technical issues, but the other half of systems were impacted by network issues. One solar system experienced reduced export from 12 noon-2 pm, the other system experienced extended periods of little to no export.

About 10 per cent of the solar systems included in the sample were moderately affected, in that they were exporting 200-300 kWh less than expected. Half of these systems were impacted by technical issues with the solar system, but the remainder seemed to face some form of network issue. The reductions in export occurred at regular times on an ongoing basis, typically between 12 noon-2 pm.

Finally, 20 per cent of the solar systems in the sample had suffered a mild impact, meaning their export was, at most, 100 kWh less than expected. The Department found that these issues were in most instances impacted by an occasional system trip that was self-rectified after a short time.

Overall, the Department analysis found that there are some solar systems in the SLIH Trial that have been affected by network issues. Consultations with stakeholders confirmed these findings. One installer estimated that about 1 in 5 of the installations was impacted by network issues. The impact was not considered to be severe in most cases. In an attempt to manage network issues in certain areas, installers were requested to notify the Department when there were export limits imposed by the system. This led to the installation of smaller output solar systems. Section 3.2.4 discussed the trade-off between installing smaller solar systems to limit the impact on the network and redistribution of costs from solar to non-solar customers versus the financial benefits and reduced GHG emissions from larger solar systems.

Interestingly, during consultations, participants seemed to be unaware of problems with network issues. One participant mentioned that a power outage had happened once, but said that this was fixed immediately. Another participant mentioned losing power during the floods in NSW. No other

instances of tripping were mentioned during consultations. These responses show that participants generally associate network issues with solar system power outages, despite these issues also resulting in power clipping, reducing the maximum output of a solar system.

Improved cooperation between the NSW Government and the distribution network service providers could help in identifying more quickly where the output of solar systems has been reduced as a result of technical problems. If the distributors are aware of the solar system size and expected generation of the SLIH Trial solar installations, they could set up an early warning system for the NSW Government which could identify possible problems at an early stage.

Possible reasons for network issues

The previous section showed that a number of SLIH Trial solar systems have been impacted by network issues. During the consultations, stakeholders discussed different reasons for these network issues. All of the installers were aware of export limits impacting the output of solar installations. With an export limit applied, households consuming less energy than generated by their solar system can only export up to a certain amount of energy.

One of the installers mentioned that often exports are limited in areas where more installations occur. An example they referred to were communities in Coffs Harbour and Tweed Heads where a large proportion of the community had installed solar systems. This is due to the abundance of household solar energy exported to the grid during peak solar generation periods.

Installers also mentioned that network issues were more common in regional areas than urban areas. Export limits can be higher (i.e., households can export more energy) in urban areas than in regional areas due to additional demand. More people in non-regional areas live in apartments (and unable to install a solar system) and there is higher overall demand for electricity. This higher overall demand balances out the extra energy generation during the day delivered by the solar installations. The problem with network issues is therefore more focused in regional areas such as the Central Coast and Hunter regions.

As a result, the export limits set by the distribution network service providers in the SLIH Trial regions vary. Ausgrid has the highest export limit, namely 10 kW on a single phase inverter[42] (Ausgrid operates in Sydney, the Central Coast and the Hunter Valley and includes the Sydney South SLIH Trial area). Endeavour Energy and Essential Energy both have a net export limit of 5 kW on a single phase inverter.[43,44] One stakeholder mentioned that the export limit in regional areas in the Essential Energy network is set at 3 kW, while the export limit in urban areas is set at 5 kW. The differences in network limits among the three distribution network service providers indicate that they have to set a lower export limit in regional areas to manage higher network congestion.

Poor DER visibility is another underlying cause of network issues. The market operator AEMO manages a database of all DER installations in Australia, this includes small-scale solar installations such as the SLIH Trial solar installations. This database, also called the DER register, provides visibility of DER locations and DER specifications like system size. When AEMO has

[42] Ausgrid, How Solar power works, Accessed 16/05/2022, https://www.ausgrid.com.au/Your-energy-use/Solar-power-and-batteries/How-solar-power-works

[43] Endeavour Energy (n.d.), Applying for a connection, Accessed 16/05/2022, https://www.endeavourenergy.com.au/connections/connect-a-solar-system

[44] Essential Energy (19 February 2021), Changes to our embedded generation connection application approval process, Accessed 16/05/2022, https://engage.essentialenergy.com.au/level3asp/news_feed/changes-to-our-embedded-generation-connection-application-approval-process

visibility of the installed DER devices in the network, it can manage the electricity grid and ensure reliable energy generation.[45]

All new solar installations need to be recorded in the DER register by installers. During consultations it was noted that not all installers update this information when they adjust the solar system size during installation. Since updating solar system information in the DER is not enforced, some of the information may not be up to date. This creates poor visibility of DER installations for both AEMO and the network service providers.

During consultations one stakeholder noted that the Essential Energy and Endeavour Energy networks are most impacted by poor visibility of DER installations in their network. This seemed to be less of an issue in the Ausgrid network. Ausgrid themselves also provide more information to AEMO about DER installations in their network.

Future proofing the network

The SLIH Trial solar installations are part of a wave of new solar installations entering the energy market in Australia. As mentioned before, this is reducing demand during the day, resulting in voltage disturbances at times. Standards Australia has amended the standard for inverters (New Inverter Standard) to help integrate solar installations in the electricity network.

The new standard was published in December 2020. The most important change in the standard is a requirement for the undervoltage ride-through performance of inverters. This means that inverters are better able to manage small network disturbances, which means that solar installations will not turn-off during such events and will be less likely to contribute to undervoltage events.[46]

During consultations, some of the installers told us they had been installing solar installations according to the new inverter standard, even before the new standard was published. However, not all stakeholders were convinced that the New Inverter Standard will prevent voltage disturbance issues. Even though the New Inverter Standard has an under-voltage ride-through ability, over-voltages can still occur which cannot be managed by the inverter.

Furthermore, while many inverters already have the required hardware, they need to be programmed according to the New Inverter Standard. However, there is no single entity responsible for the DER technology standards. Distribution network service providers do not consider it to be their responsibility to enforce the new standard. A review by AEMO identified that as many as 40 per cent of grid-connected inverters were not set in accordance with the previous standard. It has been collaborating with the CER and Clean Energy Council to incorporate settings checks into the CER's existing inspection program as part of its Small-scale Renewable Energy Scheme.[47]

One stakeholder identified two-element meters as a technology that could help with integrating solar systems into the electricity network in the future. This technology has been used in South Australia since the end of 2021 and allows AEMO the opportunity to make informed decisions in relation to DER management (including potential disconnection of solar systems remotely when needed), rather than automatic system disconnection during periods when the network is overloaded. It also provides AEMO with more visibility of the DER activity, because it provides

[45] Australian Energy Market Operator (n.d.). *About the DER Program*. Accessed 16 May 2022: https://aemo.com.au/initiatives/major-programs/nem-distributed-energy-resources-der-program/about-the-der-program.

[46] Clean Energy Council (13 September 2021). *New Inverter Standard to improve grid stability*. Accessed 16 May 2022: https://www.cleanenergycouncil.org.au/news/new-inverter-standard-to-improve-grid-stability#:~:text=The%20new%20inverter%20standard%20AS,available%20and%20enabled%20by%20default.

[47] Australian Energy Market Operator (n.d.). *AS/NZS 4777.2 – Inverter Requirements standard*. Accessed 29 May 2022: https://aemo.com.au/en/initiatives/major-programs/nem-distributed-energy-resources-der-program/standards-and-connections/as-nzs-4777-2-inverter-requirements-standard

information on the gross output of the DER installations instead of just the net output. It also provides more information to the household on their energy exports and imports from the grid.

Key Finding 18 The impact of network issues

Some solar systems have been impacted by network issues. Regional areas are impacted more than urban areas due to lower energy demand in these areas.

A lack of visibility of DER installations makes it hard for network operators to manage the grid.

An amended inverter standard was published in December 2020 to improve the performance of inverters but there is relatively low compliance with the mandated settings in the standard. The electricity system would benefit from wider adoption of two-element smart meters for DER installations to provide more control and greater visibility.

Source: ACIL Allen

4.2.2 The impact of system quality and performance

A.2. How did system quality and performance impact these savings?

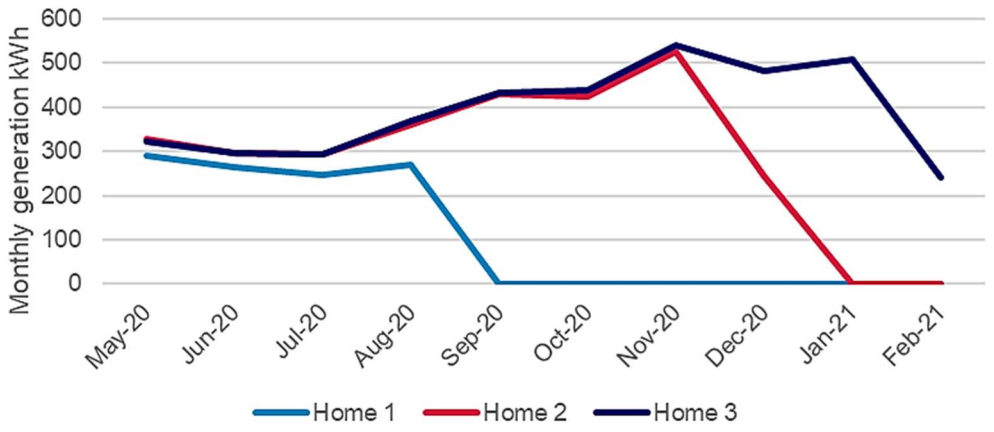
Given the solar systems being installed have at least an expected 10-year life span (at which time the inverter may require replacement), it is difficult to assess system quality and performance after only two years of operation. As such, this question focused on a performance assessment of a small sample of solar systems as well as audit information.

The performance of SLIH Trial solar installations can also be impacted by the quality of the solar system itself. This section focuses on the quality and performance of the SLIH Trial solar systems and how this impacted energy savings.

To assess the performance of SLIH Trial solar systems, the Department analysed the performance of a sample of 39 solar systems in March 2021. Issues with temporary curtailment during the day have been discussed in section 4.2.1. The analysis also identified issues with extended outages of the solar systems and inverters. This section discusses temporary outages due to technical issues with some solar systems.

Figure 4.3 shows the monthly generation of three households. Electricity generation dropped to zero in September 2020 for Home 1, in January 2021 for Home 2 and decreases from January 2021 onwards for Home 3. The identified outages ranged from days to weeks. The Department therefore concluded these outages might have multiple causes and suggested system monitoring as a way to identify the causes.

Figure 4.3 Monthly energy generation of 3 SLIH Trial homes (kWh)



Source: OECC analysis of SLIH Trial program data

These extended outages have a significant impact on the energy and bill savings of participants. If households only become aware of these outages when they receive their electricity bills, this can result in months of missed energy and bills savings.

To find out if these issues had been resolved, the Department conducted a second round of analysis in March 2022 which included a sample of 86 solar systems. This showed that only two systems were severely impacted by technical issues, meaning their exported energy was reduced by over 1,000 kWh per year. About 5 per cent of the systems experienced intermittent technical issues with their system, leading to a loss of between 100 to 1,000 kWh of exported energy.

The Department's analysis shows that only a few solar systems had technical issues and most of these had a moderate impact on energy generation. This is confirmed by the 1-year post-installation survey, which shows that 62 per cent of survey respondents were very satisfied with the operation of their solar power system so far, while 25 per cent were somewhat satisfied. Only 10 per cent of respondents were not satisfied with the operation of their solar system.

In total, 19 per cent of respondents had experienced a fault or disruption with their solar system. This had only a minor impact for two thirds of those respondents that experienced an actual fault or disruption. These issues may indicate the need for more support for participants to conduct basic troubleshooting. The time it took for these minor issues to be resolved was over a month for 47 per cent of these respondents. For 16 per cent of respondents it took several weeks and for the rest it took about a week or less.

Electrical Compliance and Work Health and Safety audits of the SLIH Trial installations were conducted in January 2020. In preparation for the audit, the auditor developed several audit tools in cooperation with the NSW Government, installers, and Fair Trading regulators. The auditor also organised workshops to involve all relevant stakeholders in the audit process.

The Electrical Compliance audit found that, overall, the solar systems were well installed. Only two minor issues were identified that needed to be addressed, namely missing silicone sealing caps over mounting screws and a misalignment of the mounting feet. With regard to the misalignment of the mounting feet, it was confirmed that this position was allowed by the manufacturer in this instance.

The Work Health and Safety audit was positive. Installations were considered to be well-managed and no areas of immediate concern were identified.

Key Finding 19 The impact of system quality and performance

Some households have experienced short-term technical issues with their solar system. Most of these technical issues had a minor impact and were resolved quickly. This contrasts with the longer-term network issues (see section 4.2.1) that are broader than a single solar system and the SLIH Trial itself.

Auditing of the installations identified minor issues with electrical compliance and no areas of immediate concern related to work health and safety.

Source: ACIL Allen

4.2.3 Quality and performance of the solar systems

F. How did the quality and performance of the solar systems installed, compare to non-program installations?

The final section of this chapter dives deeper into the quality of the SLIH Trial solar installations and compares these installations with other solar installations in NSW.

Selection of installers

The selection of high quality installers is important for delivering high quality solar system installations.

To ensure the quality of the newly installed solar systems, the Department undertook a Request for Tender (RFT) process in November 2018 to select installers. Installers were assessed against pre-determined evaluation criteria, including mandatory requirements such as the ability to provide references from residential solar installations in one of the five trial regions, the use of accredited equipment, being in possession of the necessary insurances, as well as financial health. It gave preference to installers that demonstrated capabilities such as customer management, and time and organisational management, and to installers that could provide value for money.[48]

The Department received fewer applications from installers than anticipated. The RFT was distributed through the Clean Energy Council, which meant that some companies may not have received and been aware of the RFT. Some applications were also considered economically unviable and the Department sought additional commercial advice to resolve this.

Installers were generally positive about the RFT process and the clearly defined roles and responsibilities of the Department and the installers. They commented that becoming an approved installer was beneficial as it drove business through referrals and publicity.

Quality of the system and installation

Stakeholders had mixed views on the quality of the installed solar panels. Installers offered two to three different types of products (solar panels and inverters) under the SLIH Trial. Installers had mixed views on whether the quality of the solar systems installed under this program was comparable to non-program installations. One installer mentioned that, while the 'standard' solar panels and inverters used in the SLIH Trial met Australian standards, they were of a lower quality in comparison to those used in half of their non-program installations. This is likely due to cost considerations. The other two installers used the same products for SLIH Trial and non-program participants.

The auditor identified higher scrutiny on installations under the SLIH Trial than non-program installations due to oversight and regular feedback on how to improve from the Department. Further, one of the installers commented that there are not enough audits conducted on solar installations in NSW in general. They felt that this encouraged installers outside of the SLIH Trial to cut corners where possible.

Complaints and dispute management

The previous section showed that, despite the quality of the installation and the solar system, there were participants that experienced technical problems with their solar systems.

When participants experience technical problems, they can contact their installer directly under the 10-year whole of system warranty provided with the SLIH Trial. One installer provided the evaluation with a list of warranty claims that had been logged in 2020 and 2021. This installer had installed a total of 393 solar systems between December 2019 and December 2021. A total of 44 claims had been logged, which is 11 per cent of all their installations. Of these claims, only eight (2 per cent) were identified as warranty claims. Three of these came from the same participant and one of their claims had not yet been resolved at the time of reporting. This may suggest that some participants are not being fully supported to manage and get the most benefit from their solar systems.

Participants can also contact the NSW Government using Freshdesk™, a customer-interface system. The NSW Government set up Freshdesk™ (a customer relationship management software) to manage possible problems with the quality or performance of the solar systems and to support participants with paper-based applications and provide information to assist with

[48] NSW Government (2018). *Request for Tender, Solar for Low Income Households Trial, PROC-2003189*. Sydney: Office of Environment and Heritage.

applications or other matters. Between November 2019 and November 2021, 3,149 inquiries were lodged. Most of these inquiries (3,136) were resolved. Only 45 inquiries remain unresolved.

When an inquiry is unresolved and there is an ongoing dispute between an installer and a SLIH Trial participant, participants currently can only seek support from NSW Fair Trading. This creates challenges as NSW Fair Trading encourages but cannot require the installer to resolve a dispute.[49]

A possible alternative to this process could be to provide ombudsman coverage for solar installations. This is currently being explored by the Energy & Water Ombudsman NSW.

Key Finding 20 Quality and performance of the solar systems

The Department had a rigorous process to select installers for the SLIH Trial, which was considered valuable for both the Department and the installers (i.e., participants may see them as more reliable and trustworthy, thus helping address a barrier to installation).

Solar systems installed as part of the SLIH Trial are of a similar standard as non-program installations, although there is more scrutiny on SLIH Trial installations.

The 10-year whole of system warranty provides participants with the comfort that they could get any faults rectified (through the Supplier, with the NSW Government providing dispute resolution support). However, there is no clear mechanism for resolution available in the market if disputes arise with installers.

Source: ACIL Allen

[49] NSW Fair Trading (n.d.). *Resolving a dispute*. Accessed 16 May 2022: https://www.fairtrading.nsw.gov.au/trades-and-businesses/construction-and-trade-essentials/resolving-a-dispute.

5 Conclusion

This chapter considers the terms of reference for the evaluation (see section 1.3) and the key lessons learnt and recommendations for the future of the SLIH program.

5.1 Lessons and recommendations

How effectively have the program objectives been met?

Under the SLIH Trial, a total of 1,211 solar systems have been installed and over 5,300 kW of solar PV capacity has been added in NSW to December 2021, reducing ongoing GHG emissions by approximately 3,900 tonnes per annum. It has provided participants with access to solar systems that would not have otherwise been affordable by removing the financial and non-financial barriers to installation.

What changes have occurred in electricity consumption practices?

The NSW Government and installers set the foundation for changing electricity consumption practices by providing information and support for participants to understand their systems. This has been instrumental in bringing about behavioural change by participants, in particular driving a shift in the use of electrical appliances during the day, limiting the use of major 'energy hungry' appliances (i.e., clothes dryers) where possible, and to cut back on overall energy use. Some participants used more energy on heating and cooling to improve comfort. This adjustment reflects an underuse of energy prior to installation – it appears these customers now feel they can afford the level of comfort desired without undue bill stress.

What has been achieved in terms of renewable energy generation and GHG emission reductions?

The SLIH Trial has delivered annual average benefits per participant as follows:

- almost 4,900 kWh in energy benefits, or 5,930 MWh per annum for all participants in the SLIH Trial,[50]
- more than $800 (including GST) in electricity bill savings with a TOU tariff, with most bill savings above the $600 (excluding GST) per year target set by the Department and more than double the $285 (excluding GST) value of the LIHR
- more than 3,000 kg CO_2-e of GHG emissions avoided.

What unintended impacts have occurred?

The SLIH Trial improved household living conditions (i.e., reduced financial stress and improved thermal comfort) and enabled participants to contribute to environmental outcomes and benefit from a reliable supply of energy. Some participants consider that it has provided 'future-proofing' options in that they will be well placed should they wish to install a battery in the future or purchase an electric vehicle. However, the SLIH Trial also encountered some negative unintended impacts, including issues with exports being limited, inverters tripping, technical issues with the installation, poor visibility and management of DER installations in NSW, and uncertain feed-in tariffs and price pressures (e.g., supply chain issues, labour and lifetime warranty, and additional audit requirements).

[50] Assuming the sample analysed is representative for the 12 month period analysed for all SLIH Trial participants.

What is the legacy of the long-term benefits?

The SLIH Trial has created a legacy by supporting a cohort of participants to achieve greater energy independence and quality of life. For the NSW Government, it has highlighted the need to invest in a coordinated policy response to better manage the grid and DER installations as solar penetration increases.

What have been the interactions with the LIHR program?

Participation in the SLIH Trial requires relinquishment of the LIHR. This has occurred in most cases. However, there were a limited number of instances of double-dipping (i.e., recipients continuing to receive the LIHR after installation of a system). These cases seem to have been largely unintentional and there are administrative difficulties in resolving the issue.

What has been the quality and performance of the solar systems installed?

Some households experienced technical issues with their solar systems. These were mostly minor and had only a small impact – in the main they were quickly resolved. Installations were largely conducted to a high quality, with strong electrical compliance and adherence to safety standards. The installation quality and panels installed under the SLIH Trial were on a par with industry wide installations. While some installers offered a 'premium' product to participants who requested it (e.g., solar panels of a premium brand), its pricing was outside the parameters of the SLIH Trial and generally beyond the reach of participants. The SLIH Trial installations were also affected by network issues. The extent of this problem is unknown, although anecdotal evidence suggests this could be as high as 1 in 5 installations. This has impacted the benefits delivered by the program.

The sections below outline the conclusions identified in this report and the associated recommendations. The recommendations focus on two key areas:

— opportunities to generate greater benefit for participants

— opportunities to scale up the program.

5.2 Opportunities to generate greater benefit for participants

As the program expands, there are opportunities to generate greater benefit for participants.

The NSW Government and installers provide information and guidance to support participants on how to operate their solar systems and how to change their energy behaviours in response to their installation. However, some participants do not have enough information to understand how to best use their solar systems to maximise their benefits, and half of participants do not use their monitoring systems. It is likely that these participants could generate additional renewable energy, further reduce their reliance on the grid and benefit through lower electricity bills. This represents an opportunity for further benefits to be gleaned by participants.

Recommendation 1 Education and follow-up support

Support participants (through engagement with installers) to improve their understanding of how to change their behaviour to best use their systems by improving installer-delivered education and follow-up support. This could also include educating participants on housing efficiency (e.g., window and door seals, insulation, and using electricity rather than gas appliances) to support them to optimise the benefits from their solar system.

Source: ACIL Allen

Due to the vulnerable nature of the cohort targeted by the SLIH Trial, the installers were originally restricted from advising applicants on options to upsize their solar system. As such, some participants have missed out on the opportunity to potentially install a larger system that may have been better suited to their needs and that would provide them with greater net benefit (noting the overall net benefit to participants may be lower, depending on their choice of system size). However, there is a fine line between better providing the best, comprehensive advice and 'upselling'. The NSW Government could invest further in working with installers to get this balance

right. This should consider the potential participant's purpose for participating in the program and their intended outcomes (e.g., achieving energy independence, optimised savings, thermal comfort). It should also include assessing and advising participants on their potential net benefit with a range of feed-in tariffs (noting these are anticipated to reduce over time).

Recommendation 2 Appropriate sizing of solar systems

Require installers to provide more support and technical expertise to participants to enable them to understand which solar system size is most appropriate for their circumstances and work with installers to support them to better advise participants where upsizing the solar system would deliver a greater benefit. This should focus on optimising outcomes for participants, considering their lifestyle choices and personal objectives (e.g., achieving energy independence, optimised savings, thermal comfort).

Source: ACIL Allen

Smart meters are a core element of the program. They are a requirement for solar installations, and enable participants to understand and get the most out of their solar system. Smart meters had to be installed by SLIH Trial participants where they did not already have one. Participants must legally request a smart meter to be installed (if not already in place), as only they have the legal authority to initiate such a request of their energy retailer. Installers are required to 'assist' and 'coordinate' participants through the smart meter installation process. Anecdotal evidence suggests that some participants indirectly paid for the smart meter costs through their energy retailer.

AEMO indicated that, over time, it will be more difficult for them to manage the system with the current smart meters which only measure the net energy imported from the grid. It would facilitate them better managing the system if a smart meter with two elements was installed that measured the gross output from the solar panel. Additionally, a two element smart meter with a load contactor would facilitate improved management of DER by AEMO to maintain the stability of the system.

Recommendation 3 Smart meters

Smart meters are a core requirement for a solar system and should be better embedded in program delivery (i.e., actively managed by the installer during installation, noting that it is ultimately the responsibility of the participant and retailer) to generate the most benefit to participants. Furthermore, the smart meters should have at least two elements to future proof the metering technology (to facilitate future battery installation and enhance user knowledge).

Source: ACIL Allen

The SLIH Trial has delivered greater benefit to participants with the capacity to invest more in their system. This includes participants that upsized their solar systems, could access smartphone applications to monitor their use, and could invest in system maintenance. While this is positive in helping these participants maximise their benefits, there are opportunities to explore why some participants benefit less to better target the program to ensure those that are most at need can equally benefit from the program.

Recommendation 4 Delivering greater benefits

Explore opportunities to revise the program design and ensure it is fit for purpose to achieve the intended outcomes by:

- consider raising the free 3 kW solar system size cap
- broaden the eligibility criteria to address the needs of energy-stressed households that are currently not holding a PCC or DVA Gold Card.

Source: ACIL Allen

5.3 Opportunities to scale up the program

The SLIH Trial has installed 1,211 systems during the period examined by the evaluation, which is largely on track to meet its target of 3,000 installations over four years.

During the expansion of the SLIH program, the NSW Government has an opportunity to better promote the program to improve awareness and uptake. This includes both NSW Government- and installer-driven promotional activities, but will require a higher level of responsibility on approved installers to ethically promote. While this may require additional investment from installers, they can be expected to benefit though growing their business and the reputational value arising from 'preferred installer' status under the program. There is also an opportunity to better target promotional activities to ensure that eligible applicants are specifically made aware of the program.

The number of approved installers also impacts the reach and awareness of the program due to the strong reliance on installer-led promotional activities. There is an opportunity and a need to increase the number of approved installers as the program scales. We understand this is currently being explored by the NSW Government.

Recommendation 5 Improving promotion and awareness-raising

The NSW Government has an opportunity to invest in promotion and awareness raising for the program by:

- increasing the number and breadth of tailored promotional activities that are fit for purpose for the intended target audience
- requiring installers to conduct awareness raising activities
- using additional avenues to target eligible applicants (i.e., specific targeting via Service NSW)
- increasing the number of installers.

Source: ACIL Allen

Some SLIH Trial installations have experienced network issues including export limits and inverter tripping. This has reduced the potential impact of the program in terms of electricity bill savings, renewable energy generation and GHG emission reductions. The program will encounter further network issues as the program scales and as more solar capacity is installed in NSW. The poor visibility of DER installations adds to this problem.

There are opportunities to better understand the rationale and scale of these issues and improve communication and visibility to drive improvements in program benefits.

Recommendation 6 Mitigating network issues

To maximise the benefits delivered by the program and mitigate risks to the achievement of these benefits:

- invest in understanding why some participants experience more network issues than others to inform ongoing decisions about program deployment and to enable this experience to feed into broader work (both policy and grid enhancement works) to resolve network issues, and thus improve the benefits generated
- engage with energy distributors to better understand where network issues are likely to emerge to guide program deployment (including where the grid may benefit from additional support, i.e., from local solar energy production) and ensure participants can be made aware of potential curtailments
- require installers to update the DER Register (including sanctions for non-performance) to help the distributors manage the network and improve the visibility of DER installations.

Source: ACIL Allen

The 10-year whole of system warranty for solar systems provides participants with the comfort that they can get faults rectified (assuming the warranty can be honoured).

At present, any issues or disputes between participants and installers that cannot be resolved are managed by the NSW Government. This is unlikely to be the most appropriate approach as the program scales up.

As such, there is the need for an affordable dispute resolution mechanism to ensure conflicts between participants and installers are resolved on a timely basis.

Recommendation 7 Dispute resolution

Consider establishing an affordable dispute resolution process in NSW to support customers and installers more broadly.

Source: ACIL Allen

Expanding the program beyond the trial will require the use of appropriate monitoring and support systems (i.e., survey and application form software, participant tracking databases) that allow for effective and efficient data collection and analysis to support implementation. These will also be crucial to the future evaluation of the expanded program. Selection of appropriate systems should consider privacy and security arrangements, particularly where participant data is stored.

Recommendation 8 Systems for expansion

Ensure expansion of the program is supported by appropriate monitoring and support systems to protect participant information and enable future evaluations.

Source: ACIL Allen

SLIH Trial participants were required to forgo the LIHR to cover the cost of the installation. While most participants arrange for the LIHR payments to cease through their energy retailer. Some inadvertent double-dipping occurs.

While this is mostly unintentional, it does impact the NSW Government's return on investment from the program, as in these cases, the government covers both the cost of the LIHR and the installation.

Recommendation 9 Mitigate double dipping from LIHR and SLIH

Improve visibility and information exchange between the LIHR and SLIH data holders to prevent double dipping and streamline administrative processes for energy retailers and the NSW Government.

Source: ACIL Allen

Stakeholder engagement A

Table A.1 lists the stakeholders consulted for the evaluation. At the time of writing the draft report, a total of 33 stakeholders had been consulted in 22 interviews.

Notes were recorded during interviews to enable qualitative thematic analysis. Interviewees were provided with a discussion guide.

Table A.1 Stakeholders consulted

Stakeholder group	Number of stakeholders
NSW Government – Climate Change and Clean Air Policy – Hydrogen and Clean Energy – Energy Social Programs – Energy Programs – Evaluation, Data and Analytics – Social Policy – SLIH Trial program team	12
Experts and market actors – Australian Energy Market Operator – Public Interest Advocacy Centre – Clean Energy Council – South Australia Department of Energy and Mining – Ausgrid – Energy Australia – Rheem	12
Installers – SAE Group – SolarHub – Origin Energy	3
Auditor – Work Science	2
SLIH Trial participants	5

Source: ACIL Allen

SLIH Trial application process and eligibility

B

Enquiries: from potential participants for more information on the program. These were received through the SLIH Trial website, via email or through Service NSW. They are reviewed and processed by the NSW Government and Service NSW.

Eligibility application: stakeholders applied, provided confirmation that they met the eligibility criteria (see below) and consented to the requirements of the SLIH Trial. Approved installers were responsible for assisting applicants to apply. The NSW Government was responsible for assessing an applicant's eligibility. If approved, the NSW Government provides the relevant local installer with the applicant's details. The eligibility criteria are:[51]

- live in an eligible location, including eligible postcodes in the Central Coast, North Coast, Illawarra-Shoalhaven, Sydney South and South Coast)
- hold a valid PCC or DVA Gold Card
- currently receive the LIHR and agree to forgo the rebate for 10 years
- own their own house
- do not already have a solar system installed.

House suitability assessment: installers contacted applicants to begin their solar system application. This included a technical house suitability assessment which considers roof suitability (access, orientation, shade, pitch, condition, etc.), existing electrical wiring and meter, installation complexity, usage patterns and estimated savings, and any required approvals. This identified whether applicants are suitable for installation.

Approval: involved approval of the application and organisation of the installation date with the participant. The NSW Government met the cost of the solar system (including installation costs).

Installation: agreement as to a suitable time for installation by an installer. Installers provided participants with training on how to use the solar system. Participants signed a form confirming the installation and training was completed. They agreed to allow their electricity retailer to send their electricity bills to the NSW Government, take ownership of the solar system and be responsible for its maintenance, notify the NSW Government of changes in address or electricity retailer, enter into a contract with the solar installer, and arrange and pay for a smart meter (at the participant's expense) to be installed (via their electricity retailer) to assist in monitoring their usage.

Completion: finalised documentation provided to the NSW Government and LIHR payments cease.

[51] NSW Government (2020). *Program guide: Solar for Low Income Households*. Sydney: Department of Planning, Industry and Environment.

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