



2 October 2023

Senate Standing Committees on Economics  
PO Box 6100  
Parliament House  
Canberra ACT 2600

By email: [economics.sen@aph.gov.au](mailto:economics.sen@aph.gov.au)

Dear Sir/Madam

### **Residential Electrification Senate Inquiry**

The Clean Energy Council (CEC) welcomes the opportunity to provide feedback to the Economics References Committee's Residential Electrification Inquiry.

The CEC is the peak body for the clean energy industry in Australia. We represent and work with Australia's leading renewable energy and energy storage businesses, as well as a range of stakeholders in the National Electricity Market (NEM), to further the development of clean energy in Australia. We are committed to accelerating the transformation of Australia's energy system to one that is smarter and cleaner.

Home and business electrification is not only critical to the net zero goals of our energy systems, but it is also one of the cheapest ways to transition to a modern economy driven by renewable and clean energy. Australian households have played a large and important role in driving the decarbonisation of our electricity system. This will need to continue if we are to meet our net zero goals by 2050 and the growing demand from the phase out of oil and gas in transportation and buildings. A rapid transition to electrifying homes and encouraging the uptake of consumer energy resources (CER) is required.

Electrification also has sustained economic growth and deflationary impacts if implemented correctly. Energy efficiency measures and the uptake of CER have a direct impact on lowering consumer energy bills, generating new job opportunities and enhancing worker mobility.

We support the Federal Government working towards policy objectives that promote electrification as one of the cornerstones in delivering a rapid and just transition to net-zero. We also support policies that ensure all Australians benefit from electrification, including low-income households and renters who may not have the financial or living circumstances to otherwise benefit from the transition.

The \$1.6 billion allocated in the 2023-24 Budget for an Energy Saving Plan to help households and businesses improve their energy efficiency and save on energy costs is a welcome start. The package, which includes \$1.3 billion Household Energy Upgrades Fund; \$300 million co-funding and co-design with states and territories to target vulnerable Australians in social housing, and \$310 million for the Small Business Energy Incentive providing small businesses with an additional deduction on spending on electrification and energy efficiency, will support an acceleration of the economic and emissions reductions benefits from electrification.

However, there is more we can do to complement this funding package. This includes:

- Lead harmonisation efforts around training and standards between jurisdictions, working with states and territories to invest in workforce attraction and development.
- Make the DER Implementation Plan a standing item on the ECMC Meetings.
- Ban new gas connections for homes and light commercial businesses on the distribution network across Australia.

- Implement the newly mandated 7-star NatHERS rating as soon as possible, extend the NatHERS rating system to existing homes and look at mandating further requirements to electrify the home.
- Establish a National CER Technical Standards Body
- Set a national rooftop solar target for 2030 and 2040, reflecting the Integrated System Plan's Step Change scenario.
- Set a national distributed energy storage and flexible energy target for 2030 and 2040, reflecting the Integrated System Plan's Step Change scenario.
- Work with states and territories to invest strongly in clear and sustained public information campaigns to support consumer awareness of the electrification transition.
- Extend the SRES program to 2040, including storage and orchestration.

The remainder of this submission provides a detailed response to the Terms of Reference of the Residential Electrification Senate Inquiry.

If you have any queries or would like to discuss the submission in more detail, please contact Emily Perrin, Policy Officer, at [eperrin@cleanenergycouncil.org.au](mailto:eperrin@cleanenergycouncil.org.au).

Yours sincerely



Con Hristodoulidis  
Director Distributed Energy

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## Response to Inquiry's Terms of Reference

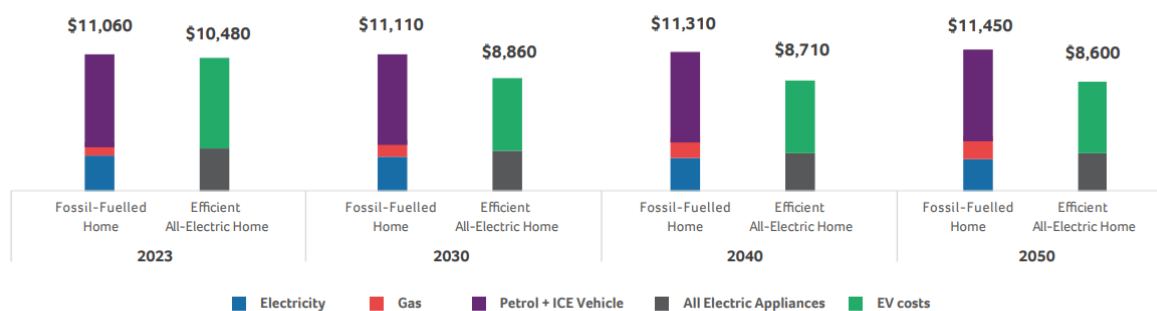
### Economic opportunities of household electrification

Electrification of homes, business, industry and transport, underpinned by renewable energy and storage, is a key decarbonisation strategy for the Australian economy, and should be expedited wherever possible, noting the energy productivity benefits it offers consumers.

#### Long-term reduction of energy price inflation

As summarised by Energy Consumers Australia in its recent report, *'Stepping up: a smoother pathway to decarbonising homes'*,<sup>1</sup> the approximately 5 million homes connected to the gas network of the existing 11 million households in Australia will need to switch their home heating and cooking from gas to electricity within ~25 years. At the same time, 15 million passenger vehicles will need to be 'swapped' for electric vehicles with the necessary infrastructure in place to support them.

This change will involve higher upfront costs but will deliver substantial cost savings over the long term, as is shown in the chart below. The 'average' fossil-fuelled household would spend \$2,250 more in 2030 per annum than an efficient all-electric home. The savings would be substantially greater (a further \$1,250) for a home with rooftop solar and a battery.



**Figure 1: Total household energy spending in select years – an average fossil fuelled home compared with an efficient all-electric home (Energy Consumers Australia, 2023).**

*Note: projected savings are higher for households with rooftop solar and a battery.*

Fuel switching from gas and oil to direct electricity is more energy efficient and will ultimately result in lower consumer costs and greater energy productivity across the economy. And with high and volatile gas and oil prices currently being experienced – and the expectation that Australia's east coast gas prices will remain elevated over the long term<sup>2</sup>– there is no reason for delay.

#### Long-term employment opportunities

The workforce development impacts of the energy transition are substantial. Almost two thirds of jobs are blue-collar and most of these require vocational education and training, which includes electricians, electronics and telecommunications trades workers, construction workers and labourers. One third of jobs will require a tertiary degree and include professional occupations such as electrical and civil engineers, project managers and administrators. The 2022 Clean Energy Council report *Skilling the Energy Transition* provides an overview of the existing and worsening skills shortages experienced by the clean energy sector. Core roles in shortage include electricians and engineers. These shortages are due to a range of factors:

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<sup>1</sup> Energy Consumers Australia, *Stepping Up: A smoother pathway to decarbonising homes* (August 2023), URL: <https://energyconsumersaustralia.com.au/wp-content/uploads/Stepping-Up-Report-Final.pdf>

<sup>2</sup> Reserve Bank of Australia, *Bulletin: Understanding the East Coast Gas Market*, (March 2021) URL: <https://www.rba.gov.au/publications/bulletin/2021/mar/understanding-the-east-coast-gas-market.html#fn1>

- **Visibility** – jobs in clean energy jobs and pathways to work in the industry are poorly understood, with most workers side-stepping from other industries. Consequently, the industry has low participation of workers under 30.
- **Location** – the regional location of most jobs is a major impediment to attracting qualified graduates, who are typically attracted to metropolitan areas.
- **Training** – the clean energy industry is already experiencing a critical lack of training capacity, notably in electrical trainers. A slow and unwieldy VET system has been a brake on the development of relevant and meaningful qualifications for electrical and mechanical tradespeople in renewable energy. Australia's enduring STEM (science, technology, engineering, mathematics) crisis threatens clean energy project developments, which rely heavily on STEM-based skills.
- **Mobility** – workers currently face barriers to mobility between projects. There are opportunities to increase worker mobility, such as harmonising the required qualifications and training, and enabling the portability of long service leave and parental leave entitlements.
- **Entitlements** – long-standing policy uncertainty and tight operating margins have meant that the clean energy sector has struggled to compete with more established (and subsidised) sectors on salaries and entitlements such as oil and gas.<sup>3</sup>

The Australian Government should develop a Workforce Strategy that encompasses all priority industries that the Government will actively seek to grow during the energy transition. This should include an expanded role for domestic manufacturing and the critical minerals industry. Sectoral plans developed in isolation create unnecessary competition between growing industries for a limited supply of workers. This risk is particularly acute for common skills in the construction and installation industry. Clean energy would also struggle to compete on salaries and entitlements with high-wage extractive industries such as critical minerals. Holistic planning also delivers clear government signals on energy and workforce policy, creating a stable environment for investment and long-term workforce planning.

#### *Tertiary education provision*

On the university side, the issues are both quantitative – concerning the number of graduates from relevant disciplines – and qualitative – relating to the misalignment of course content with the needs of industry. Australia is experiencing an enduring STEM crisis. Australia's proportion of engineering graduates is just 8.2%, which is the lowest in the OECD, compared with Germany at 24.2%<sup>4</sup>. As a result, there is a dependency on skilled migration to meet demand, with over half of all engineers working in Australia being born overseas<sup>5</sup>. The enduring effects of the COVID-19 pandemic on skilled migration can be seen in the 2022 Skills Priority List, which identified national shortages of all engineering occupations, with moderate to strong anticipated future demand<sup>6</sup>. Finally, the Job-Ready Graduates Program in 2020 reduced funding for units in STEM, which disincentivises universities from offering robust STEM programs.

#### *Regional attraction of skilled workers*

It is important to invest in resources to help regional communities understand what jobs are available, and the pathways open to working in the clean energy industry. The Clean Energy Council is working with the Energy Efficiency Council and industry partners to deliver a Careers for Net Zero Fair, a one-day exhibition and conference to showcase jobs needed in net zero future. This exhibition is being paired with a major advertising campaign to promote the top jobs to prospective employees.

Whilst the industry is responding to the need to attract skilled workers to the clean energy industry, the Federal Government should work on identifying key opportunities for regional growth, as well as capacity analysis to understand regional capacity shortfalls. Attracting workers with families to regional parts of Australia may require additional investments in social infrastructure, including education, health, transport, and housing.

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<sup>3</sup> Clean Energy Council. (2022). *Skilling the Energy Transition*. URL: [https://assets.cleanenergycouncil.org.au/documents/CEC\\_Skilling-the-Energy-Transition-2022.pdf](https://assets.cleanenergycouncil.org.au/documents/CEC_Skilling-the-Energy-Transition-2022.pdf)

<sup>4</sup> Clean Energy Council. (2022). *Skilling the Energy Transition*. URL: [https://assets.cleanenergycouncil.org.au/documents/CEC\\_Skilling-the-Energy-Transition-2022.pdf](https://assets.cleanenergycouncil.org.au/documents/CEC_Skilling-the-Energy-Transition-2022.pdf)

<sup>5</sup> Engineers Australia. (2020). *Migrant engineers – research and resources*. URL: <https://www.engineersaustralia.org.au/news-and-media/2022/07/migrant-engineers-research-and-resources>

<sup>6</sup> Australian Government, *Skills Priority List (2022)* URL: <https://www.nationalskillscommission.gov.au/topics/skills-priority-list>

*Recommendation: The Federal Government should lead harmonisation efforts around training and standards between jurisdictions.*

### **The scaling up of domestic capacity**

CER will play a major role in achieving Australia's decarbonisation ambitions, especially in moving towards our targets in the immediate future and during the current period where we work towards unlocking investment in large scale renewable projects. AEMO's latest ISP forecasts that by 2032, over half of the homes in the NEM are likely to have rooftop PV systems, rising to 65 per cent with 69 GW capacity by 2050.<sup>7</sup> This will make rooftop PV the largest source of electricity generation in the NEM. The integration and management of that level of distributed generation is forecast to require almost 30GW of distributed storage and flexible demand. The AEMO advises that these findings assume that the investment made in distribution systems will be coordinated with CER expansion for efficient operation and export. The Distributed Energy Resources Implementation Plan is seen as the primary means of ensuring this essential integration and management of CER occurs in a timely and efficient fashion.

Whilst the Energy Security Board (ESB) has done some great work coordinating a policy response to the evolving industry through the DER Implementation Plan, given its transition to the Energy Advisory Panel (EAP), it is critical that Energy Ministers do not lose sight of the requirement for continuing national co-ordination of the numerous workstreams in the DER Implementation Plan. The CEC has sent requests to Federal and State Ministers to make the DER Implementation Plan a standing item on the ECMC Meetings.

*Recommendation: The Federal Government make the DER Implementation Plan a standing item on the ECMC Meetings.*

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## **Macro-barriers to increasing the uptake of home electrification**

### **Reliance on gas**

Although electric appliances will be cheaper than gas in the long run, the upfront costs of buying and installing them are still high for many consumers. As is explored throughout this submission, monetary incentives and rebates are still required to encourage CER uptake and abandon gas. Of these incentives is the need for rebates to help cover the heavy costs of disconnecting houses from gas. Currently, the upfront costs of disconnecting from gas are currently acting as a barrier to households wanting to reduce their energy costs and emissions. As such, rebates for consumers to disconnect and also rebates focused on plumbers is needed to cover the cost of capping gas to an appliance and running in wiring.

*Recommendation: New gas connections for new homes and light commercial businesses (e.g., retail, offices) should be immediately banned across Australia*

Given that there is no prospect that hydrogen or biomethane will be an efficient or scalable solution for distributed gas networks. It therefore makes no sense to continue to expand a network that cannot deliver net zero emissions. These gases may however make an important contribution in the industrial sector as chemical feedstocks or for 'hard-to-electrify' energy needs such as very high-temperature process heating.

The National Construction Code (NCC)<sup>8</sup> should be utilised further to promote electrification through mandatory requirements of adopting certain design features and installing electric appliances. A joint report by the Green Building Council of Australia and the Property Council of Australia recommends a variety of changes to current and emerging standards of new and existing buildings (residential and commercial) to improve energy performance for Australians

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<sup>7</sup> AEMO, 2022 *Integrated System Plan* (June 2022) Part B: ISP Development Opportunities, page 39, URL: <https://aemo.com.au/-/media/files/major-publications/isp/2022/2022-documents/2022-integrated-system-plan-isp.pdf?la=en>

<sup>8</sup> *The National Construction Code is Australia's primary set of technical design and construction provisions for buildings. As a performance-based code, it sets the minimum required level for the safety, health, amenity, accessibility and sustainability of certain buildings.*

equitably.<sup>9</sup> Among these recommendations, the report recommends implementing a national rating scheme for the energy performance of homes to facilitate disclosure of performance in residential buildings to owners, buyers and renters.<sup>10</sup> As the Senate is well aware, the Nationwide House Energy Rating Scheme (NatHERS) provides energy ratings for new dwellings based on hundreds of factors such as the home's construction, natural climate and house orientation.<sup>11</sup> The CEC commends the recent amendments made to require a 7-star NatHERS rating for new builds. The CEC encourages the Federal Government to extend NatHERS to include existing homes in the energy efficiency ratings insofar as the current energy rating is disclosed to owners/renters/buyers, and suggests including an estimated energy cost per annum is also calculated. Not only will this empower buyers and renters when looking for energy efficient properties, but it will also empower owners of properties to make appropriate changes. Having a 7-star NatHERS rating mandated on new builds nationwide and requiring disclosure of existing homes' energy performances, will not only simplify the comparison of home efficiency, but it would also establish a market for energy efficient homes, all while enhancing consumer protection for both buyers and tenants.

*Recommendation: Implement the recent changes to mandate 7-star NatHERS rating as soon as possible, require disclosure of existing homes' energy efficiency rating to buyers and tenants, and mandate solar PV systems for new residential builds, whilst also looking at opportunities to mandate home storage where it provides benefits.*

### **Workforce**

As is advised above, skill shortages in the relevant industries are a barrier to the implementation and maintenance of CER. Increased investment will also be required in workforce attraction and development for electricians, plumbers and other related occupations to ensure that we can mobilise the skilled workers we need to support Australians in this major transition.

*Recommendation: Work with states and territories to invest in workforce attraction and development.*

### **National consistency key to the transition**

Having such varied approaches to integration of CER across the NEM results in problems and challenges for the industry that could be avoided. As Australia is a relatively small market, national consistency is a key criterion in keeping industry implementation and on-going management costs as low as possible.

National consistency is not only key to encouraging businesses to supply Australia with products, it is essential for increasing the pace of CER uptake Australia-wide. An improved national governance structure will help to ensure ongoing compliance issues continuously raised by industry and market bodies are prevented or managed better in the future. Given the importance of compliance in installing CER, plus the likely increasing need for cybersecurity compliance, a new body to oversee CER technical standards will be the most appropriate and cost-effective approach to assign roles and responsibilities and co-ordinate compliance across the industry.

Currently there is no coordinated or central approach to developing new CER technical requirements and industry has little engagement in the development of CER technical requirements. Current organisations, such as DNSPs, Clean Energy Regulator, State Electrical Safety Regulators, the Australian Energy Regulator or the Clean Energy Council accreditation processes, capture various aspects of technical standards or compliance but there is no central co-ordinating body to provide governance and co-ordination oversight across these various market bodies. While DNSPs do have recourse through the connection agreement to manage non-compliant connections, they are focused on arrangements within their own service areas only and may not be seen as being sufficiently independent or the most appropriate to coordinate a national response.

*Recommendation: The Federal Government advocate for and facilitate the establishment of a National CER Technical Standards Body.*

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<sup>9</sup> Green Building Council Australia & Property Council of Australia, *Every Building Counts* (2023), URL: <https://everybuildingcounts.com.au/wp-content/uploads/sites/37/2023/04/Every-Building-Counts-2023-Edition.pdf>

<sup>10</sup> Green Building Council Australia & Property Council of Australia, *Every Building Counts* (2023), Recommendations 7.1-7.3, pages 59-61, URL: <https://everybuildingcounts.com.au/wp-content/uploads/sites/37/2023/04/Every-Building-Counts-2023-Edition.pdf>

<sup>11</sup> [Nationwide House Energy Rating Scheme \(NatHERS\)](#)

The current status of CER technical standards regulation is not satisfactory and is neither serving the industry nor consumers. It is clear that a national technical regulatory framework for CER is needed. A structure is required that supports industry to innovate and unlock CER revenue streams for consumers, acknowledge consumers are the investors and owners of these devices, and therefore should have control over the functionality of the devices as well as being rewarded for consenting that their devices provide grid support services.

A National CER Technical Standards Body would have a coordinating and facilitation role, rather than a compliance role, providing strategic oversight of the development of technical standards for CER; aid in developing an appropriate model for testing and certification capabilities to service the Australian market and oversee the development and maintenance of it; and ensure for nationally consistent application and interpretation of standards and key technical approaches (e.g., flexible exports/imports, minimum demand management).

The AEMC in its final report into consumer energy resources technical standards, found that a National Technical Standards body can generate over \$500m in compliance costs savings.<sup>12</sup> The AEMC also undertook a preliminary assessment of four potential options in establishing a national standards body. It is critical the Energy and Climate Change Ministerial Council pick up the establishment of a National technical Standards body as a priority.

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## Optimal timeline for household electrification accounting for the likely timing of decarbonising electricity

The first action by governments must be to communicate end dates for the sale of combustion-based household vehicles and appliances. These timeframes should be set as soon as possible in alignment with achieving Australia's goal of net zero emissions by 2050, while allowing ample time for markets and consumers to plan and adjust.

Next, governments should provide incentives for early movers, and assist low-income households to be among them, ensuring that wherever appliances are replaced, consumers are strongly incentivised to select a more efficient electric appliance or vehicle. Priority should be given to supporting low-income households to be among the early movers.. All electric appliances (e.g., heat pumps; electric vehicles) are typically more expensive than their fossil fuel equivalents, and as such, governments should seek to close the cost gap. This could be delivered through a variety of methods from movers to tax write offs, though we note that the objective should be to make the process as simple as possible. These incentives can complement access to low-cost finance via the Clean Energy Finance Corporation, which the Government announced in its Budget earlier this year.

Finally, governments should ultimately use regulation to enforce broad-based change, by outlawing the sale of less efficient appliances and vehicles through tightening efficiency standards, including the promised fuel-efficiency standard for vehicles. Throughout this change, strong communication and public information campaigns will be required to ensure that all consumers are aware of the direction of travel and Australians do not wind up investing in new equipment which will not only cost them more to run, but may also have a limited lifespan. This should also include an educational piece to consumers on hot water appliances, something that is not yet understood or used to their full potential by industry and consumers, often resulting in a missed opportunity for consumers hoping to change to a more efficient hot water system.

*Recommendation: Set a national rooftop solar target, and distributed energy storage and flexible energy target for 2030 and 2040, reflecting the Integrated System Plan's Step Change scenario.*

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<sup>12</sup> AEMC, *Final Report: Benefits of CER Compliance CER Technical Standards* (23 August 2023), URL: <https://www.aemc.gov.au/sites/default/files/2023-09/Oakley%20Greenwood%20economic%20assessment.pdf>

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## Impacts of household electrification on reducing household energy spending

The economic prospects for both residential and commercial photovoltaic (PV) systems are highly favourable in Australia, the combination of Australia's high electricity prices, affordable PV systems and abundant renewable resources results in a typical payback period of 3 to 5 years.<sup>13</sup>

*Recommendation: Work with states and territories to invest strongly in clear and sustained public information campaigns to support consumer awareness of the electrification transition.*

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## Solutions to the economic barriers to electrification for low-income households

Due to the risks of low-income households becoming exposed to, and stranded on, an increasingly expensive gas network over time, the CEC recommends that Governments prioritise support for these households to move off the gas network in the next decade. The earlier this shift occurs, the better, noting that gas prices are likely to remain elevated for a number of years.<sup>14</sup>

Introducing schemes to support renters and low-income households move off gas and access solar PV may include tax incentives and interest free loans for solar installations. For example, introducing tax incentives for rental providers that implement CER, coupled with interest free loans that the tenant pays back in increments parallel, and separate to, their rent using the money saved on electricity bills. The loan repayments could be transferrable between tenants. A further measure to support lower-income households, and as recommended by the Grattan Institute in its recent 'Getting off gas' report, Government should also consider introducing a tax-write off for landlords who opt to replace broken gas-based appliances with efficient electric ones.

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## Effectiveness of existing Australian Federal, state and local government initiatives

Consumer uptake of rooftop solar has been built off the back of a very successful Small-scale Renewable Energy Scheme (SRES) program. Not only has the SRES help reduce the upfront costs associated with the purchase of rooftop solar, but it has also built a very strong compliance program. Running in parallel to the policy reform agenda in developing new market opportunities there also has to be a continued focus on maintaining and building a compliance culture established by the SRES program. It is critical that successful policy settings like SRES continue to underpin the rapid uptake of rooftop solar and storage to deliver on Australia's climate goals and encourage household electrification.

The CEC is proud of the role it has played in building robust installer and product accreditation programs. These programs have raised rooftop installer standards and also ensured solar products conform to necessary safety and functional requirements. Supported by voluntary codes of conduct, initially the Solar Retailer Code of Conduct that has recently been superseded by the New Energy Technology Code of Conduct, the CEC has provided a framework for consumers to have confidence in purchasing rooftop solar and having it installed safely. This must continue to encourage and support the uptake of CER.

Consumer confidence in the industry is crucial. It has built a social licence and community acceptance of the positive financial benefit to energy bills that the uptake of rooftop solar has had. It is positive that we are exploring policy options to create these incentives. However, it is important that we do not lose sight of the value of a strong compliance culture that we have built over the last 15 years through the installer and product accreditation programs.

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<sup>13</sup> International Energy Agency, Photovoltaic Power Systems Programme, *Annual Report 2022*, page 42, URL: [https://iea-pvps.org/wp-content/uploads/2023/04/PVPS\\_Annual\\_Report\\_2022\\_v7-1.pdf](https://iea-pvps.org/wp-content/uploads/2023/04/PVPS_Annual_Report_2022_v7-1.pdf)

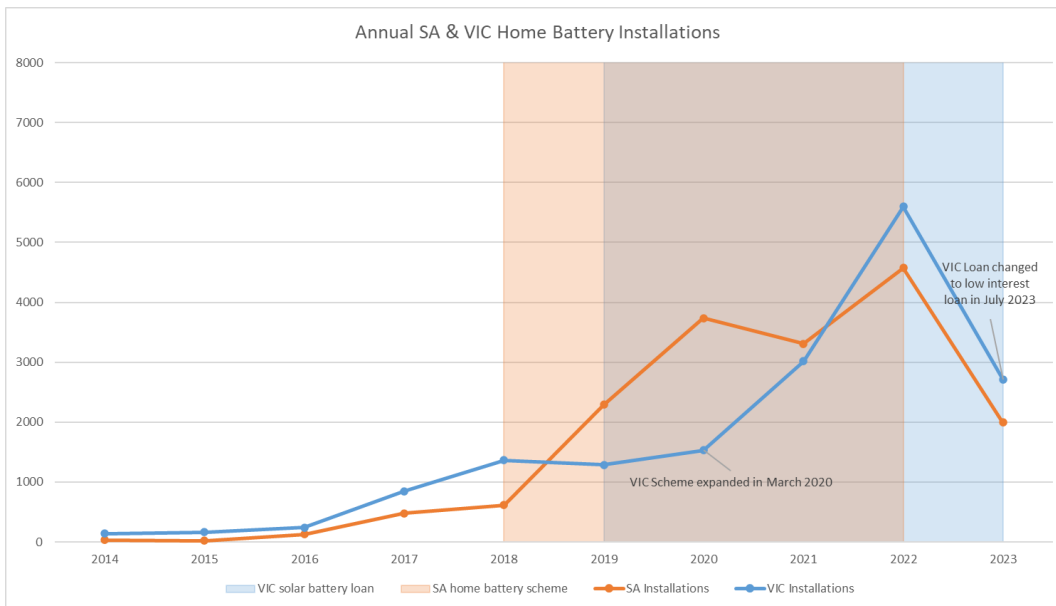
<sup>14</sup> Reserve Bank of Australia, *Statement on Monetary Policy – May 2023*, URL: <https://www.rba.gov.au/publications/smp/2023/may/economic-outlook.html>



This compliance culture is even more important as we move to a world where consumers are turning their passive rooftop solar generation into active and flexible energy that has both value to the individual consumer and the wider system through the use of storage.

We know that the SRES works. Along with the Renewable Energy Target, no policy has delivered as much abatement, given as much certainty and unlocked as much investment as the SRES.

Furthermore, including home batteries in the SRES would mean that nationwide home battery uptake could continue to grow. Household batteries have become increasingly popular in Australian homes. While the cost of household batteries continues to fall, the upfront cost of systems remains a barrier for most Australians. As is shown in figure 2 below, the recently concluded battery schemes in South Australia and Victoria had a noticeable impact on the uptake of home batteries in those states. Given storage is more important than ever to ensure grid stability and maintain power backup systems, encouraging residential uptake is essential and monetary incentives are proven to work. To support nationwide uptake, home batteries should be included as an eligible technology to earn Small-scale Technology Certificates (STCs) through the SRES.



**Figure 2: Annual South Australian and Victorian home battery installations**

*Recommendation: Explore the extension and expansion of the Small-scale Renewable Energy Scheme (SRES) to support distributed battery installation uptake, which will enable Australia to better exploit the immense value of rooftop solar, and support a more flexible and resilient system.*

These policy approaches could be introduced quickly, and there is reason to believe the costs associated would be far outweighed by the benefits. Albeit more work needs to be done to explore what an expanded SRES might look like, we believe it shows some real promise as a way to support the transition.

## Australia's current standing against international standards

Despite having a smaller population than many countries and an even smaller population density, Australia continues to be a world leader in rooftop solar PV installations. Whilst Australia ranked 9<sup>th</sup> in the global rankings of total added solar PV capacity in 2022 and 6<sup>th</sup> on total cumulative capacity, it still remains the country with the highest solar PV installed *per capita* of any country in the world.<sup>15</sup> Additionally, Australia is ranked 5<sup>th</sup> highest in PV penetration.<sup>16</sup>

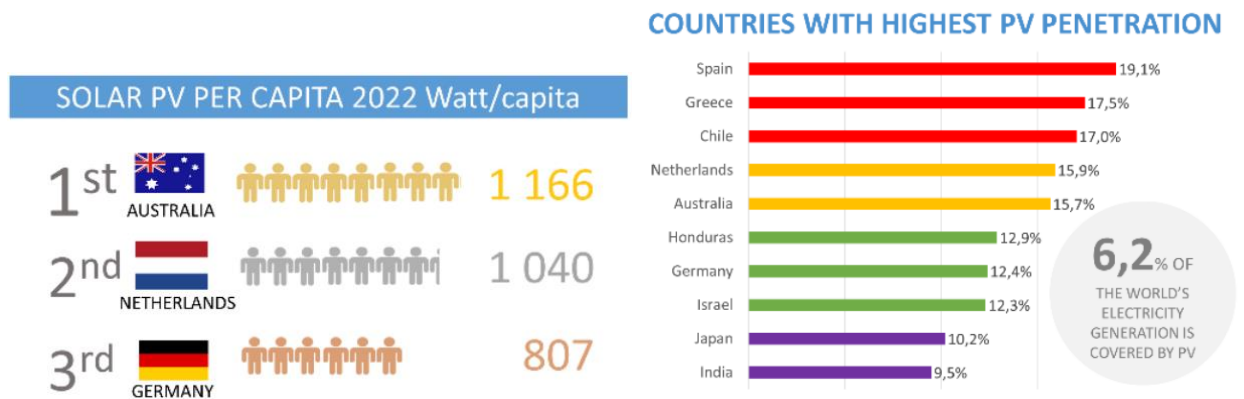


Figure 3 & 4: Solar PV per capita and Countries with highest PV Penetration in 2022<sup>17</sup>

**TABLE 1: TOP 10 COUNTRIES FOR INSTALLATIONS AND TOTAL INSTALLED CAPACITY IN 2022**

FOR ANNUAL INSTALLED CAPACITY				FOR CUMULATIVE CAPACITY			
1		China	106 GW	1		China	414,5 GW
(2)		European Union	38,7 GW	(2)		European Union	209,3 GW
2		USA	18,6 GW	2		USA	141,6 GW
3		India	18,1 GW	3		Japan	84,9 GW
4		Brazil	9,9 GW	4		India	79,1 GW
5		Spain	8,1 GW	5		Germany	67,2 GW
6		Germany	7,5 GW	6		Australia	30 GW
7		Japan	6,5 GW	7		Spain	26,6 GW
8		Poland	4,9 GW	8		Italy	25 GW
9		Australia	3,9 GW	9		Korea	24,8 GW
10		Netherlands	3,9 GW	10		Brazil	23,6 GW

Note: The European Union grouped 27 European countries in 2022, out of which Germany, Spain, France, the Netherlands and Italy also appear in the Top Ten, either for the installed capacity or the annual installations. The European Commission is a member of IEA-PVPS through its Joint Research Centre (EU-JRC).

Source: IEA PVPS

Figure 5: Top 10 countries for installations and total installed capacity in 2021<sup>18</sup>

<sup>15</sup> International Energy Agency, Photovoltaic Power Systems Programme, *Snapshot 2023*, page 5, URL: [https://iea-pvps.org/wp-content/uploads/2023/04/IEA\\_PVPS\\_Snapshot\\_2023.pdf](https://iea-pvps.org/wp-content/uploads/2023/04/IEA_PVPS_Snapshot_2023.pdf)

<sup>16</sup> International Energy Agency, Photovoltaic Power Systems Programme, *Snapshot 2023*, page 5, URL: [https://iea-pvps.org/wp-content/uploads/2023/04/IEA\\_PVPS\\_Snapshot\\_2023.pdf](https://iea-pvps.org/wp-content/uploads/2023/04/IEA_PVPS_Snapshot_2023.pdf)

<sup>17</sup> International Energy Agency, Photovoltaic Power Systems Programme, *Snapshot 2023*, page 5, URL: [https://iea-pvps.org/wp-content/uploads/2023/04/IEA\\_PVPS\\_Snapshot\\_2023.pdf](https://iea-pvps.org/wp-content/uploads/2023/04/IEA_PVPS_Snapshot_2023.pdf)

<sup>18</sup> International Energy Agency, Photovoltaic Power Systems Programme, *Snapshot 2023*, page 8, URL: [https://iea-pvps.org/wp-content/uploads/2023/04/IEA\\_PVPS\\_Snapshot\\_2023.pdf](https://iea-pvps.org/wp-content/uploads/2023/04/IEA_PVPS_Snapshot_2023.pdf)