Submission in response to:
National Energy Performance Strategy: Consultation Paper

Date of submission: 3 February 2023
Submitted by email to: < EnergyPerformance@dcceew.gov.au>

Submission by:

Brad Riley at the Australian National University's Centre for Aboriginal Economic Policy Research
https://researchers.anu.edu.au/researchers/riley-b

Dr Lee White at the Australian National University's School of Regulation and Global Governance
https://researchers.anu.edu.au/researchers/white-lx

Dr Thomas Longden at the Australian National University's Crawford School of Public Policy
https://researchprofiles.anu.edu.au/en/persons/thomas-longden

Sally Wilson at the Australian National University's Crawford School of Public Policy and School of Regulation and Global Governance https://regnet.anu.edu.au/our-people/academic/sally-wilson

Dr Simon Quilty at the Australian National University's Research School of Population Health
https://nceph.anu.edu.au/people/students/simon-quilty

Michael Klerck, Social Policy and Research Manager at Tangentyere Council; University of Newcastle
https://researchers.uon.edu.au/researchers/klerck-m

Vanessa Napaltjari Davis, Senior Aboriginal Researcher at Tangentyere Research Hub; Tangentyere Council https://tangentyere/researchers/davis-vn

Norman Frank Jupurrurla, Julalikari Council Aboriginal Corporation, Tennant Creek NT
https://julalikari.org.au

*White, Riley and Longden work on the ANU's **Grand Challenge: Zero Carbon Energy for the Asia-Pacific.***

Introduction

Thank you for the opportunity to provide a submission in response to the Department of Climate Change, Energy, the Environment and Water's (**DCCEEW**) National Energy Performance Strategy (**NEPS**) Consultation Paper dated 10 November 2022. We commend DCCEEW on the consultation outline for a new National Energy Performance Strategy as both important and timely. We are an interdisciplinary research team from the Australian National University (**ANU**) and Tangentyere Research Hub in Alice Springs, whose research focuses on energy insecurity and related issues in the energy transition. Here our submission is focused on those questions that relate to areas of (a) energy governance and (b) residential electricity customers, as identified in the Consultation Paper.

In summary, we support an inclusive and well-resourced National Energy Performance Strategy, that seeks to:

- Reduce emissions in line with 1.5º
- Reduce poverty and inequality through reducing household energy insecurity
- Ensure healthy homes for a changing climate through evidence-based standards and energy efficiency, electrification and support for distributed energy resources
- Decarbonisation of Australia's industrial sectors
- Resource a rapid and inclusive transition to electromobility.

We also want to highlight that an inclusive, people-centred, and place-based National Energy Performance Strategy will necessarily support Aboriginal and Torres Strait Islander leadership and participation in the energy transition, in accordance with (at minimum) the United Nations Sustainable Development Goals (**SDGs**), the United Nations Declaration of the Rights of Indigenous Peoples (**UNDRIP**) and be based on the principle of Free, Prior and Informed Consent (**FPIC**).

1. Energy governance

How can demand considerations be better integrated into Australian energy governance and what are the priorities for change?

The recent well-articulated vision of Australia's potential transition to a green energy superpower has been successful in mobilising incentives and policymaking focused on energy supply side considerations, justifiably premised on Australia's diverse wealth of renewable energy resources (Jotzo 2022; Hannam 2022; Geoscience Australia 2022). Yet in practice, many Australian households, communities, businesses (and governments) remain exposed to unpredictability, insecurity and uncertainty in meeting essential energy needs, due to high prices and manifest in lost opportunities (St Vincent de Paul 2019; QCOSS 2014; Longden et al. 2021; Vivoda 2022). This is partly because energy policy is multi-dimensional, it requires managing supply and demand across Commonwealth and state and territory governments, local government authorities, and private and public utilities, which operate across a variety of national and sub-national legislation, regulations and consumer protections and operate at the margins of international markets.

Given these challenges, it is critical that supply side interests and a supply-centric vision are met by an equally compelling demand side narrative - premised upon and mobilized by the promise of energy secure homes, communities and industries all operating on known parameters grounded in metrics matched and leveraged to locally abundant renewable energy resources. Improving energy efficiency is a highly cost-effective alternative to increasing energy availability. Yet demand side voices are often quiet, excluded or absent in policymaking, and a strong national energy performance champion is needed to drive change. Demand considerations in energy governance should be based on achieving net-zero emissions by 2050, reducing poverty and inequality through reducing household energy insecurity, ensuring healthy homes for a changing climate through improved building standards and energy efficiency and distributed energy resources, support for decarbonizing our industrial sectors, and resourcing for a rapid and inclusive transition to fossil-fuel free transport across society.

What new or modified coordination mechanisms or institutional responsibilities would be appropriate to better drive energy performance action in the future?

Energy efficiency and demand management rewards action through lower consumer costs, reduced costly and polluting imported fuels, and reduced emissions over time (Lazowski, Parker, and Rowlands 2018; Clarke 2022). Australia needs to act quickly on energy efficiency and in ways that build on our natural advantages and leverage our recent successes. While there are a number of committed and credible advocacy groups and standards agencies committed to improving energy performance, there is currently no person or body responsible for driving, co-ordinating and measuring our national energy performance - no single entity or authority is yet accountable for identifying and setting priorities, for engaging with communities and businesses, for prioritizing research, setting targets and incentivizing (through finance and demonstration) necessary structural and behavioural adaptations to achieve the desired change. Nor is any organisation answerable for monitoring and enforcing metrics in relation to national and sub-national targets and communicating and celebrating our progress toward necessary demand side aims among the broader public.

It is therefore unsurprising that Australia punches below its weight across several critical energy performance metrics. Out of the top 25 countries for overall energy consumption Australia ranks 18th for efficiency i.e., amount of unnecessary wasted energy, lagging developing economies including Mexico, Turkey, India and Indonesia (Energy Efficiency Council 2018). A responsible entity might usefully co-ordinate, implement and report upon progress (for example an Australian Demand, Energy Efficiency Agency or ADEEFA) – operating as a demand side counterpart to variously challenge, co-operate and complement existing energy governance bodies (often focused on supply innovation). The remit of any responsible authority should be to advocate for, encourage, promote, support, measure, monitor and communicate the value of energy efficiency and energy conservation measures, across jurisdictions and sectors, and to pool and disseminate demand side knowledge in order to amplify and build upon Australia's energy performance successes.

Would an energy efficiency target or targets be suitable for Australia?

Yes, an Australian energy efficiency target, with subsidiary sub-national and sectoral targets, would be suitable for Australia. A "target drives action towards improved efficiency by providing the basis and motivation for a government to establish energy efficiency policies and programmes" (IEA 2022). In much the same way that ambitious policy settings in relation to supply side energy initiatives have mobilized and motivated partners and finance (for example, national and sub-national Hydrogen strategies) - setting targets are a proven means of signalling intent and flagging a credible pathway to change (DCCEEW 2022). Targets can provide a minimum level of certainty (for investors, communities, governments and industrial partners and civil society broadly) through making transparent the proposed or desired trajectory of change. An energy efficiency and energy performance target would likely similarly enable parties to forecast by providing metrics and timeframes upon which to reasonably mobilize and allocate finances and action, foreseeably measured and reported on a national or sectoral energy performance scorecard.

What is the most appropriate methodology for designing and implementing a target that effectively drives demand side action towards Australia's overall net zero target? How should progress towards an energy efficiency target be measured?

Ideally a target should be ambitious, realistic and resourced appropriately for the task. It is critical to note that the choice of what and how to measure energy performance will shape the subsequent design of policies, thus defining measurement is a key methodological aspect of evidence-based target-setting. We support a range of national and sectoral targets, first and foremost based on our known required commitments to emissions reductions goals as part of our National Determined Contributions (NDCs), with the aim of limiting global warming to 1.5ºC. While targets in other jurisdictions often start with quantitative frameworks such as kWh/m2/year, targets should also be designed in ways that capture services derived from energy in addition to absolute energy use. There is work being done internationally on diverse metrics that include measures of energy and retrofit poverty, energy insecurity and other factors such as wellbeing indexes which can complement purely quantitative metrics (Tong et al. 2021).

It is critical that targets fit together, linking with and complementing other national and sub-national plans and aims (for example the ISP, state and territory renewable targets, hydrogen strategies etc.). A first step may be to undertake quantitative analyses and modelling as to where the early opportunities lie across jurisdictions, sectors and domains, engage bodies already working in this space and review extant policy and metrics. The decision to set a target is likely to be a stepwise and dynamic process based on identifying and reviewing relevant policy and data, subsequent broad consultation and engagement, quantitative analysis and modelling followed by implementation, iteration and monitoring, evaluation and reporting (IEA 2022). The IEA outlines several categories of energy efficiency targets as potentially being applicable depending on available data, knowledge and expertise.

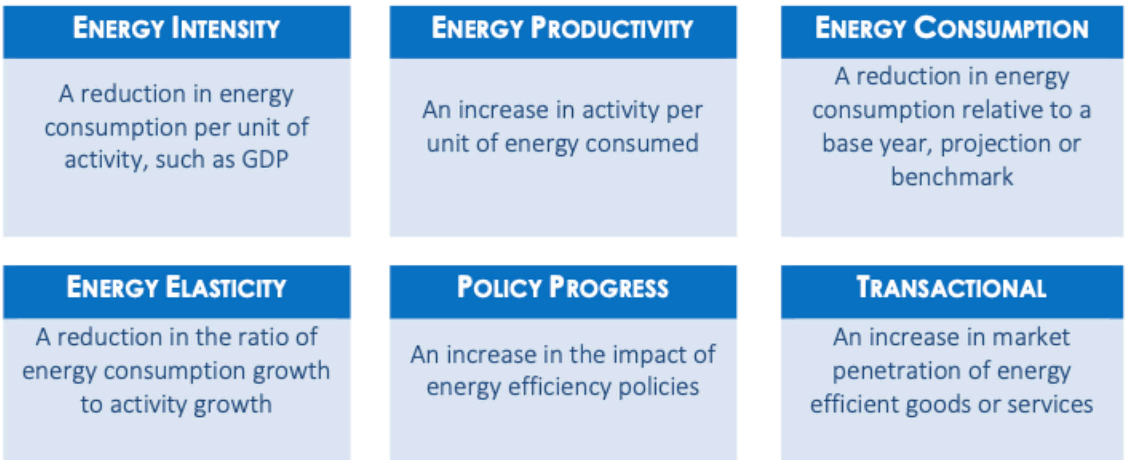


Figure 1: Categories of targets (IEA 2022)

3.1 General

What are the key opportunities to improve the energy performance of new and existing residential buildings? What opportunities are there to improve or streamline existing policies aimed at empowering consumers to undertake energy performance improvements in their homes?

Residential buildings are responsible for approximately 24% of overall electricity use and 12% of total carbon emissions in Australia (AG 2022). There are numerous practical opportunities to improve the energy performance of new and existing residential buildings. Energy demand, consumption and overall performance of the building are linked. Therefore, reducing demand and/or improving performance requires high performing design; installation of energy-efficient facilities and services that demand as little energy as possible to perform necessary functions, and the use of renewable energy, all proven paths to improving energy performance.

Many (most) existing residential buildings were built before energy building standards came into effect, resulting in poor energy performance, yet these shortcomings can generally be at least partially ameliorated via discrete (piecemeal) or more comprehensive whole of envelope structural and behavioural interventions. These variously include subsidized rooftop PV, draught proofing, ceiling and/or sub-floor insulation, high-efficiency heating and cooling appliances, double-glazing and window coverings. Replacing gas heaters with reverse cycle air-conditioning supports electrification of heating/cooling can all improve performance of existing buildings.

It is important to note that across both new and existing residential buildings, renters are often the cohort most likely to live in homes that fail to protect them from the heat and cold (Souza 2018a). Homeowners are more likely and more able to make improvements to the homes in which they reside, while landlords are less likely to improve residential energy efficiency than homeowners (Petrov and Ryan 2021). Subsequently, the most consequential national opportunity to improve existing policymaking in relation to energy performance for new and existing buildings, likely lies in reframing the national conversation away from housing as a tax-efficient investment vehicle and toward a narrative that measures and values housing as a fundamental prerequisite of health and wellbeing.

In this context, transforming landlord-tenant relations is a major driver in realizing systemic change in energy performance and residential energy efficiency over longer timeframes (Lang et al. 2021). Changes to the tax system can be optimized to efficiently reallocate support away from those landlords who own and refuse to improve inefficient rental properties, through limiting government support to only those landlords whose properties meet prescribed energy efficiency standards either via construction or through commitment to meaningful energy retrofits of existing stock. Along the same lines, regulation could be used to dissuade investment lending for those properties that fail to meet energy efficiency and performance objectives (see Lang et al. 2022).

What are the key financial and non-financial barriers to the uptake of energy performance improvement opportunities? How can these barriers be overcome?

The key financial and non-financial barriers to the uptake of energy performance improvement opportunities are often framed as being related to one of four barriers; financial, administrative, lack of knowledge or social barriers (see **Table 1**. from (Alam et al. 2019)). Alam et al (2019) provide a strategy to overcome barriers to energy performance improvement opportunities (e.g., subsidies, coordination schemes, minimum regulatory requirements perceived as fairer by rental owners etc.) as shown at **Figure 4.**

Types of barriers to uptake	
Financial barriers	Lack of access to capital Lack of priority Uncertainty of actual gains Split incentives
Administrative barriers	Government not a strong driver (not mandatory) Lack of interdisciplinary expertise and collaboration across sectors Multi-stakeholder issues

Types of barriers to uptake	
Knowledge barriers	Lack of information and awareness Lack of motivating factors Lack of relevant skills and knowledge
Social barriers	Interruption to building function and operation

Table 1. Types of barriers to uptake of energy performance, energy efficiency and demand management (Alam et al. 2019)

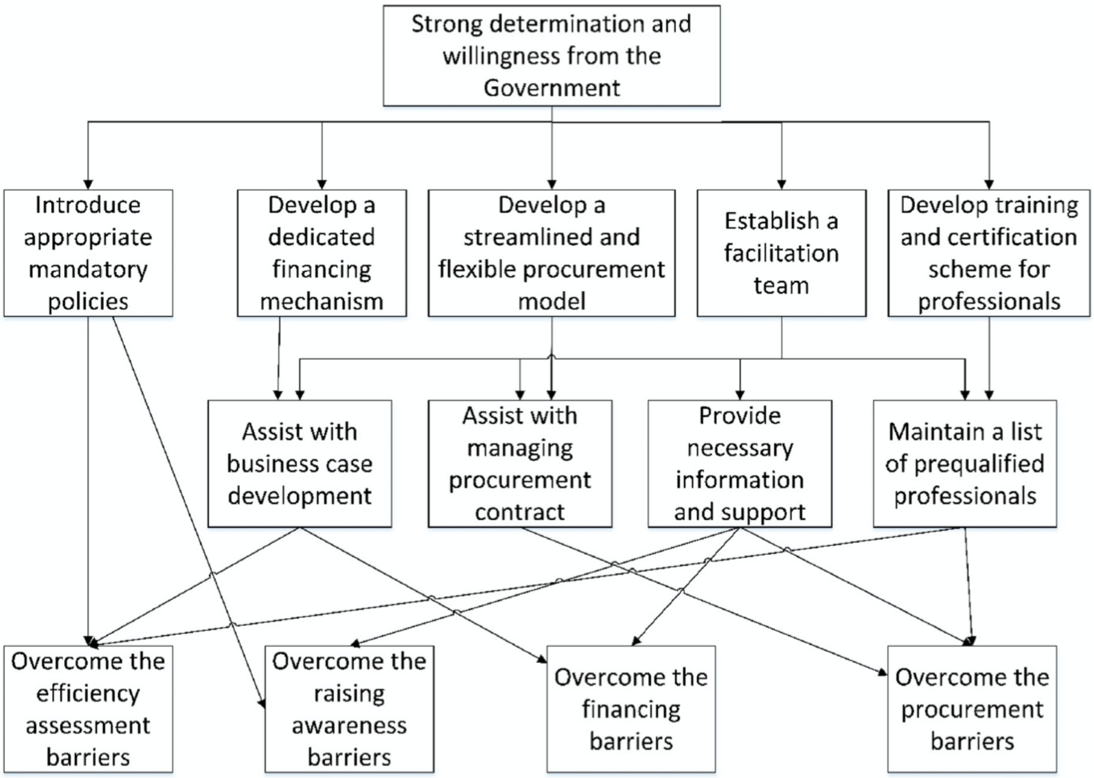


Figure 2: Strategy to overcome barriers to energy performance improvement opportunities (Alam et al. 2019)

How can demand management and electrification support lowering energy bills and emissions?

Demand management and electrification support lowering energy bills and emissions by creating novel ways to shift loads to those times of the day (month/year) when there is plenty of energy - optimising services rendered by available generation and minimizing the required build out. At the household level energy performance improvements include generating electricity onsite through use of distributed energy resources, improving the function of living spaces through draught proofing and double-glazing, improved insulation, and replacing fossil gas heaters with electric heating and cooling appliances. Scheduling the operation of facilities and appliances to when generation is at (solar, wind) maximum and potentially charging stationary and mobile storage (EV's) so as to later satisfy peak demand in the evening can lead to household savings.

For industrial sectors, increasingly, automation is providing opportunities for optimization during periods of abundance (of solar and wind) especially for users with large loads. Periods of abundance, and the low prices that attend these times, greatly improve the economics of operating electrolysers used to produce green hydrogen, which can be used in power and chemical processes for metal and the production of zero carbon derivatives. Demand management and electrification can bring benefits from accessing cheaper energy (at times) adding optionality and additionality in the process of decarbonisation.

How does poor energy performance impact on disadvantaged communities?

Low-income and racial/ethnic minorities are more likely to be living in inefficient housing (Reames 2016). Inefficient homes deliver a lesser amount of energy services (e.g., thermal comfort) for the same cost. However, these groups often lack resources to improve the buildings, and may be renters, so there is a need to provide support alongside targets. Research has shown that disclosure systems support transparency. Tenants will often pay more for more energy efficient and thermally comfortable properties. However, "it is also shown that the option of leaving the energy efficiency rating of a rental property unreported presents a moral hazard for landlords of sub-standard properties, in that the likelihood of rating disclosure increases in line with the number of energy-efficient features of a property, as revealed in the marketing material. Analysis reveals that socio-economically disadvantaged areas suffer from disproportionately higher levels of rating non-disclosure, potentially constituting a 'double disadvantage' of non-disclosure and low–energy efficiency dwelling stock. From a market and asset-pricing perspective, it thus seems preferable to extend the requirement to obtain and present a valid energy efficiency rating to the rental market" (Fuerst and Warren-Myers 2018). Upgrades of social and community housing is largely a matter for government funding. Without government resources, housing providers are unlikely to be able to afford upgrades, and tenants will very likely miss out.

3.2 Low-income households

What are the opportunities to improve the energy performance of residential buildings for low-income households?

Low-income households are more likely to live in energy inefficient homes and are more likely to have constrained ability to spend on mechanically heating and cooling their inefficient residence (Porto Valente, Morris, and Wilkinson 2022). This is because energy inefficient homes require greater inputs to achieve the same level of comfort or other service, a combination that doubly disadvantages low-income households in terms of having a home that meets their needs. Yet, low-income households are also both less likely and less able to request energy efficiency improvements than high-income neighbours (Lang et al. 2022a). Moreover, there is no measure or monitoring of retrofit poverty that might reasonably enforce improvements to the status-quo. Low-income tenants are therefore often left with few options to directly improve the energy performance of their home and they may be reticent to call attention to remedial options.

There is a surfeit of opportune ways in which to improve the energy performance of residential buildings for low-income households as mentioned above, including subsidized rooftop PV, draught proofing, ceiling and/or sub-floor insulation, high-efficiency heating and cooling, double-glazing and window coverings. Replacing gas heaters with reverse cycle air-conditioning supports electrification of heating/cooling and in addition to structural changes education and training can encourage behavioural change.

What are the financial and non-financial barriers to uptake of energy efficiency upgrades for low-income households, and what can be done to overcome them? What actions should be prioritised to assist low-income households to improve energy efficiency in their homes?

National data shows that low-income households spend more than 10 percent of their disposable income on electricity, compared to an average of 4 percent of spending for an average household (Saddler 2018). Reliance on air-conditioning for thermal comfort and safety results in higher energy costs. Improving household cooling (and heating in cool climates) to ensure houses are less reliant on air-conditioning is critical for the health and wellbeing of low-income households (Moore et al. 2017). Improving thermal envelopes of homes is a high priority for household health and wellbeing. As established internationally, including in New Zealand, houses that are cold and damp can exacerbate conditions such as asthma and lead to increased mortality rates; improving building energy efficiency can alleviate these adverse outcomes (O'Sullivan, Howden-Chapman, and Fougere 2015; 2011).

There is a corollary during extreme heat; mortality is increased during heatwaves and other circumstances where people are unable to cool down (Longden 2020). Many jurisdictions internationally are moving to prevent electricity disconnections during extreme heat and extreme cold to avoid known preventable adverse health outcomes (World Health Organization 2018; Barreca, Park, and Stainier 2022; Friedman 2022). This will become more essential as climate change increases the frequency and severity of these weather events (Jessel, Sawyer, and Hernández 2019). Therefore, a high priority is to improve aspects such as ceiling, floor, and wall insulation, adding double-glazing, and increasing efficiency of and electrifying all heating, cooking and cooling appliances.

Other critical appliances such as refrigerators and washing machines should also be targeted; these are critically important for the storage of medicine; for the maintenance of food security enabling healthy and affordable home cooking; and for the washing of people, children and bedding as critical to health.

> One member of our research team, Dr Thomas Longden was part of a research group working on the Sustainability Victoria Healthy Homes Program which provides one example of a scheme that could be expanded to assist many more low-income households. The Healthy Homes program facilitated holistic upgrades that included draught proofing, ceiling and/or sub-floor insulation, high-efficiency heating and cooling appliances and window coverings. In many cases it replaced gas heaters with reverse cycle air-conditioning in support of the electrification of heating/cooling, leading to lower emissions as the electricity grid decarbonises.
>
> For more please see: https://www.sustainability.vic.gov.au/research-data-and-insights/research/research-reports/the-victorian-healthy-homes-program-research-findingshttps://www.sustainability.vic.gov.au/research-data-and-insights/research/research-reports/the-victorian-healthy-homes-program-research-findings.

What delivery mechanisms would be most effective to provide targeted support?

For the proportion of households that own their homes, there are opportunities to provide financing for household upgrades. However, research has shown that even when financial supports such as subsidy programs are offered there may be low uptake (Miller et al. 2018; Hafner et al. 2019). Actions such as improving wall insulation and glazing standards can be perceived as time consuming, as can the process for application. In addition to providing support to overcome financial barriers, it is likely that informational and logistical barriers will also need to be tackled in efforts to improve energy performance (Havas et al. 2015; Hafner et al. 2019). Simply providing written information typically has low efficacy in prompting change. Programs tend to have greater success when information comes from a local source, such as a neighbour, a neighbourhood ambassador, or a neighbourhood group (de la Rue du Can et al. 2014).

Streamlining applications processes is one means of supporting greater uptake. Low-income households may be particularly likely to require short payback periods for any investment, which suggests that subsidies should cover substantial portions of the installation cost rather than expecting benefits to accrue via bill savings over 10-year periods or longer. Longer payback periods require low-income households remain tenants for longer terms. The immediate benefits of energy efficiency improvements for low-income households would likely be heavily weighted towards non-financial aspects such as improved wellbeing and comfort for the same energy costs in a household.

3.3 Renters

What are the opportunities to improve the energy performance of residential buildings for renters?

Renters often have very little ability to improve the energy efficiency of the buildings that they dwell in (Souza 2018a; 2018b; Lang et al. 2021). They may also face resource constraints in other ways, such as having less money to put towards energy bills necessary to maintain a comfortable indoor environment in inefficient buildings. Other countries have pursued minimum standards for rental buildings, and the EU requires a high standard of disclosures of energy efficiency information for both rental and purchase within member states (Petrov and Ryan 2021; Economidou et al. 2020). This is likely to affect those with resource constraints the most severely. A minimum standard for renters could be important to consider, such as that implemented in New Zealand (Chisholm, Howden-Chapman, and Fougere 2017)

More information is available at: (https://www.healthyhousing.org.nz/our-research/past-research/rental-housing-warrant-fitness).

What options are available to overcome the split incentive for renters and landlords?

Australian work has shown that tenants pay more for homes with better energy efficiency ratings (Fuerst and Warren-Myers 2018b). Other work within Australia has found that "proactive retrofitting by landlords is rare and that the retrofits undertaken were generally low-cost, incremental energy efficiency improvements. Most retrofit activity was prompted by government subsidies, tenant requests, or appliance breakdown" (Lang et al. 2022b). There can also be issues of perceived fairness; some landlords would prefer a situation where everyone was required legislatively to meet the same minimum, so that there is a level of certainty regarding what is required of others in the same space (Hammerle, White, and Sturmberg 2022). Retro-fit programs and the revision of standards focused on energy efficiency and better insulation should account for differences across climate zones and the known dangers of extreme heat and cold. For example, the New Zealand healthy homes standards introduced minimum standards for heating, insulation, ventilation, moisture ingress and drainage, and draught stopping in rental properties that differ across climate zones.

More information is available at: https://www.tenancy.govt.nz/healthy-homes/about-the-healthy-homes-standards/

One member of our research team, Dr Lee White was part of a research group who surveyed renters to show that barriers to energy efficiency upgrades include the lack of visibility of energy efficiency upgrades, and associated perceptions that a more energy efficient property would not be more highly valued (Hammerle, White, and Sturmberg 2022). This box summarises several relevant findings reported in the study.

Interviews of property investors and property managers indicated that property investors are unlikely to exceed legally binding requirements set by state and national governments, stating "with the construction, it's always whatever the requirements are at that time. I've never gone above and beyond the standards. Just no benefit to me" (property investor 2). One reason for the lack of focus on energy efficiency by renters may relate to the lack of visibility of some energy efficiency features: "it's something that new tenants can't see; they don't know it. They don't know that the owner has put insulation in the roof. I can tell them, but a lot of people don't know what that means in terms of comfort" (property manager 3). Based on interviews, the key barriers to property investors installing energy efficiency measures in rental properties are:

- Long payback periods
- No benefit to the property investor
- No change in rental prices
- No impact on time-on-market for rental properties
- High costs
- Not knowing that low energy efficiency is an issue
- Potential for over-capitalisation
- Belief that renters don't care about energy efficiency
- Belief that having a low energy efficiency rating doesn't really matter to a renter, as long as they have somewhere to live (in areas with highly competitive rental markets)
- Difficulties in renters being able to directly observe many energy efficiency measures

For full findings of this study, please visit: https://c9cdneca.azureedge.net/media/3141/solar-for-renters-report-2022.pdf?rnd=132998139880000000

What options are available to support public and community housing tenants?

Data from the National Social Housing Survey shows that 4 in 10 social housing tenants report their homes as not satisfying their requirements for thermal comfort (Australian Institute of Health and Welfare 2018). Given the rapidly growing awareness of the need for cooling and heating requirements for health and wellbeing in hot and cold regions, coupled with rising energy prices and increased availability of granular energy data, energy insecurity is growing as a focus for energy policymakers (Sawyer, and Hernández 2019). Research published this year in Western Australia's Kimberley region identifies public housing as aged, overcrowded, poorly maintained, and not built for the heat, while tenants rely on costly and ineffective cooling or sleep outside, during periods of extreme heat which coincide with financial stress (Dudley 2022). In the remote Northern Territory town of Tennant Creek, an Indigenous family seeking to install rooftop PV on their public housing residence are required to submit an engineer's report for their (territory owned) roof and walls and commit to removing all solar panels and equipment should they vacate their tenancy (Riley et al. forthcoming).

These examples are all too familiar - no work comprehensively documents the significant challenges facing public and community housing residents seeking to participate in energy transition and improve the energy performance of their rented home. Australia requires a massive scaling up across all levels of government to support heathy (warm, cool, affordable) public and community housing retrofits suitable for a changing climate. Federal, state and territory governments must as a priority electrify and improve energy efficiency of public housing; through deep energy retrofits and installing solar PV (or at least not prohibiting connection agreements) in all public and community housing, preferably before 2030.

There are innumerable opportunities to support public and community housing tenants through facilitating holistic upgrades that include draught proofing, ceiling and/or sub-floor insulation, high-efficiency heating and cooling appliances and window coverings/ glazing. Australian governments should be aiming to increase access to reverse cycle air conditioning in community and social housing in support of the electrification of heating/cooling, improving wall, floor and ceiling insulation and glazing standards in new and existing builds. Neither renting in public and community housing, nor prepaying for access to power (which is ubiquitous in many Aboriginal and Torres Strait Islander communities in QLD, WA, SA and NT), should wholly preclude the potential to access clean energy which can bring significant direct and proven benefits to householders.

Given the extensive solar resources in many communities where community or public housing is the only option, and the substantial known opportunities for self-consumption associated with rooftop solar, public and community housing residents could greatly benefit from much greater levels of resourcing for household solar PV installation. Finance is often the chief barrier for housing providers and residents alike, to achieve the required scale, state and territory governments will very likely need to subsidise application processes and support residents to navigate procedures necessary to connect solar PV to public housing. In addition to individual residential rooftop PV options likely include virtual power plants that can provide improvements akin to rooftop PV when appropriately designed.

In designing policy to increase access to clean energy for public and community housing residents, any realistic policy changes will necessarily require comprehensive community involvement and understanding of the relative costs and potential benefits. Moreover, many state and territory minimum housing standards are poorly applied, infrequently enforced and in some cases indirectly discriminatory. Demand management and energy efficiency education and training for intermediaries such as housing providers will play an important role in this process. The Sustainability Victoria Healthy Homes Program is an example of a scheme that could be adapted to public and community housing tenants. The Healthy Homes program included upgrades like draught proofing, ceiling or sub-floor insulation, high-efficiency heating and cooling appliances and window coverings. It also replaced gas heaters with reverse cycle air-conditioning, which supports electrification of heating/cooling and leads to lower emissions as the electricity grid decarbonises.

More information is available at: https://www.sustainability.vic.gov.au/research-data-and-insights/research/research-reports/the-victorian-healthy-homes-program-research-findings.

How can the energy performance of rental homes be made more transparent to prospective tenants?

In the United Kingdom, Energy Performance Certificates (EPCs) are needed whenever a property is: built, sold, and rented. This provides a rating of the property's energy efficiency rating from A (most efficient) to G (least efficient) and is valid for 10 years (Economidou et al. 2020).

More information is available at: https://www.gov.uk/buy-sell-your-home/energy-performance-certificates.

There is a minimum standard for rental properties and funding schemes to help landlords meet these requirements, for more information see: https://www.gov.uk/guidance/domestic-private-rented-property-minimum-energy-efficiency-standard-landlord-guidance.

There are proposals to lift this minimum standard to a rating of C, which would lead to notable savings for residents, for more information refer to: https://www.theguardian.com/environment/2023/jan/14/uk-private-renters-could-save-billions-if-energy-efficiency-minimum-is-raised.

How can governments and private sector support renters to improve energy performance?

Renters have limited ability to improve the buildings that they live in. This stems both from limits placed on building modifications by landlords, and by the uncertain returns that a renter would face after improving a building that they may dwell in only temporarily. Given this, the onus for energy performance improvements should be on rental providers, not on the renters themselves. Transparency regarding efficiency of appliances within a dwelling, and regarding the building's overall efficiency and likely expected running costs by season (within express parameters), can assist renters in making the most efficient energy use decisions (e.g., what times to run certain appliances, which heating options to use with preference over others, which rooms to heat) or indeed which home to rent through a greater capacity to compare different housing stock.

3.4 Regional, remote and First Nations

How are communities in different geographic locations impacted by poor energy performance and what needs to be done to ensure access to improvements?

Many communities in different geographic locations are at greater risk of being impacted by poor energy performance and high energy costs across housing, transport and industry (Golubchikov and O'Sullivan 2020). Financial viability typically has a disproportionate impact on many small and widely dispersed communities and local government authorities residing at the spatial periphery. These same locations often face socio-economic limitations (higher costs of goods and services) and lesser political power which can lead to policy neglect (Sovacool 2021). The generally limited resourcing of local government means investment in social infrastructure in remote areas likely requires regional or central government support and resourcing in order to facilitate communities at the socio-spatial and political periphery to share in the benefits of a transition away from costly and polluting imported fossil fuels. This requires acknowledging where standards are weak and can be improved across jurisdictions and committing to an ambitious program of engagement and finance to improve energy performance in communities at the spatial periphery, based on minimum standards and defined access to opportunities, ideally derived through inclusive and ethical participatory research (Ravikumar et al. 2022).

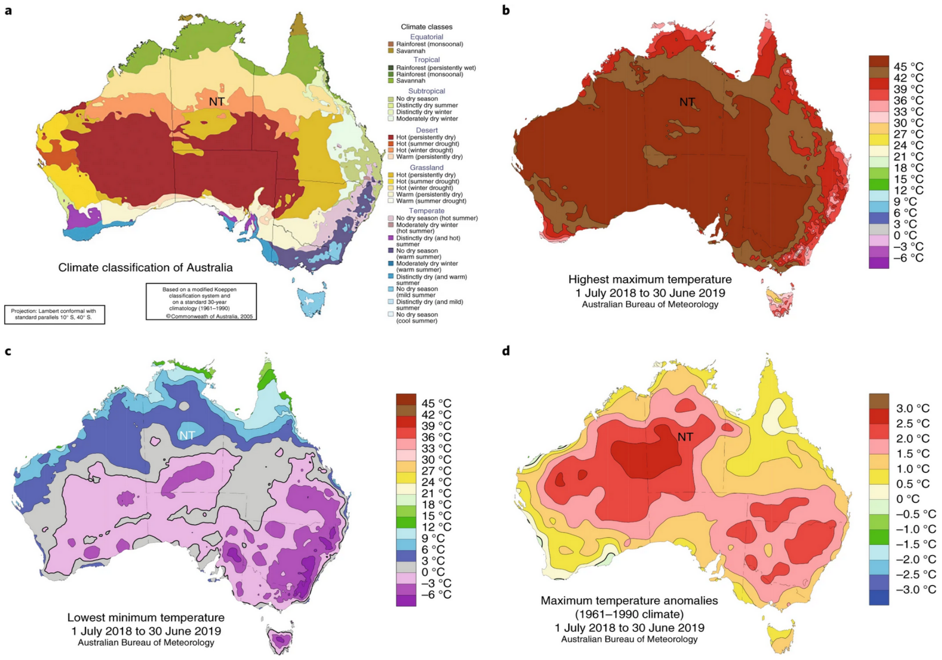
What are the key opportunities to ensure the benefits of improved energy performance are available to First Nations Australians, and Australians located in remote communities?

Energy transition must not contribute to greater marginalisation and harm, nor only benefit those already with the most, but be aimed at delivering real change and addressing the many extant socio-economic disparities between Indigenous and non-Indigenous Australians. Here we discuss key opportunities to ensure the benefits of improved energy performance with reference to the following interlinked domains of **housing, energy security, climate**, and **transport**.

Housing, energy security, climate: Improved energy performance is much more difficult to achieve in poorly sited, insensitively designed and constructed housing that is inadequately insulated. Housing must be built with close attention to local environmental and climatic conditions. While direct causal relationships between poor housing and poor health are complex, nonetheless, housing circumstances (including tenure, affordability, the amount of living space and the location of the home) all play a significant role in determining physical and mental health and wellbeing (Quilty et al. 2022).

Fig. 1: NT compared with other Australian regions.

From: Energy insecurity during temperature extremes in remote Australia



a, Climate zones. **b**, Highest maximum temperatures. **c**, Lowest minimum temperatures. **d**, The 12-monthly mean maximum temperature anomaly for Australia compared with 1961 to 1990. Panels reproduced with permission from the Australian Government Bureau of Meteorology under Creative Commons license CC-BY 3.0 AU: **a**, ref. [73]; **b**, ref. [72]; **c**, ref. [74]; **d**, ref. [75].

Figure 3: NT compared with other Australian regions *Source:* Longden et al. (2022) https://rdcu.be/c4wn0

Climate zones matter greatly (see **Figure 3**) as they impact upon liveability and impact upon energy use immediately and over time, as climate is a structural driver of energy insecurity and its' attendant adverse impacts upon human health and mortality (see Longden 2020; Longden et al. 2020). For almost 30 years the Nationwide House Energy Rating Scheme (NatHERS) has provided energy performance information and ratings, by providing information about the thermal performance (heating and cooling needs) of a new home based on home design, materials and climate. We understand work is underway to expand and improve home energy ratings through delivering tools to support improvements to existing homes through a framework that leverages NatHERS. Obviously, the maintenance of up-to-date climate files for remote First Nations communities is critically important so as to best inform appropriate lines of best fit. Any current or future review would necessarily include examples from remote and very remote settlements as well as urban and regional communities. Examples might include Kulgera (shown on the South Australian border) and Elliot (in the Barkly region) which are both currently rated as Climate Zone 3, in the remote Northern Territory (see **Figure 4**).

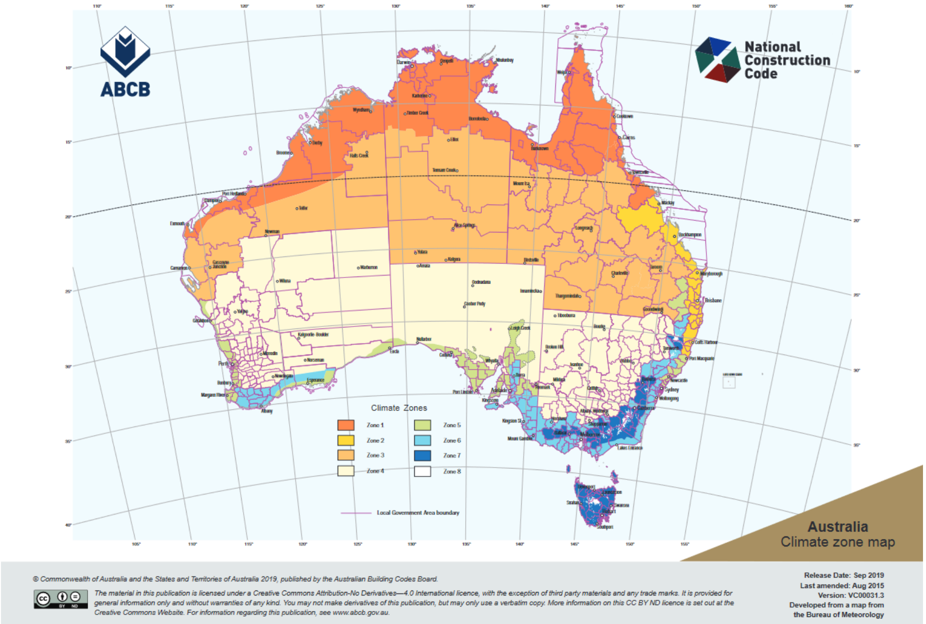


Figure 4: Australian climate zone map *Source: ABCB (2022)*
https://www.abcb.gov.au/sites/default/files/resources/2022/Climate-zone-map-aust.pdf

Research published this year in Western Australia's Kimberley region identifies Aboriginal public housing as being aged, overcrowded, poorly maintained, and inappropriately built for the climate (particularly heat), while tenants necessarily rely on costly and ineffective cooling or choose to sleep outside during periods of extreme heat (which coincide with financial stress) (Dudley 2022). This is salient as remote living Aboriginal and Torres Strait Islander households are predominantly renting (67%), in many remote communities there is no private housing market, and in many jurisdictions this proportion is higher. According to the Australian Institute of Health and Welfare, 34% of Indigenous adults rented through social housing (data for 2018/19) meaning 71% of those remote living First Nations adults who are renting live in social housing (Australian Institute of Health and Welfare 2019; 2021; AIHW 2022). Pertinently, research shows that the poorest rating for household amenity in Aboriginal and Torres Strait Islander public housing households' is 'thermal comfort' *and safety* (italics ours) (Australian Institute of Health and Welfare 2019).

The rational response to poor housing design and operation is substantive commitment to deep energy retrofits to improve passive building performance. Indigenous residents living in public and social housing have both limited resources and constrained legal rights in seeking to improve energy performance. In the absence of any state mandated structural improvements to building envelopes (and in lieu of subsidized PV which we encourage) residents rely on mechanical space cooling which necessitates uninterrupted access to electricity to maintain thermal comfort and safety.

Given the rapidly growing awareness of the need for cooling and heating requirements for health and wellbeing in hot and cold regions, coupled with rising energy prices and increased availability of granular energy data, energy insecurity is rightly growing as a focus for energy policymakers (Sawyer, and Hernández 2019). In our previous research, we have shown that for Indigenous public housing residents in 28 remote communities in the Northern Territory (who prepay for power) the risk of disconnecting from energy services *increases* during temperature extremes - precisely at those times when energy is most needed for the maintenance of health, safety and wellbeing (Longden et al. 2021). We found that nearly all households (91%) experienced a disconnection from electricity in the 2018/19 financial year. Almost three quarters of households (74%) were disconnected more than ten times. Households with high electricity use located in the central climate zones had a one in three chance of a same-day disconnection on very hot or very cold days. We recorded 170,226 same and multi-day disconnections from electricity (due to an inability to pay) during the 2018–2019 financial year (n= 1,674,786 daily observations from 3300 households across four climate zones) see **Figure 4a** and **Figure 4b.**

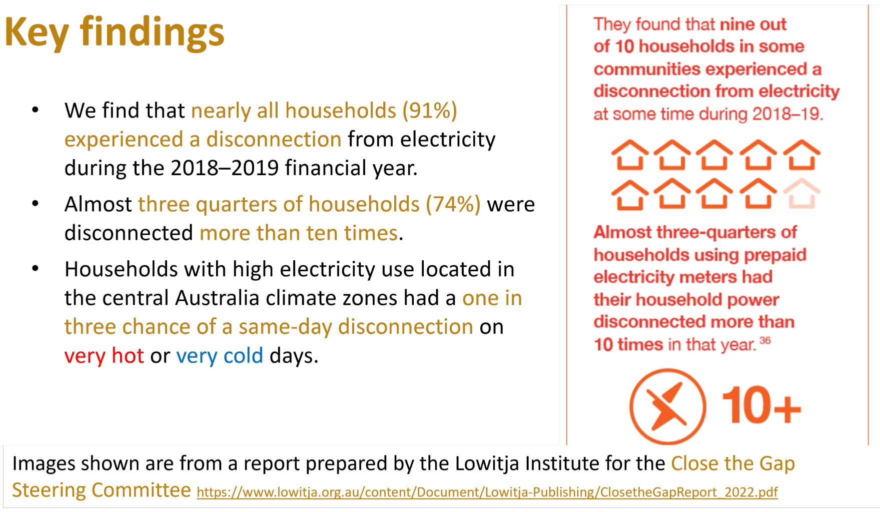


Figure 4a: Energy insecurity during temperature extremes in remote Australia from (Longden et al. 2021)

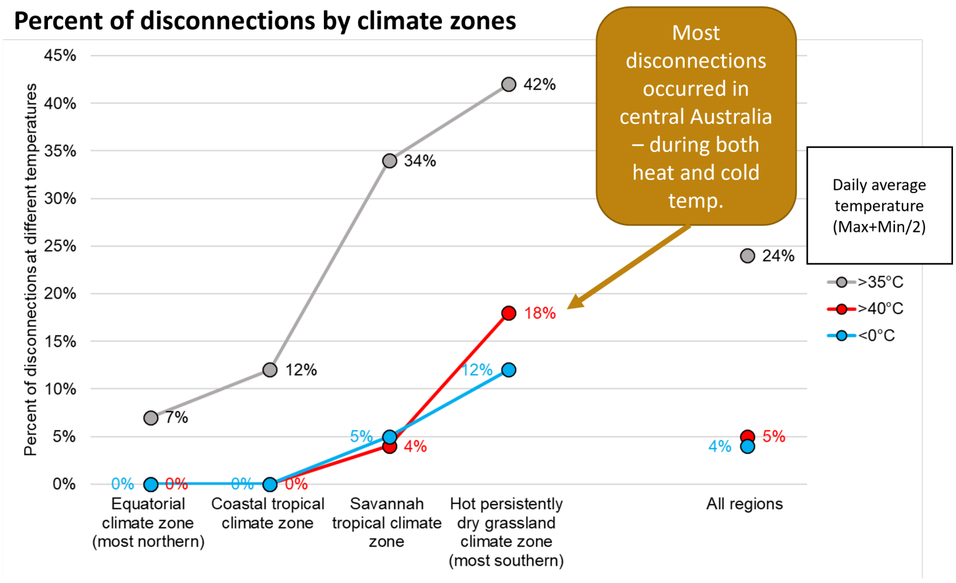


Figure 4b: Energy insecurity during temperature extremes in remote Australia from (Longden et al. 2021)

In this context any improvement to energy performance is difficult for individual public housing residents to achieve. Enterprising residents will be required to submit an engineer's report for their (state or territory owned) residence, if they are to install rooftop PV, and are generally required to commit to removal of system components should they vacate their tenancy (Mellor 2022). Renters are essentially dependent upon landlords doing the right thing - and in much of remote Australia this means state and territory governments are responsible for any changes enabling of improved energy performance. Yet housing authorities and state and territory governments (who are acting as both landlord and monopoly energy provider) often have few incentives to change and greater levels of resourcing are required (Hunt et al. 2021; Riley 2021; Byrnes et al. 2016).

Improved access to energy data for remote communities is an essential step toward improved energy performance. More information is available at: Data are key to proving green-energy benefits https://www.nature.com/articles/d41586-022-02831-4.

Intersecting disadvantage and decarbonizing transport: While Australia is generally assumed to have achieved the United Nations Sustainable Development Goal 7.1, 'access to affordable, reliable and modern energy for all' in practice there remain considerable disparities in who has the available means to access necessary energy and transport services. Ensuring the benefits of improved energy performance are available to First Nations Australians living in remote communities will require recognising and tackling intersectional disadvantage. In regional and remote areas, energy insecurity and poor energy performance of homes interacts with other forms of inequity such as poverty, transport disadvantage, employment and income disadvantage and food insecurity. Without access to a car, transport options within remote Indigenous communities can be extremely limited (Currie and Senbergs 2007). In the latest available survey data (from 2014-15), only 59.8% of Indigenous people in the Northern Territory aged 15 years and over reported being able to get to the places they needed to easily, compared to 88.3% of non-Indigenous Australians. Moreover, 18.2% of Indigenous people living in the Northern Territory aged 15 and over reported being unable to get to those places they needed to, never going out, or being housebound, compared to only 1.1% of non-Indigenous Australians (AIHW 2020). Remote households of limited means face many competing demands on their budget and transport disadvantage interacts with and compounds other deprivations, such as household energy and food insecurity (Mattioli et al., 2018).

Prior research undertaken in the northern town of Katherine (NT), identified complex and intersectional disadvantage faced by community residents who were frequent attenders to the Katherine Hospital Emergency Department (Quilty et al. 2019). 80% had little or no transport, were concurrently experienced food insecurity, domestic violence, housing issues and/or overcrowding. Consideration of these issues is highly pertinent in the context of remote communities and energy performance, wherein residents are facing; very high levels of extant household energy insecurity (Klerck 2020; Thomas Longden et al. 2021; 2022; Davis et al. 2022; Wright-Pedersen 2020); often associated with the use of prepay metering; food insecurity (NTCOSS 2022; Wright-Pedersen 2020), a new rent framework for public housing that seeks to increase rent for remote residents; (Markham 2022); and well known cost of living pressures that underlie transport and fuel poverty (NTCOSS 2022).

The transportation sector is responsible for 25% of global emissions and more than 18% of Australia's greenhouse gas pollution. Many remote and regional First Nations communities in particular have long faced unique mobility challenges and these stand being further complicated by the transition from internal combustion engine vehicles to electrified transport - which has as a prerequisite accessible, available electricity (Spandonide 2017). No doubt, EVs offer numerous advantages including lower maintenance requirements and independence from costly, dangerous and polluting petroleum imports. Yet the adoption of EVs in Australia has thus far been slow by international standards (Whitehead et al. 2022). What policies do exist tend to focus on incentivising uptake among urban residents with the means to afford new technologies ready access to the requisite infrastructure and technical support.

There is the potential that in the absence of policy reform in the transition to electromobility, many remote communities are simply left in the 'too hard basket', reliant on uncertain supplies of increasingly costly and polluting imported liquid fuels (Demaria et al. 2022). First Nations communities deserve concerted, focussed funded policy support across all levels of government in their efforts to decarbonize as swiftly and as safely as possible. Members of our research team have previously undertaken preliminary assessments of the feasibility of EVs for travel between remote communities and their nearest service hub towns in Australia. We show that, while EV travel is often not currently feasible for trips to large (>5000 residents) service hub towns using low-range (336km) vehicles, *over 99% of communities and residents would be able to travel to their nearest small (>1000 residents) service hub town with existing long-range (600km)* EVs (see **Figure 5**). The barriers to the electrification of transport in remote communities are significant but they are not insurmountable, and they deserve significant consideration in national and state policy developments in the deployment of charging infrastructure (Demaria et al. 2022).

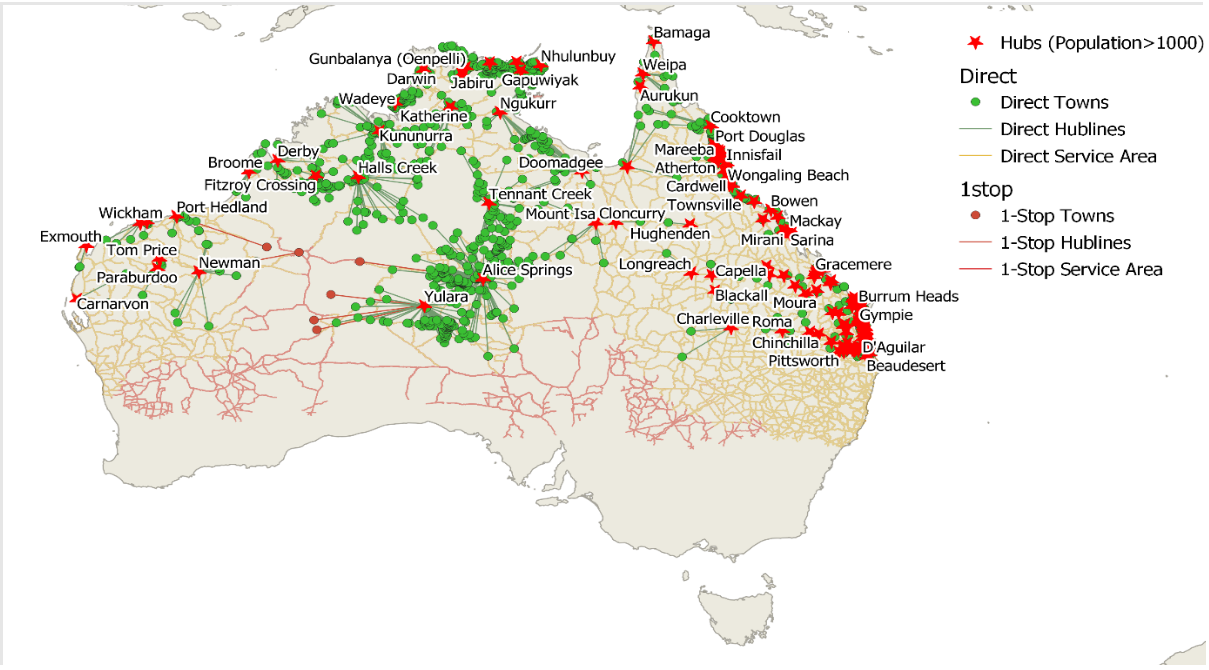


Figure 5: Network map of remote communities and their closest small service hub (population>1000) using available longer-range electric vehicle (660km range) 26ºN only from (Demaria et al. 2022)

Even within the limited range of those EVs currently available in Australia, a majority of intended trips between communities and service hubs could be travelled without recharging en-route. The barriers to EVs for regional, remote and First Nations communities are likely not solely the oft-quoted tyranny of distance, or the range of existing EVs, but very likely a combination of the availability of charging infrastructure in towns, communities and en-route charging stations plus likely a multiplicity of more prosaic – and surmountable- barriers including accessibility, availability and financing of EVs in remote markets, the training of technicians (and lay people) to service and repair EVs, and perceptions related to the use case of EVs in remote areas. No doubt a major idealisation of our study is that the power needs of EV charging could possibly be serviced by existing power systems in many regional, remote and First Nations communities – this leads us to the major implication of the findings of our study – regional and remote communities ought to be systematically incorporated early into planning for the electrification of transport including funding for requisite charging infrastructure.

Greater levels of engagement and resourcing will be critical to supporting the continued leadership and participation of First Nations peoples and communities in Australia's transition to net zero, in which the forthcoming National Energy Performance Strategy will no doubt play a critical role.

References:

AG. 2022. "Energy.Gov.Au: Government Priorities: Residential Buildings." 2022. https://www.energy.gov.au/government-priorities/buildings/residential-buildings.

AIHW. 2020. "Aboriginal and Torres Strait Islander Health Performance Framework - Summary Report 2020. Australian Institute of Health and Welfare." *Canberra, ACT*.

———. 2022. "Australian Burden of Disease Study: Impact and Causes of Illness and Death in Aboriginal and Torres Strait Islander People." https://www.aihw.gov.au/reports/burden-of-disease/illness-death-indigenous-2018/report-editions.

Alam, Morshed, Patrick X.W. Zou, Rodney A. Stewart, Edoardo Bertone, Oz Sahin, Chris Buntine, and Carolyn Marshall. 2019. "Government Championed Strategies to Overcome the Barriers to Public Building Energy Efficiency Retrofit Projects." *Sustainable Cities and Society* 44 (January): 56–69. https://doi.org/10.1016/j.scs.2018.09.022.

Australian Institute of Health and Welfare. 2018. “National Social Housing Survey 2018 : Key Results.” Canberra: AIHW.

———. 2019. “Aboriginal and Torres Strait Islander People: A Focus Report on Housing and Homelessness.” https://www.aihw.gov.au/reports/housing-assistance/indigenous-people-focus-housing-homelessness/contents/summary.

———. 2021. “Indigenous Housing.” https://www.aihw.gov.au/reports/australias-welfare/indigenous-housing.

Barreca, Alan, R. Jisung Park, and Paul Stainier. 2022. “High Temperatures and Electricity Disconnections for Low-Income Homes in California.” *Nature Energy*, October. https://doi.org/10.1038/s41560-022-01134-2.

Byrnes, Liam, Colin Brown, Liam Wagner, and John Foster. 2016. “Reviewing the Viability of Renewable Energy in Community Electrification: The Case of Remote Western Australian Communities.” *Renewable and Sustainable Energy Reviews* 59 (June): 470–81. https://doi.org/10.1016/j.rser.2015.12.273.

Chisholm, Elinor, Philippa Howden-Chapman, and Geoff Fougere. 2017. “Renting in New Zealand: Perspectives from Tenant Advocates.” *Kōtuitui: New Zealand Journal of Social Sciences Online* 12 (1): 95–110. https://doi.org/10.1080/1177083X.2016.1272471.

Clarke, D., Baldwi, K., Baum, F., Godfrey, B., Richardson, S., Robin, L. and Vivoda, v. 2022. “Australian Energy Transition Report Plan. Report Five: Transition Dynamics.”

Currie, G., and Z. Senbergs. 2007. “Indigenous Communities: Transport Disadvantage and Aboriginal Communities, in: No Way to Go: Transport and Social Disadvantage in Australian Communities. .” *Monash University Publishing, Melbourne, Victoria, Pp. 98–108.*

Davis, V., B. Riley, L.V. White, and M. Klerck. 2022. “Temperature Extremes Exacerbate Energy Insecurity – Australia Needs to Better Support Remote Indigenous Communities to Prepare Now.” Springer Nature Sustainability Community. 2022. https://sustainabilitycommunity.springernature.com/posts/temperature-extremes-exacerbate-energy-insecurity-australia-needs-to-better-support-remote-indigenous-communities-to-prepare-now-3d514d55-d403-4931-9200-44ccef116e4c.

DCCEEW. 2022. “Australian Hydrogen Strategy ‘Establishing a New Renewable Fuel Scheme with a Legislated Hydrogen Target Reaching Eight Petajoules (67,000 Tonnes) by 2030’.”

Demaria, Keigan, Björn C. P. Sturmberg, Brad Riley, and Francis Markham. 2022. “Exploring the Feasibility of Electric Vehicle Travel for Remote Communities in Australia.” *Australian Geographer* 53 (2): 201–22. https://doi.org/10.1080/00049182.2022.2086720.

Dudley, G. 2022. “Stuck in the Heat: Lived Experiences of Public Housing Tenants in the Kimberley.”

Economidou, M., V. Todeschi, P. Bertoldi, D. D’Agostino, P. Zangheri, and L. Castellazzi. 2020. “Review of 50 years of EU Energy Efficiency Policies for Buildings.” *Energy and Buildings* 225 (October): 110322. https://doi.org/10.1016/j.enbuild.2020.110322.

Energy Efficiency Council. 2018. “AUSTRALIA RANKS WORST FOR ENERGY EFFICIENCY IN DEVELOPED WORLD,” 2018. https://www.eec.org.au/news/eec-news/article/australia-ranks-worst-for-energy-efficiency-in-developed-world.

Friedman, Carli. 2022. “Unsafe Temperatures, Going without Necessities, and Unpayable Bills: Energy Insecurity of People with Disabilities in the United States during the COVID-19 Pandemic.” *Energy Research & Social Science* 92 (October): 102806. https://doi.org/10.1016/j.erss.2022.102806.

Fuerst, Franz, and Georgia Warren-Myers. 2018a. “Does Voluntary Disclosure Create a Green Lemon Problem? Energy-Efficiency Ratings and House Prices.” *Energy Economics* 74 (August): 1–12. https://doi.org/10.1016/j.eneco.2018.04.041.

———. 2018b. “Does Voluntary Disclosure Create a Green Lemon Problem? Energy-Efficiency Ratings and House Prices.” *Energy Economics* 74 (August): 1–12. https://doi.org/10.1016/j.eneco.2018.04.041.

Geoscience Australia. 2022. “Solar Energy: Australia’s Solar Energy Resources and Production.”

Golubchikov, Oleg, and Kate O’Sullivan. 2020. “Energy Periphery: Uneven Development and the Precarious Geographies of Low-Carbon Transition.” *Energy and Buildings* 211 (March): 109818. https://doi.org/10.1016/j.enbuild.2020.109818.

Hafner, By Rebecca, David Elmes, Daniel Read, and Mathew P. White. 2019. “Exploring the Role of Normative, Financial and Environmental Information in Promoting Uptake of Energy Efficient Technologies.” *Journal of Environmental Psychology* 63 (June): 26–35. https://doi.org/10.1016/j.jenvp.2019.03.004.

Hammerle, M., L.V. White, and B. Sturmberg. 2022. “How Can We Involve Renters in the Energy Transition in Australia.” *Energy Consumers Australia*.

Hannam, P. 2022. “Sun Cable’s Giant Northern Territory Solar Project Gets $210m Funding Boost.” *The Guardian Australia*, March 14, 2022.

Havas, Lisa, Julie Ballweg, Chris Penna, and Digby Race. 2015. “Power to Change: Analysis of Household Participation in a Renewable Energy and Energy Efficiency Programme in Central Australia.” *Energy Policy* 87 (December): 325–33. https://doi.org/10.1016/j.enpol.2015.09.017.

Hunt, J., B. Riley, L. O’Neill, and G. Maynard. 2021. “Transition to Renewable Energy and Indigenous People in Northern Australia: Enhancing or Inhibiting Capabilities?” *Journal of Human Development and Capabilities* 22 (2). https://doi.org/10.1080/19452829.2021.1901670.

IEA. 2022. “Energy Efficiency Targets; International Energy Agency.” https://iea.blob.core.windows.net/assets/8c0b7b02-3f86-4662-815f-13d260dd6f99/EnergyEfficiencyTargetsEnergyEfficiencyInsightsBrief.pdf.

Jessel, Sonal, Samantha Sawyer, and Diana Hernández. 2019. “Energy, Poverty, and Health in Climate Change: A Comprehensive Review of an Emerging Literature.” *Frontiers in Public Health* 7 (December). https://doi.org/10.3389/fpubh.2019.00357.

Jotzo, F. 2022. “Hydrogen.” In *The Superpower Transformation: Making Australia’s Zero-Carbon Future*, edited by R. Garnaut, 196–219.

Klerck, M. 2020. “Tangentyere Council, Submission to the House of Representatives Inquiry into Homelessness in Australia. Tangentyere Council, .” Alice Springs, NT.

la Rue du Can, Stephane de, Greg Leventis, Amol Phadke, and Anand Gopal. 2014. “Design of Incentive Programs for Accelerating Penetration of Energy-Efficient Appliances.” *Energy Policy* 72 (September): 56–66. https://doi.org/10.1016/j.enpol.2014.04.035.

Lang, Michaela, Ruth Lane, Kun Zhao, and Rob Raven. 2022a. “Energy Efficiency in the Private Rental Sector in Victoria, Australia: When and Why Do Small-Scale Private Landlords Retrofit?” *Energy Research & Social Science* 88 (June): 102533. https://doi.org/10.1016/j.erss.2022.102533.

———. 2022b. “Energy Efficiency in the Private Rental Sector in Victoria, Australia: When and Why Do Small-Scale Private Landlords Retrofit?” *Energy Research & Social Science* 88 (June): 102533. https://doi.org/10.1016/j.erss.2022.102533.

Lang, Michaela, Ruth Lane, Kun Zhao, Stephanie Tham, Katrina Woolfe, and Rob Raven. 2021. “Systematic Review: Landlords’ Willingness to Retrofit Energy Efficiency

Improvements." *Journal of Cleaner Production* 303 (June): 127041. https://doi.org/10.1016/j.jclepro.2021.127041.

Lazowski, Bronwyn, Paul Parker, and Ian H. Rowlands. 2018. "Towards a Smart and Sustainable Residential Energy Culture: Assessing Participant Feedback from a Long-Term Smart Grid Pilot Project." *Energy, Sustainability and Society* 8 (1). https://doi.org/10.1186/s13705-018-0169-9.

Longden, T. 2020. "Heat Kills. We Need Consistency in the Way We Measure These Deaths." *The Conversation*, December 10, 2020.

Longden, Thomas, Simon Quilty, Philip Haywood, Arnagretta Hunter, and Russell Gruen. 2020. "Heat-Related Mortality: An Urgent Need to Recognise and Record." *The Lancet Planetary Health* 4 (5): e171. https://doi.org/10.1016/S2542-5196(20)30100-5.

Longden, Thomas, Simon Quilty, Brad Riley, Lee v. White, Michael Klerck, Vanessa Napaltjari Davis, and Norman Frank Jupurrurla. 2021. "Energy Insecurity during Temperature Extremes in Remote Australia." *Nature Energy* 7 (1): 43–54. https://doi.org/10.1038/s41560-021-00942-2.

Longden, Thomas, Simon Quilty, Brad Riley, Lee v. White, Michael Klerck, Vanessa Napaltjarri Davis, and Norman Frank Jupurrurla. 2022. "Temperature Extremes Exacerbate Energy Insecurity for Indigenous Communities in Remote Australia." *Nature Energy* 7 (1): 11–12. https://doi.org/10.1038/s41560-021-00968-6.

Markham, F., Klerck, M. 2022. "Simplifying the System or Deepening Poverty? The New Remote Rent Framework in the Northern Territory." *Centre for Aboriginal Economic Policy Research, ANU*.

Mellor, L. 2022. "Personal Communication: Original Power." August.

Miller, Wendy, Lei Aaron Liu, Zakaria Amin, and Matthew Gray. 2018. "Involving Occupants in Net-Zero-Energy Solar Housing Retrofits: An Australian Sub-Tropical Case Study." *Solar Energy* 159 (January): 390–404. https://doi.org/10.1016/j.solener.2017.10.008.

Moore, Trivess, Ian Ridley, Yolande Strengers, Cecily Maller, and Ralph Horne. 2017. "Dwelling Performance and Adaptive Summer Comfort in Low-Income Australian Households." *Building Research & Information* 45 (4): 443–56. https://doi.org/10.1080/09613218.2016.1139906.

NTCOSS. 2022. "Cost of Living Report: General Update Tracking Changes in the Cost of Living, Particularly for Northern Territorians on Low Incomes and Northern Territorians Experiencing Vulnerability and Disadvantage."

O'Sullivan, Kimberley C., Philippa L. Howden-Chapman, and Geoff Fougere. 2011. "Making the Connection: The Relationship between Fuel Poverty, Electricity Disconnection, and Prepayment Metering." *Energy Policy* 39 (2). https://doi.org/10.1016/j.enpol.2010.10.046.

O'Sullivan, Kimberley Clare, Philippa L. Howden-Chapman, and Geoffrey M. Fougere. 2015. "Fuel Poverty, Policy, and Equity in New Zealand: The Promise of Prepayment Metering." *Energy Research & Social Science* 7 (May): 99–107. https://doi.org/10.1016/j.erss.2015.03.008.

Petrov, Ivan, and Lisa Ryan. 2021. "The Landlord-Tenant Problem and Energy Efficiency in the Residential Rental Market." *Energy Policy* 157 (October): 112458. https://doi.org/10.1016/j.enpol.2021.112458.

Porto Valente, Caroline, Alan Morris, and Sara J. Wilkinson. 2022. "Energy Poverty, Housing and Health: The Lived Experience of Older Low-Income Australians." *Building Research & Information* 50 (1–2): 6–18. https://doi.org/10.1080/09613218.2021.1968293.

QCOSS. 2014. “Empowering Remote Communities Experiences of Aboriginal and Torres Strait Islander Customers Using Electricity Pre-Payment Meters in Queensland.”
Quilty, Simon, Norman Frank Jupurrurla, Ross S Bailie, and Russell L Gruen. 2022. “Climate, Housing, Energy and Indigenous Health: A Call to Action.” *Medical Journal of Australia* 217 (1): 9–12. https://doi.org/10.5694/mja2.51610.
Quilty, Simon, Lisa Wood, Sophie Scrimgeour, Geordan Shannon, Elisha Sherman, Bruce Lake, Richard Budd, Paul Lawton, and Mary Moloney. 2019. “Addressing Profound Disadvantages to Improve Indigenous Health and Reduce Hospitalisation: A Collaborative Community Program in Remote Northern Territory.” *International Journal of Environmental Research and Public Health* 16 (22): 4306. https://doi.org/10.3390/ijerph16224306.
Ravikumar, A. P., E. Baker, A. Bates, D. Nock, D. Venkataraman, T. Johnson, M. Ash, et al. 2022. “Enabling an Equitable Energy Transition through Inclusive Research.” *Nature Energy* 8 (1): 1–4. https://doi.org/10.1038/s41560-022-01145-z.
Reames, Tony Gerard. 2016. “Targeting Energy Justice: Exploring Spatial, Racial/Ethnic and Socioeconomic Disparities in Urban Residential Heating Energy Efficiency.” *Energy Policy* 97 (October): 549–58. https://doi.org/10.1016/j.enpol.2016.07.048.
Riley, B. 2021. “Scaling up: Renewable Energy on Aboriginal Lands in North West Australia.” https://doi.org/10.32613/nrp/2021.6.
Saddler, H. 2018. “How Low Income Households Use Electricity.” *Australia Institute*.
Souza, M.N.M. 2018a. “Why Are Rented Dwellings Less Energy-Efficient? Evidence from a Representative Sample of the U.S. Housing Stock.” *Energy Policy* 118 (July): 149–59. https://doi.org/10.1016/j.enpol.2018.03.013.
———. 2018b. “Why Are Rented Dwellings Less Energy-Efficient? Evidence from a Representative Sample of the U.S. Housing Stock.” *Energy Policy* 118 (July): 149–59. https://doi.org/10.1016/j.enpol.2018.03.013.
Sovacool, Benjamin K. 2021. “Who Are the Victims of Low-Carbon Transitions? Towards a Political Ecology of Climate Change Mitigation.” *Energy Research & Social Science* 73 (March): 101916. https://doi.org/10.1016/j.erss.2021.101916.
Spandonide, Bruno. 2017. “Sustainable Remote Australian Transport for Living on Country and Going out Bush.” *International Journal of Rural Law and Policy*, no. 2 (June). https://doi.org/10.5130/ijrlp.i2.2017.4941.
St Vincent de Paul. 2019. “Households in the Dark: Mapping Electricity Disconnections in South Australia, New South Wales, Victoria and South-East Queensland.” https://alvissconsulting.com/wp-content/uploads/2019/10/Households-in-the-Dark-II-Report.pdf.
Tong, Kangkang, Anu Ramaswami, Corey (Kewei) Xu, Richard Feiock, Patrick Schmitz, and Michael Ohlsen. 2021. “Measuring Social Equity in Urban Energy Use and Interventions Using Fine-Scale Data.” *Proceedings of the National Academy of Sciences* 118 (24). https://doi.org/10.1073/pnas.2023554118.
Vivoda, Vlado. 2022. “Australia’s Energy Security and Statecraft in an Era of Strategic Competition.” *Energies* 15 (19): 6935. https://doi.org/10.3390/en15196935.
Whitehead, J., E. Whittlesea, P. Newman, and B. Sturmberg. 2022. “FACTS: A Framework for an Australian Clean Energy Transport Strategy.” March 30, 2022.
World Health Organization. 2018. “Low Indoor Temperatures and Insulation: Who Housing and Health Guidelines.” Geneva. 2018. https://www.ncbi.nlm.nih.gov/books/NBK535294/.
Wright-Pedersen, S.,. 2020. “Alice Springs Food Security Needs Assessment 2019-2020: Final Report.” *Northern Territory*.