JUST TRANSITIONS IN AUSTRALIA

MOVING TOWARDS LOW CARBON LIVES ACROSS POLICY, INDUSTRY AND PRACTICE

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JUST TRANSITIONS IN AUSTRALIA: MOVING TOWARDS LOW CARBON LIVES ACROSS POLICY, INDUSTRY AND PRACTICE

Acknowledgement of Country

We wish to acknowledge the traditional custodians and owners of the diverse lands on which we live and work. We pay our respects to their Elders, past and present, and recognise that just transitions to decarbonisation in Australia and elsewhere must centre First Nations justice through local economic development, recognition of Indigenous knowledges, empowerment and self-determination.

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- ADM+S Submission prepared by: Dr. Emma Quilty, Dr Thao Phan and Jeni Lee
- Chief Clean Futures Officer, Clean Energy Finance Corporation (CEFC)
- ClimateWorks Centre submission, prepared by Anna Malos Australia – Country Lead.
- Energy Consumers Australia submission, prepared by Lynne Gallagher, Chief Executive Officer
- Personal submission, prepared by Dr. Ron Ben-David, Professorial Fellow, Monash Business School
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Fieldwork reports

- Workshop report from the Digital Energy Futures ARC Linkage project, Sarah Pink, December 2021
- Fieldwork report 'NSW mining and agricultural communities', Susan Wright, January 2022
- Fieldwork report 'Insights for Just Transitions for Coal Communities in Australia', Kari Dahlgren, November 2021
- Documentary report 'EVs, Housing and inequalities', Sarah Pink, January 2022

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EXECUTIVE SUMMARY

Australia's position over its natural resources has recently been identified as a resource or 'coal curse' (Brett, 2020). Australia is characterised as a 'wealthy nation with the economic profile of a developing country'. National government is reluctant to set new targets, or take seriously the challenges of a transition to decarbonisation, pinning some of its hopes on natural gas, hydrogen and technological breakthroughs. Meanwhile the complex effects of the climate emergency are tangibly experienced in the greater frequency and unpredictability of extreme weather events, including vast bushfires, cyclones, floods and droughts, which signal climate change biting. Yet there is growing acknowledgment of the need for and wide ranging benefits of transitions to decarbonisation. Beneath the scale of federal government response, the electricity market is markedly changing with the onset of renewable electricity, and there are many green shoots of progress to transition.

Yet Australia still has to come to terms with what a transition entails in terms of the socially uneven distribution of risks and benefits of transitions to decarbonisation, and the unequal opportunities and challenges to engage in the transition. In order words, how can Australia shape transitions to decarbonisation that are ecologically sound ánd socially just? Transitions to decarbonisation in Australia entail two risks: entrenching existing injustices associated with carbon-based energy systems and economic activities; and generating new conditions of harm and inequality as a consequence of introducing low-carbon energy systems. Moreover, just transitions to decarbonisation need to consider the implications and trade-offs across multiple intersecting domains of contemporary life. Addressing these risks and trade-offs is critical in revisiting the concept of just transitions and imagining new pathways to a fair politics of climate change in Australia.

This research aimed to gather and collate evidence on just transitions that can be disseminated and formulated to shape policy and practice at multiple scales, from the national to the local and community. The report is the central output of the 'Just Transitions in Australia: moving towards low carbon lives across policy, industry and practice' (Oct 2021-March 2022) project. The project was funded by the British Academy's Just Transitions to Decarbonisation in the Asia-Pacific programme, and involved a collaboration between research teams based at Royal Holloway University of London and Monash University.

The research has identified a set of key Principles that are pivotal for successfully understanding and governing just transitions in Australia. Each of these Principles offers a different entry point from which stakeholders can approach the complex question of ensuring a transition to decarbonisation is just. These are not suggested as "do this" or "do that" instructions, as if a just transition could follow a simple recipe, but rather as propositions upon which to base/reflect on future actions and decisions. The full report is structured into four sections: 1) the introductory section; 2) a set of key principles for just transitions focusing on places and scales, timescales, innovation, people, identities and experiences, and responsibilities; 3) possibilities for just transitions; and 4) five detailed domain reports which provide the detailed evidence produced through the research process, and from which the principles have been developed. The domains include: the home; mobilities; work and industry; renewable energy; and technology and data.

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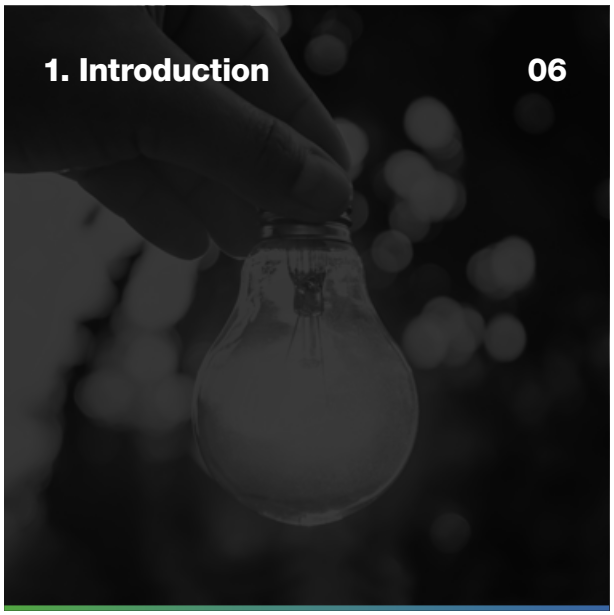

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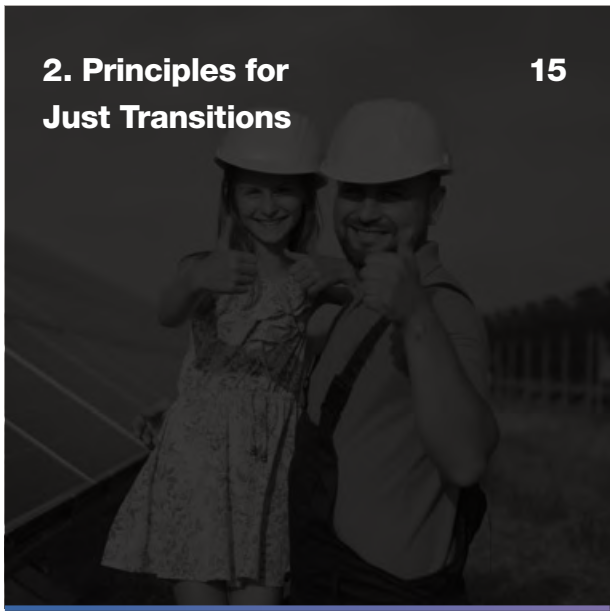

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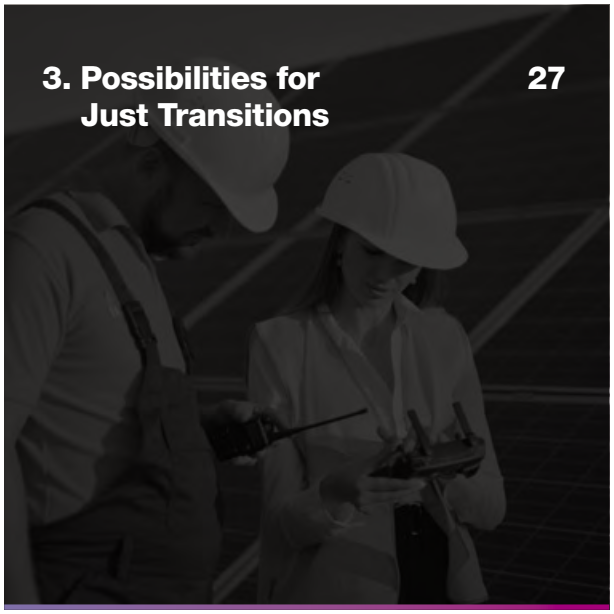

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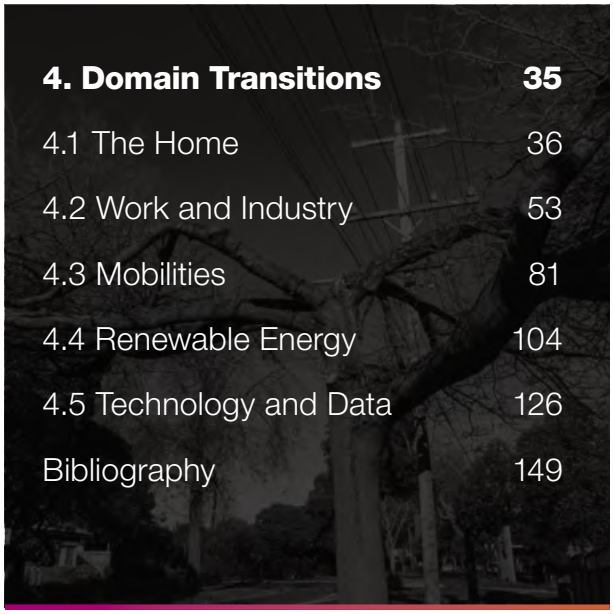

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Introduction

1.1 Background

Just Transitions in Australia **reports on and assesses the policy, practice, and realistic possibilities for 'Just transitions to decarbonisation' in Australia. The research aimed to gather and collate evidence on just transitions that can be disseminated and formulated to shape policy and practice at multiple scales, from the national to the local and community. This report is the central output of the 'Just Transitions in Australia: moving towards low carbon lives across policy, industry and practice' (Oct-March 2021-22) project, a collaboration between research teams based Royal Holloway University of London and Monash University funded by the British Academy (United Kingdom).**

1.2. The Australian Context

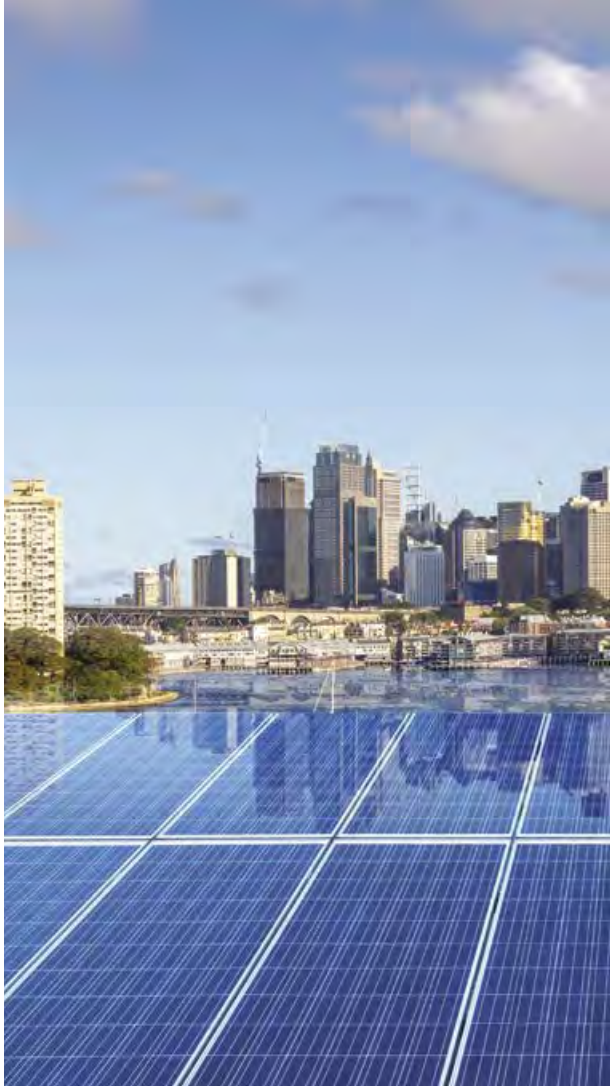
Australia's position over its natural resources has recently been identified as a resource or 'coal curse' (Brett, 2020). Australia is characterised as a 'wealthy nation with the economic profile of a developing country'. National government is reluctant to set new targets, or take seriously the challenges of a transition to decarbonisation, pinning some of its hopes on natural gas. The current government's plans have only just advanced from its Paris Climate agreement commitments, to reduce to 26-28% of 2005 levels by 2030, to a net zero position by 2050. Meanwhile the complex effects of the climate emergency are tangibly experienced in the greater frequency and unpredictability of extreme weather events, including vast bushfires, cyclones and droughts, which signal climate change biting. Yet there is growing acknowledgment of transition. Beneath the scale of federal government response, the electricity market is markedly changing with the onset of renewable electricity, and there are many green shoots of progress to transition, where 'just transitions' can be realised. Australian states have also proven to be much more active in decarbonisation. In November 2021, the Net Zero Emissions Policy Forum was formed through a collaboration of the NSW, ACT and SA state governments.

The context is complicated further by the multiplicity of definitions and approaches towards transition and highly uneven outcomes and experiences. In particular this involves Australia's relationship to Indigenous populations. The complex political and legal questions relating to Aboriginal and Torres Strait Islander communities' land and resources, poses challenges for equitable ownership, social investment and autonomy over low-carbon transition schemes and practices. Moreover, the reliance of Australian industry on resource exports and jobs creates a distinctive set of issues for 'just transition' to decarbonisation. The submission from ClimateWorks helpfully outlines several issues or limits to decarbonisation in Australia.

ISSUES FOR DECARBONISATION IN AUSTRALIA:

- Heavy economic dependence on energy intensive, high emissions industries particularly in some regional areas.
- The perception of higher economic dependence on these industries than is numerically the case. Noting that jobs in these fields can be highly paid and high status.
- A small number of very powerful, major employers in highly emitting industries that create powerful, well-financed voices and have strong vested interests
- A lack of recognition or belief in economic opportunities relating to the net zero economy – especially strong considering that transitions away from industries in Australian regions has often been poorly managed with major negative social and local economic impacts.

— Country Lead, ClimateWorks, Submission Jan 2022



1.3 Defining Just Transitions: Key concepts and terms

Since the inclusion of the concept of 'just transitions' in the Paris Agreement (2015), it is more broadly recognised that a shift towards zero emissions needs to take into account "the imperatives of a just transition of the workforce and the creation of decent work and quality jobs in accordance with nationally defined development priorities." Scholarly work on just transitions has flourished before and since the agreement, but arguably the Australian conversation has become controversial to a point where even talking about 'just transitions' can be critically received. This report recognises that 'just transitions' has many meanings for different audiences, and that there is both a need and potential to deliberately engage in revisiting meanings across people and sectors. If we can accept the multiplicity of just transitions, new pathways towards a fair politics of climate change can be opened up.

Our approach towards 'just transitions' is based on the principle that for transitions to be just, we must treat transitions as dynamic and multi-dimensional. Importantly this means moving beyond a narrow focus of technological solutionism and taking the step of incorporating the attention to people and everyday futures developed in new and innovative approaches to futures in design anthropology, sociology and transformative innovation policy framings. We bring together new knowledge created by shifts in these disciplines with socio-technical approaches to 'energy' and 'sustainability transitions' (Markard, Raven and Truffer 2012), concepts and principles towards mobility transitions and mobility justice (Nikolaeva et al 2019; Adey et al 2021), the everyday as a site of transition (Pink et al 2017), and social practice innovation, intervention and change (Strengers & Maller 2014). We propose that this offers a new interdisciplinary and theoretically, methodologically and empirically robust framework for conceptualising, defining, approaching and creating viable, realistic and stakeholder-engaged pathways towards addressing the deep complexity of just transitions.

Approaches towards 'just transitions' have been influenced by labour movements in North America and Australia – through the retrenchment of jobs within heavy high-carbon industries and sectors such as the automotive industry. In engaging the concept of 'just transitions' in relation to the wider Australian context, we have been careful to attend to how it will manifest both institutionally and societally. The Australian Council of Learned Academies (ACOLA), in their 2021 Australia Energy Research Transition Plan, suggested that 'a successful transition must also encompass the perspectives and wellbeing of people, in the context of their lives, communities, economy and employment, in a way that is fair' (2021: 3). At

the same time, we recognise that while the term 'just transitions' has travelled further than labour relations, it does not always simply translate so easily or come without baggage, especially given its history within Australia. But while other terms could be used, we recognise utility in the plurality of ways 'just transition' could be applied to the Australian context.

Our approach puts people, their actions, values, needs, hopes and concerns at the heart of any understanding of a just transition. Technological change undoubtedly participates in transition but just transitions must better account for what people do, and how they, and other 'multi-species' lives (Tschakert 2020) (animals, environments and natures), are differentially entangled in transitions to decarbonisation.

Sovacool et al. (2017) ask how might policies and practices of low-carbon transition become more 'justice aware' (Sovacool et al., 2017)? We respond by drawing on multiple perspectives on 'just transitions' adapted from Wang and Lo (2021). Here we see Just Transitions:

- as a labour concept, involving issues and challenges related to changes in work/jobs, role of trade/labour unions and movements; sites and spaces of labour (including the home);
- as a policy/governance concept: issues and challenges related to the political context, policy framings, institutional arrangements, public-private partnerships, contestations; understanding policies distributionally;
- as a geographical concept: issues and challenges of place, scale and space; where do just transitions take place (or not) and why there (or not there)?; issues around justice across scales and places;
- as an everyday life concept: issues and challenges in relation to everyday practices, the home, the household, and especially individual and shared feelings and experiences;
- as a geopolitical relation: issues and challenges of states, NGOs, social movements, and global institutions lobbying for transition, making calculations on transition in relation to other strategic goals.

We mobilise an 'integrated justice concept', to weigh transitions and these different perspectives on justice in relation to one another. Issues and challenges related to unequal distribution of costs/benefits/trade-offs of transition are examined across, the environmental, climate, the everyday, energy justice, geopolitical relations and labour definitions. At the same time we work more broadly to understand who and what has agency within just transitions and their multiple and overlapping and sometimes contradictory or in-tension relations, as blue-green antagonisms, jobs vs the environment, rather than alliances etc.

This is not necessarily, then, about determining an idealistic 'just transition', but recognising its value in widening the distributional ways just transitions could be assessed, and, more pragmatically, in advancing discussions between actors such as 'unions, environmentalists, governments, and community members on how best to balance ecological and social needs when making critical environmental policy decisions' (Snell 2018, 561). For others, failure to transition in a 'just' way, threatens decarbonisation in Australia altogether.

> [I]f we're going to talk about Just Transition, we do have to talk about ecological, environmental questions. And if that's not part of the issue at stake or the issue of concern, for me it's… it's not about Just Transition [...] for me the Just Transition discussion is very much connected to debates about environmental policy and addressing environmental concerns. And that… that's where I think… it gets a bit problematic where it just becomes a catch all concept to explain all workers in transition.
>
> *— Interview, Associate Professor, Darryn Snell, RMIT*

1.4 Key Domains

Against this backdrop our project recognises 5 critical domains from which 'just transitions' can be examined and evaluated in Australia.

- The Home
- Work and Industry
- Mobilities
- Renewable Energy
- Technology and Data

THE HOME

Australian homes vary regionally and in relation to social and economic inequities. The Building Code of Australia specifies eight climate zones with different standards, and vernacular practices regarding heating and cooling techniques for properties. Australian homes occupy some of the largest footprints in the world, while the inner suburbs of Australia's cities are characterised by high-density and high-rise apartment living. While Australia is cited as first in the world for the rate of solar and wind capacity installed per person annually, possibilities for solar uptake are unevenly distributed. New home-based technologies, routines and practices could be pivotal in supporting a just transition. However, design for this outcome requires further research and engagement, particularly considering the impact of the COVID-19 pandemic on increased home-working, making homes intensified hubs of activity with increased energy demand to support heating and cooling and a diversification of digital and smart devices, solar generation storage and automation.

WORK AND INDUSTRY

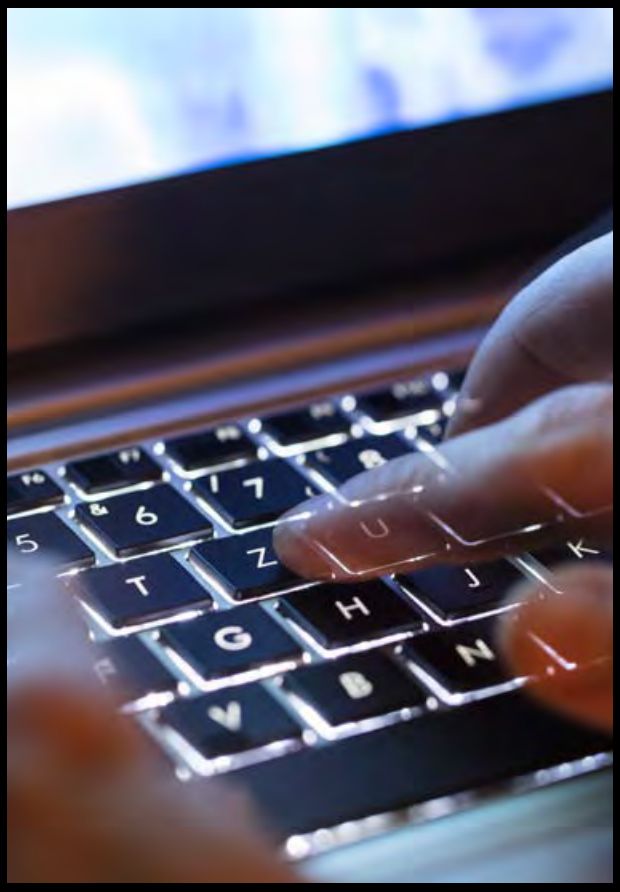
In many parts of Australia work is a highly carbon intensive occupation. Remote working, by fly-in, fly-out workers (FIFO) employed in Australia's resource boom, has lured especially skilled tradespeople away from cities and regional towns, towards remote communities. They depend upon regular regional air-transportation to move backwards and forth, and for the provision of key services, even healthcare. Whilst the COVID-19 pandemic and successive urban lockdowns have led the way towards home and remote working, they are strikingly unevenly enjoyed for only certain kinds of work and worker – particularly white collar office-based professionals, with vastly different consequences for agricultural work which has relied upon mobile migrant and tourist workforces. Agriculture, construction, manufacturing and tourism are amongst the key industries upon which just transitions to decarbonisation pivot.

MOBILITIES

Australia's vehicles are amongst the most polluting in the world, with carbon emissions higher than in the EU or the United States and contributing to a fifth of the country's total emissions. Efficiency standards, the elimination of the internal combustion engine, and targets for net zero mobility are below international expectations. Yet mobility transitions mean more than simply moving to low-carbon technologies; they also require a shift in the meanings, routines, and practices that shape mobilities within society. They also require attention to social inequalities in order to create a just transition. For instance, in Australia only 5-10% of daily journeys are taken on foot and the accessibility of alternative mobility options like this is unevenly distributed. In some places innovations in public transport (such as electric buses or autonomous metro) and e-micromobilities (such as electric scooters) are proliferating, with some Australian cities having expansive and accessible public transport systems. However, other cities and remote regions, especially regional and remote First Nations households, may not have access to options beyond private fossil-fueled automobility.

RENEWABLE ENERGY

The mainstreaming of small- and large-scale renewable energy technologies presents opportunities and risks for energy justice. In the absence of coherent national energy policy aligned with the imperatives of the climate emergency, renewable energy production and access remains geographically uneven and offers varying value propositions for producers and end-users. The benefits of rooftop solar PV in meeting household energy needs and improving energy affordability are unequally accessed, highlighting the limitations of "self-management" and energy market regulation. Meanwhile, remote communities outside of energy markets and poorly serviced by private providers stand to gain from off-grid renewable energy systems if carefully co-designed in place. Large-scale (corporate) renewable energy development intersects with First Nations land rights and has uncertain outcomes for Indigenous participation in decision-making and local economic development. Grassroots movements call for more radical community empowerment and First Nations justice through self-determination in local energy ownership and management. Tensions between corporate, public, and community-led development raise critical questions around responsibility for, and appropriate scale(s) of, essential energy services provision.



TECHNOLOGY AND DATA

The Australian government views technological innovation through a vague but hopeful lens: that global innovations, smarter use of data, and general market forces will drive transitions to decarbonisation. There are many opportunities to innovate locally, but there are conflicts in the means by which innovation is approached in domestic policies and strategies. Green investments often coalesce around emerging technologies such as blockchain, while programs to decarbonise existing technological infrastructure remain contingent on global transitions, including, the challenges posed by e-waste and energy-intensive data centres. These serve as reminders of how digital innovations negatively impact the environment through their manufacture and maintenance. Technology can also render individual users as commercial data points, and as vectors of cybersecurity risk. In everyday life, this raises questions of data governance, privacy, and user-centric control, and the role of citizens in transitions to decarbonised technology futures – concerns which Australia is yet to address.

1.5 Research approach

This report is primarily developed through collective synthesis and interpretative analysis by the authors on the basis of secondary data from across a range of sources, complemented with primary data from a limited number of interviews and submissions:

- An academic and grey literature review of the state of the art of policy and practitioner knowledge on transitions to decarbonisation in Australia.
- Semi-structured interviews were undertaken with academic project advisors at key positions within research networks, and with stakeholders in academic, public policy and community organisations.
- Drawing on the findings of existing and ongoing ethnographic, design ethnographic futures and interview based research projects being undertaken in Australia and spanning all the domains.
- Submissions from leading academic, policy and industry stakeholders.

1.6 How to read this report

This report is structured into four sections: 1) this introductory section; 2) a set of key principles for just transitions; 3) possibilities for just transitions; and 4) five detailed domain reports which provide the comprehensive evidence produced through the research process outlined in 1.5 above, and from which the principles have been developed.

The **principles** presented in **section 2** are a starting point to any person or organisation wishing to participate in a just transition. They embody the shared values that will be needed across all sectors of society for a just transition to take place. They are then explained further in the domain sections of **section 4** of this report. Therefore each domain should be read in conjunction with the principles.

Each domain is structured to report on policies, strategies and practices towards just transitions to decarbonisation within different social and economic sectors in Australia. Each domain begins with a summary, then a substantive, cross-cutting 'state of the art' section which draws across policy and examples with commentary and insights from academic literature, project submissions and interviews with academics, policy makers and practitioners in Australia. The domain reports all conclude with a set of **possibilities** which outline more practical, productive routes forward, and existing cases of a just transition in that particular domain. We summarise these in **section 3.**

However, because a just transition is a complex process, we emphasise that no single domain can be seen as existing – or being able to transition – in isolation from the others. The domain reports (**section 4**) offer important context for each of the other domains.

Principles for Just Transitions

2.1 Introduction

Australia is grappling with how to transition towards decarbonisation in ways that are environmentally sustainable and socially just, whilst at the sharp edge of the impacts of climate change. This report moves beyond a common focus on decarbonisation and the impacts for coal communities and workers. While the transition away from coal is important, the research underpinning this report acknowledges the much broader range of issues and concerns that underpin just transitions to decarbonisation.

Transitions to decarbonisation in Australia entail two risks: entrenching existing injustices associated with carbon-based energy systems and economic activities; and generating new conditions of harm and inequality as a consequence of introducing low-carbon energy systems.

Moreover, just transitions to decarbonisation need to consider implications and trade-offs across multiple intersecting domains and geographies of contemporary life, including the domains of the home, work and industry, mobilities, renewable energy, and technology and data.

Our research has identified **a set** of **key Principles** that are pivotal for successfully understanding and governing just transitions in Australia. Each of these Principles offers a different entry point from which stakeholders can approach the complex question of ensuring a transition to decarbonisation is just. These are not suggested as "do this" or "do that" instructions, as if a just transition could follow a simple recipe, but rather as propositions upon which to base/reflect on future actions and decisions.

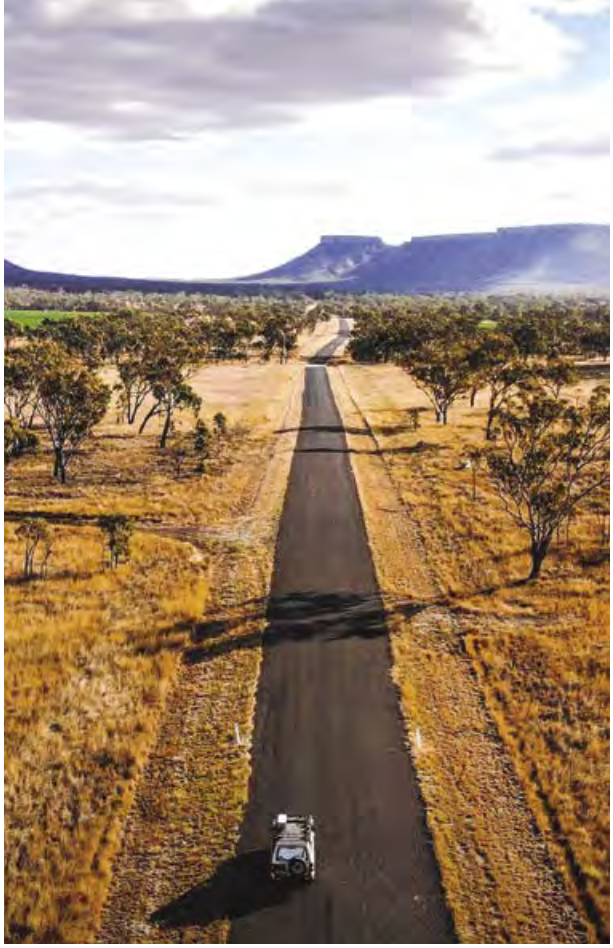
The principles presented here are organised through five key lenses: 1) places and scales; 2) timescales for transition; 3) innovation; 4) people, experiences and identity; and 5) responsibilities.

2.2 Places and Scales

For just transitions, we need to attend to how transitions unfold unevenly across different places and spatial scales. This means looking at different places and their spatial, material and social complexities, their climatic, geographical and housing variabilities, given that the sheer size, industrial, cultural and social diversity, and uneven population distribution of Australia presents a particularly challenging environment for enacting broad brush transition directives at the policy level, when their application might mean very different things for a rural or urban community.

Following Weller (2019), how places and regions are framed within just transitions to decarbonisation may be a way to serve strategic ends.

- **National policy directives for just transitions to decarbonisation must reflect the diversity and uneven population distribution of Australia.** The application of such directives will mean different things for rural, regional and urban areas. Disparities in energy infrastructure access for households in well-serviced urban centres compared with poorly resourced remote communities, compounded by climate extremes, provide a stark illustration. Accounting for diversity is necessary to avoid silencing and excluding certain voices and inhibiting community buy-in for decarbonisation initiatives.
- **In places with pre-existing carbon-intensive technologies and infrastructures, just transitions to decarbonisation should consider the spatially uneven costs and difficulties of moving away from these systems.** For instance, retrofitting or adaptive reuse of existing built environments may be cost-effective and avoid maladaptation in resource waste. Challenges to consider around issues of lock-in can also include, for example, not only the presence of roads built for the private car that are expensive to demolish, rebuild or adapt, but the legal and economic contracts they are tied up with, and the social structures dependent upon these infrastructures and the mobility they enable.
- **Just transitions require recognition that decarbonisation is unfolding on the unceded lands of First Nations peoples.** There is a tendency to see large parts of Australia as a deep well of untapped potential for green and renewable energy resources, without contemplating the cultural heritage and spiritual value of place for First Nations peoples. Transitions to decarbonisation can only be just if First Nations land rights and entitlements are upheld and strengthened, and where First Nations peoples and traditional landowners and custodians are empowered to participate and lead the transition.



- **Careful deliberation and transparency is needed around how the benefits and/or negative consequences of just transitions are understood and accurately communicated in and for localities and regions.** How places may be affected by transitions can be framed in different ways for a variety of political purposes. While the understanding of impacts can be important for identifying the most disadvantaged by transitions or the best forms of distributional support, local opposition can also be unfairly sidelined or dismissed on the basis of regional, national or even global benefit. Tendencies to orient transition as a way to garner global competitive advantage are popular and hopeful ambitions (Garnaut 2020). And yet, ambitions for Australia's transition to become a 'hydrogen superpower' may be at odds with just transitions at a local or regional scale given the continued use of coal or gas, and the faith in the efficacy of carbon capture technologies.

> It is the slippery nature of 'just transition' which allows it to become this kind of moral battering ram. Because the term doesn't specify which group and it doesn't necessarily specify even which scale, it's always open to contestation.
>
> *— Interview, Professor Lauren Rickards, RMIT*

- **The potential for scaling up production and deployment of clean technologies as part of a just transition must be considered across scales and geographies.** Hopeful ambitions for leveraging global competitive advantage and expanding international trade may be at odds with just transitions at local or regional scales. For instance, electric vehicle uptake in cities and big battery development at regional nodes can drive emissions reductions. At the same time, these interventions – alongside continued growth in energy demand – could strain mineral resources and supply chains, have other downstream impacts in terms of waste, and further entrench the lifestyles, social structures, and urban forms that depend upon the private car. Australia's movement away from coal use domestically, for example, may not prevent its exportation to other countries in the Asia Pacific. There is overall a need for a radical rethink of Australia's attitude to technological innovation in a global context. Other nations are looking to meet net zero targets by evaluating their progress based on the goods and materials they import, and whether these are produced in carbon-intensive ways (Wood et al., 2021). But Australia's current positioning sees it looking to preserve existing pipelines of exchange, remaining both reliant (on incoming goods) and contributing (through material like steel or energy like hydrogen) to the global flow of raw materials and products.

2.3 Timescales for Transition

Careful attention must be paid to the timescales for transition, including how these vary within and across domains. Appropriate timescales for implementing just transitions can only be understood in context.

- **Just transitions unfold over multiple and intersecting timescales.** For instance, workers and communities transitioning from fossil fuel industries have short-term needs for employment and income. In contrast, long-term renewable energy targets necessitate transmission infrastructure investment in the present, which may in turn be hindered by current national policy uncertainty. Energy regulators need to ensure immediate energy security by managing energy prices and deal with existing household vulnerabilities while also accommodating renewable energy uptake over time.
- **Just transitions means engaging with the implications of articulating speed, acceleration and urgency of transitions**. Short-term climate change imperatives and mid-century net zero emissions targets, as well as extreme climate impacts being experienced today, promote emergency and crisis policy responses. Nevertheless, care should be taken in how the speeds of transitions are communicated and proposed. There may be material consequences of moving too fast towards alternative practices and systems for those who get 'left behind' or who unfairly bear financial and other burdens of change. For example, the 'emergency' responses to the Hazelwood mine fire of 2014 tended to overtake and obscure the existing and longer term transition of the industry's decline, even if those transitions – when experienced by the community – were ultimately inseparable from the disaster.
- **Just transitions must avoid being based on vague or unrealistic ambitions.** Some responses to decarbonisation imperatives have been to defer decision making and investment in anticipation of future (technological) breakthroughs that reach far into the distance, without investigating or understanding the possible social implications and conditions associated with such breakthroughs. These approaches naively suggest that climate change can be managed without significant changes to lifestyles, built forms, and economic development. Our interviews show how actors such as the CEFC can leverage private investment by taking on shorter term risks themselves such as those associated with emerging technologies. Clear long-term policy settings are also needed to establish confidence for private sector investment necessary for scaling up low carbon infrastructures such as renewable energy.
- **Just transitions require better understanding of what is being transitioned from and to, and with what implications for whom.** This means engaging critically with framings of the past and recognising alternative histories and memories. Some transitions can be resisted by nostalgic ideas about a better past in the face of an unpredictable present and worse future. And yet, such ideas can obscure the existence of past transitions, for example from one

industry's predominance to another, which may have already generated injustices for localities, First Nations peoples, and environments. Historical and contemporary dispossession and marginalisation of First Nations peoples must be deliberately acknowledged.

- **How the future is (un)equally framed or imagined requires careful unpacking.** Workers and communities can easily feel 'left behind' or marginalised from future visions in which they do not appear to fit, or even to have a future. The social enactment and plurality of timescales through which transitions unfold and are framed – including past, present, and future opportunities and constraints – need to be engaged with explicitly to understand how time and transition is discussed and imagined by people and communities. This may include working with novel, more socially embedded and politically sensitive modes of exploring the timescales of just transitions such as through new techniques of futuring.

> [I]t's just not to downplay the importance of just transition but it's not the only transition. There's been a lot of unjust ones, which is not to say two negatives make a right.
>
> *— Interview, Professor Lauren Rickards, RMIT*

2.4 Innovation

The existing and dominant innovation paradigm in Australia follows a technological solutionist narrative, whereby technological innovation is uncritically seen as a solution to societal and environmental problems. This narrow approach to solving climate challenges has important limitations in terms of the extent to which social, ecological, and localised values and outcomes are understood and prioritised in investment and policy making. Just transitions should critically re-consider the role of technology invention, design, innovation and economic growth in decarbonisation. This means that to stand any realistic chance of a just transition to decarbonisation, a plural conception of innovation is needed beyond existing narrow framings of innovation as technological development for economic growth. Instead, new conceptualisations of innovation – including grassroots, social, and institutional innovation recognised and developed internationally and in Australia – are needed to acknowledge the role of people, communities and places in a just transition and to adequately respond to intersecting social and ecological challenges. It also requires consideration of innovation in dimensions beyond technology, such as institutions, governance, collaborative models, values, behaviour, culture, economic models and paradigms. Approaches to innovation for just transitions must reconsider what value means, to whom, and how it is created, sustained or disrupted in the first place.

> [T]here's a strong counter-current to think that there are tech fixes and that we maybe don't need policy fixes other than the policy which accelerates tech adoption. And I think that's a big tension in the policy development space, because the political ideal, I suppose, would be, we can keep doing what we do but just with cleaner technologies, and I think there's a question about the extent to which we can do that. They do solve a lot of our problems, obviously, but whether they're genuinely sustainable is … a thorny question
>
> — *Interview, Anthony, Transport for NSW*

- **New innovation frameworks and policies for just transitions are needed to adequately respond to intersecting social and ecological challenges.** Innovation occurs beyond technological invention through the application of new ideas, processes, and policies in organisations and institutions, governance frameworks, social practices, and economic models and paradigms. Collaborative, challenge-oriented, and grassroots models of innovation can help address the social and ecological short-comings of linear, narrow and technology-focussed models based solely on R&D, technology transfer and research commercialisation.
- **Everyday action should be considered as a driver and a conduit of innovation for just transitions, rather than simply an outcome of top-down change.** This includes the consideration of a broader range of actors as innovators beyond technology entrepreneurs or multinational corporations, such as community organisations, local governments, households, and NGOs. For instance, diverse participation in the early design phases of 'smart' systems and automated technologies is needed to avoid the unjust consequences of past interventions – such as the Australian Robodebt failure – which had disastrous consequences for the lives of people who were already severely impacted by social and economic inequalities.
- **Just transitions in settler-colonial states like Australia must advance the decolonisation of science, technology and innovation.** To do so, the value of Indigenous knowledges and the generative potential in collaboration should be recognised, and the 'where', 'how' and 'for whom' of the existing dominant innovation paradigm should be interrogated. This includes reconsidering the reliance of government and public sector organisations on private sector solutions (including taking guidance from consultancies, and buying in pre-made non-specific solutions from technology companies) – especially in the handling of data. A greater consideration of possible long-term harms is necessary, as evidence suggests that corporations and market-driven solutions are likely to profit from extending the status quo, at the expense of people and communities. New, collaborative, transformative and challenge-oriented models of innovation can help address the short-comings of linear, narrow and technology-focussed models based solely on R&D, technology transfer and research commercialisation.

> I'm always very, very frustrated by the kind of direction of policy mobilities that take place in Australia as often we look to the UK and press repeat [...] I think that the place specificity of Australia demands that actually we can be confident in developing policy in a way that actually starts out from the specific problems and challenges we are experiencing here rather than looking at what's worked elsewhere and then short cutting to an answer.
>
> — *Interview, Associate Professor David Bissell, University of Melbourne*

2.5 People, Experience and Identities

People, experience and identity need to be at the core of transitions to decarbonisation. Technology-led approaches characterised by top-down and short-termist interventions are inherently limited because they regard people as 'recipients' of transition, seeking their 'acceptance' or 'social licence' to proceed rather than creating meaningful engagement or active participation. Ignoring the complexity of lived experiences and identities may also lead to failed transitions. Such approaches are often based on naive assumptions that behaviour change can be brought about amongst individuals and communities through technological or policy interventions. However, research evidences that such approaches fail to account for the complexity of everyday life and are unlikely to have any lasting impact.

- **Just transitions must account for the complexity of everyday life to have a lasting impact.** A transition is more likely to be just if it emerges from the circumstances in which its justice will be experienced, and becomes integrated into the ways communities and people move forward in just transition, rather than in 'nudging' behaviours towards sustainability. This requires acknowledging that people are complex and their everyday lives are contingent on many factors. Existing initiatives tend to categorise people one-dimensionally in terms of their relationships to powerful organisations – such as the 'customers' of transport or energy companies, 'users' of technologies, or 'citizens' of states and cities – which fails to appreciate diversity and complexity.
- **Just transitions involve listening to and respecting local knowledge and everyday expertise.** This means avoiding making uninformed assumptions about or speaking on behalf of certain workforces, communities, and geographies. A wealth of existing knowledge and good practice which work towards transition to decarbonisation can be identified in everyday life, in people's own homes, communities, workplaces, and modes of transport. In order to ensure a just transition, these should be gathered, learned from, surfaced and shared. It is possible to build up from existing success and existing sites of justice. Failure to do this may result in slower or stalled transitions. Making assumptions about certain workforces, communities, and geographies and what would be just for them – rather than listening to them – wastes time.

> [T]here's a lot of talk in the Australian just transition space about coal workers transitioning to aged care workers and becoming happily ever after driving the school bus. A lot of that is fantasy really [...] I mean, coal workers working in aged care is really not going to happen and there's a lot of naïveté in the climate based transition people about labour market processes. If we create some jobs in aged care it will be alright but the coal workers aren't going to get them. Never ever.
>
> — *Interview, Associate Research Professor in Economic Restructuring, Sally Weller, University of South Australia*

- **A just transition is not simply an abstract process which can be modelled, but is always experienced as just from the ground-up.** Experiences of transition are personal, intimate, and felt, especially in terms of loss and harms to well-being, personal and social identities. As such, just transitions should be tailored to the experiences of those affected – at home, in work places, in communities. Assumptions of resilience and a suppleness to change (sometimes noted as strong Australian qualities of identity (Rickards et al. 2017)) should be seriously questioned. In the case of mining and extraction communities, it is clear that the work stretches far beyond remuneration and is a fundamental element of individual and community identity. A just transition must acknowledge this and work with individuals and communities to create shared forward journeys that ensure strong and supportive communities and secure, fulfilled and healthy individual identities. Transitions should be tailored to the emotional experiences of those it will affect, who may feel abandoned, carried away, left behind, shocked, resentful, angered by transition, and even threatened by the uncertain clouds of change (Bissell 2021).

- **Careful, embedded, and participatory approaches to just transitions from within communities are critical.** A just transition needs to recognise cultures and identities, and to design collaborative, participatory interventions towards transitions which emerge from and move forward within them. A just transition must work with individuals and communities to create shared forward journeys that ensure strong and supportive communities and secure, fulfilled and healthy individual identities.

> I think some of the language that is used around transformation and some of the presumptions about people's capacity to transition and to transform and to reinvent and to evolve is actually… it feels kind of unethical really. So this isn't simply about pivoting, for example, to a new economy. Some people just can't do that. So then the question from a policy perspective I guess is, okay, what can you do, what can you provide in that space that is both obviously material but also is about fixing and amending some of those intangible things that need repairing here that require consolation, that require repair?
>
> — *Interview, Associate Professor David Bissell, University of Melbourne*

> I'm really interested in those emotional and affective relationships […] for me emotion is really important in those ideas of power. How does it move us? How does it shift our ideas? [I]t's not a state you move to and that's it. It moves in and out [...] It shifts and I think because the environment itself keeps shifting and so these other things come up. People won't be having one feeling or one sensation at a time. It will be multiple, in all sorts of ways. So yeah, management is the wrong word. [...] We make decisions with this sort of bubbling away all the time.
>
> — *Interview, Associate Professor Michelle Duffy, University of Newcastle*

2.6 Responsibilities

Prospects for just transitions open up questions around the distribution of roles and responsibilities, including ensuring that the wellbeing of people, communities, non-human species, and the planet is central to decarbonisation. Financial and other costs and benefits of decarbonisation are unevenly and unequally shared in market economies without state intervention. Powerful private corporations stand to profit from expanding green markets, often subsidised by government investment. We also see communities mobilising around shared goals and collective self-organisation.

- **Consideration of democratic accountability and appropriate scales of authority and governance will underpin just transitions.** Business as usual governance frameworks position private investors as the likely beneficiaries of transitions to low-carbon systems – potentially at the expense of investment centred around the empowerment of households and localities. Just transition programs should consider which stakeholders take responsibility for management of costs, access, benefits, and individual and community wellbeing over time and space, including prospects for new governance arrangements. For example, how might energy market regulation at different levels of government facilitate greater local and household energy autonomy, or nationalisation of energy production? Localised collectives are already pushing the boundaries of incumbent systems through cooperative ownership of renewable energy assets and distribution of revenues in line with social goals.
- **Just transitions must be inclusive and participatory, and will likely benefit from cross-sectoral coalitions of actors.** For example, in the domain of work and industry, industry organisations who are seeking to monetise labour at every opportunity may be unwilling to take responsibility for a just

transition, while SMEs are usually unable to afford to do so. There is an urgent need for a powerful joined up strategy whereby government, industry, unions and (appropriately remunerated) workers can move forward by taking shared responsibility to design just transitions, and having the adequate time to do so with the communities affected.

- **Decarbonisation objectives should seek to overcome siloed governance.** They must consider and account for interconnections between systems, underlying processes, overlaps of responsibility, or unintended consequences and feedback loops. Integrated, multi-scalar and reflexive policy making is needed to avoid conflicts or contradictions. Insights from the energy sector highlight the need for horizontal coordination of multiple government department activities and strategies because of the way energy vulnerability and insecurity is an outcome of energy market conditions as well as housing and income. Similarly, within transport and mobility planning, operational priorities for road management, or breakneck suburban housing expansion, may undermine wider goals to encourage public transport or active travel.
- **Just transitions must attend to and resist the ongoing marginalisation of First Nations peoples in decision-making and benefit-sharing through decarbonisation.** The principles of Free, Prior and Informed Consent (FPIC) provide one framework through which decarbonisation projects with Indigenous peoples can be undertaken with mutual benefit, and where communities can fully consider, and be involved in leading decisions over, the implications of transitions on their freedoms and capabilities.

> [W]hat will this mean for people and how will this expand human freedoms and capabilities? That's what we're interested in.
>
> — *Interview, Honorary Associate Professor, Janet Hunt, Centre for Aboriginal Economic Policy Research (CAEPR), ANU*

Possibilities for Just Transitions

3.1 Summary

This section sets out a series of plausible and realistic possibilities towards a just transition in Australia. Transition is neither a linear nor a one-dimensional process, as demonstrated by the principles above, it works at different scales, levels and timescales. Thus, in seeking a just transition we must acknowledge that we will need multiple different, but connected starting points, tailored to the capabilities of different individual, organisational and political actors and necessarily shaped by shared values. The possibilities we outline therefore do not pretend to constitute what would always be an artificial vision of a 'whole' transition, pursued from just one perspective. Rather, they represent the lived and practical reality of the complex, messy and inevitable imperfect transition which Australia is confronted with.

> [T]here is incredible latent potential here for much more progressive, socially just ways of bringing about transitions
>
> — *Interview, Associate Professor David Bissell, University of Melbourne*

3.2 The Home

Everyday life in the home offers significant opportunities for a ground-up just transition to decarbonisation. A just transition offers the simultaneous opportunity to eliminate the existing inequalities and inequities in access to housing, renewable energy and technologies. Subsequently, the home could become a site for just transition if equitable modes of access to infrastructures, technologies, skills and human services were secured:

- A just transition is best supported by dedicated and tailored policies and initiatives for vulnerable and marginalised groups, particularly to support low-income households, those living in poor quality and/or rental housing, and people who do not have adequate digital skills or interest, or ability to access and afford emerging technologies, to participate in many of the opportunities proposed for an energy transition.
- Careful applications of emerging technologies supporting decarbonisation in homes could support a just transition. To achieve this, smart home and automated technologies and systems must be tailored and flexible to people's real needs and must enable people to feel in control of technology and its data security and privacy settings. Supporting trust in energy policy, businesses and companies involved in the transition, and in technology itself, must underpin the transition.
- A just transition at the household level could be one of the key elements underpinning processes of transition from the ground up, but it will only be achieved if it is built on deliberate and committed research and design with those households, especially people typically unable to participate. Further immersive and place-based social science and futures-led design, testing and trialling of the human services and technologies required to support such a transition would facilitate this process.
- Future research must also be attentive to how property ownership and living arrangements are envisaged and hoped for in the future, and accommodate these visions to plan for and co-design inclusive, just and enduring transitions that people will be able to fully participate in as we move into near and far futures.

3.3 Work and Industry

Just transitions in the workplace represent a challenge of significant magnitude, involving diverse industries, workers and stakeholders. Across all sectors, important decisions must be made around who takes responsibility for the costs of investment? And who reaps the benefits of this investment in a transitioned future? In the past, and in other international contexts, there has been governmental responsibility to pay costs and fund investment, whilst private industry and shareholders have reaped the benefits (often in lieu of local residents, workers, and communities experiencing the benefits they deserve).

- The evidence demonstrates that private industry alone is neither willing, nor capable, of instituting just transitions toward decarbonisation for Australian workers. However, possibilities for a just transition are most likely to come about through collaborative and cooperative initiatives between stakeholders who are given 'time' to prepare adequately.
- The question of 'who takes responsibility' is fundamental to making just transition in work and industry possible.
- The futures of Australia's diverse industries are entangled and interdependent. Acknowledging this and making the interdependencies visible creates the opportunity to account for and address the 'hidden' emissions across the sectors.
- Economic and employment vulnerabilities are also often entangled with environmental vulnerabilities.
- New possibilities towards a just transition would be created by revising the current innovation paradigm, which currently holds a just transition back because it supports socio-economic systems that lead to inequalities and modes of exclusion which impact people's working and non-working lives deeply.
- The Australian Cooperative Research Centre (CRC) model provides a fruitful possibility. A CRC for Just Transitions would provide a basis for private, public and university sector partners to co-invest in just transition processes.

> [T]he main thing is sufficient time, that companies are required to announce closure… four, five years in advance, so people can plan, they can make adjustments, you can… you can get all the detail you need about that workforce, what it looks like, the level of skills, the training, experience, if need be. [...] just having time is incredibly important. [...] So, for me that one thing, that makes a huge difference.
>
> *— Interview, Associate Professor, Darryn Snell, RMIT*

3.4 Mobilities

The unequal distribution of mobility options poses challenges when the way we move about is the lifeblood of society. Mobility helps in fulfilling social obligations and responsibilities, accessing services, participating in work, taking time off, and ensuring that commodities and goods can get from one place to another. Mobility in Australia is also highly meaningful. It is a way of accessing landscape and Country, a cultural practice of identity and status. And yet, so embroiled in everyday life – as well as complex systems and infrastructures – transitioning to decarbonisation is an integrated problem that requires an integrated solution.

- Moving beyond the technocentric view is an important process if the 'just' aspects of a transition are to be addressed. This could involve 'commoning' mobility – a way of collectively shaping fairer and greener forms of mobility, bringing decarbonisation transitions together with mobility justice and equity.
- Reducing car use, and expanding public transport and active travel, would both contribute to a just decarbonisation transition in the transport sector, with broader improvements to liveability and wellbeing. Achieving this requires attention to the needs and practices of diverse groups of peoples in Australia.
- Integrating mobility transitions within urban planning constraints, housing markets and density, services, and work and employment is essential given their interdependencies and the social structures that they enable – such as long distance commuting across large metropolitan regions. Ambitious strategies at the local and state government level – and cooperation between them – are providing some possible entries to these issues.
- Cultures of individual and private mobility, and associations of the car with identity and status, are engrained but may be reshaped through the generation of participatory and shared processes and values, even in the transition to electric vehicles.
- Attention to how mobilities are likely to be shaped by the needs of future everyday life, in relation to homes, work and technology – and through research and design with diverse communities – will enable more effective planning for flexible pathways towards a just mobilities transition.

3.5 Renewable Energy

The possibilities for just transitions in the energy sector can be understood across varied configurations and scales of renewable energy infrastructure and services provision. Opportunities for realising energy justice can be identified in terms of recognition of structural inequalities and injustices, democratic participation and non-discrimination, and fair distribution of costs and benefits.

- Individuals can increasingly exercise agency through their choice of energy provider within the energy market. In contrast to commercial models, cooperatively owned and other social enterprise type energy retailers are offering consumers both green electricity supply and the opportunity to have a say in how the provider's profits can be distributed in the community according to social priorities.
- Renewable energy investment designed for distribution is more likely to achieve equitable access to renewable energy than individualised market interventions. Adequate regulation of energy markets should minimise unfair and burdensome cost transfers to consumers least able to afford them (including environmental levies and network upgrade costs). Prioritising public investment in renewable energy and energy efficiency upgrades in social housing and remote communities – alongside increased income support – can address structural energy vulnerabilities.
- Participatory and democratic modes of renewable energy development can respond to the energy needs of households and communities in ways that empower people and centre First Nations justice. For large-scale developments, negotiation of land use agreements between corporations and Traditional Landowners according to principles of Free, Prior and Informed Consent (FPIC) provide opportunities for local economic development and enhanced land management.

Local, community-owned renewable energy development can enable energy transitions that reflect shared local priorities and needs and generate local wealth, including those led by First Nations peoples as a form of self-determination. The **First Nations Clean Energy Network** is playing a leading role in this agenda.

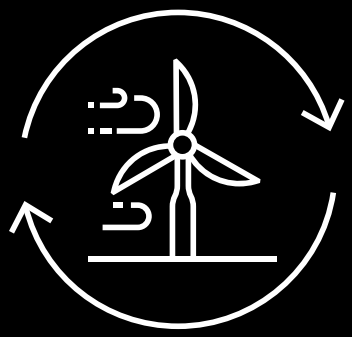
- These insights demonstrate the value of place-based experimentation and challenge-oriented innovation policy that foreground social and ecological objectives as part of a just transitions research and action agenda.

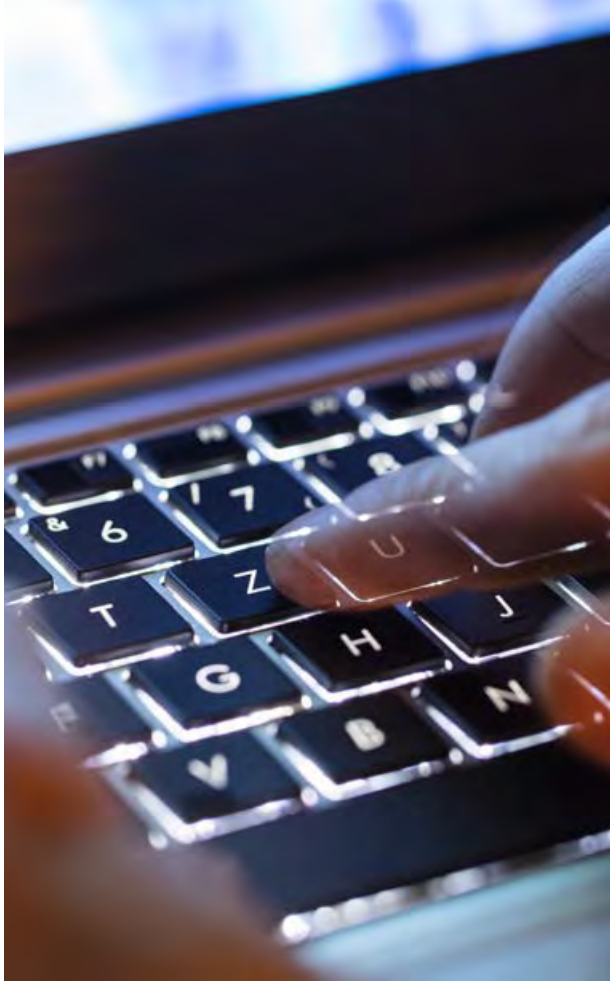
SUPPLIER LED VS COMMUNITY LED ENERGY PLANNING

"We've got this great renewable energy, clean energy system that we're selling. We know exactly what you guys need and this would be great for you."

It's kind of like, well that's not your call to make. That's the community's call to understand what the implications of these things are, and in the end they have to live with that. Success is self-defined so those issues of equity between households, those sort of decisions are really important, and it's important to genuinely involve people in those decisions, not just some implicit agreement - but actual free, prior and informed consent.

— Interview, Research Fellow, Brad Riley, Centre for Aboriginal Economic Policy Research (CAEPR), ANU.





3.6 Technology and Data

There is not a particularly 'Australian' manifestation of data use, technology enterprise, or consumer behaviour for decarbonisation. Australia's position on technology investment – which prioritises cheap short-term action, a resuscitated manufacturing identity, and a longer-term stance of 'watching' overseas developments – sits in tension with a recognition of the need for local innovation. There are many opportunities, and an emerging community groundswell, for the bridging of these tensions, and to accelerate just technology transitions. The private sector drives much innovation in Australia, while government investments remain vexed: publically stalling innovations in some areas, while also making significant investments in emerging technologies. Greater harmony is needed to achieve net-zero goals in a transparent, consultative, and *just* manner.

- Just transitions in the technology space show the importance of thinking globally and locally, as Australia relies on imported devices and systems. Developing a focus on such an approach would open up increased possibilities towards a just transition.
- There is an opportunity to enshrine green, equitable, consultative practices in all new technological design. Importantly, through avenues such as reuse and recycling, these principles can be articulated in the present.
- Developers of energy-hungry infrastructure (i.e., cryptocurrencies) and data-driven systems should – and some are beginning to in Australia – enshrine net-zero aims, and prioritise these ahead of cybersecurity and wealth generation.
- The role of people, as communities and as individual consumers, citizens, and technology users – must be considered in all future technology design and development.

There are possibilities to re-think technology design and development to account for and involve people and their everyday circumstances and needs in processes of transition to decarbonisation from the outset.

Domain Transitions

4.1 The Home

SUMMARY

Australian housing aspirations have long been characterised by the quintessential dream of an owner-occupied 'quarter-acre block' with a house, shed and yard or garden (including pets). While there has been increased demand for apartment, unit and townhouse living, particularly in inner urban areas, the goal to own land in Australia persists, as evidenced by housing demand and the continual expansion of cities into suburban areas on the urban fringe. Furthermore, opportunities to participate in the energy transition typically rely on people living in owner-occupied housing in order to access solar PV generation, battery storage and/or electric vehicle charging opportunities. However, for many Australians, this Australian 'dream' is not attainable. Access to homes in Australia is inequitable and this means that access to the means to participate in transition to decarbonisation is unequal.

The sheer diversity of the Australian climate presents challenges for residential decarbonisation transitions. Regional and local climate variations (including urban heat islands) require flexibility in any national strategies. Therefore, local policies and practices have emerged that directly address the challenge of home energy consumption in local contexts. Historically, approaches to energy consumption in the Australian home have taken on one of two modalities. First, homes have been the site of vernacular strategies toward temperature regulation - such as common-held knowledges on how to effectively cool a room, or architectural norms that encourage ventilation - that require low levels of energy consumption. Second, homes (and practices and routines within them) have been developed on the basis of inexpensive and readily available energy that has been used to artificially cool or heat homes using air conditioning appliances. Changes in the home to reduce energy consumption must become widespread for just transitions to take place. However, with the advent of climate change, higher energy and housing prices, poor housing quality, and uneven access to efficient appliances and energy technologies, many households now experience energy poverty and/or heat stress at home, despite new policies and programs for increasing rooftop solar PV generation rapidly growing in popularity. With relatively high rates of rental accommodation and rising numbers of houses with both multiple and single occupancy, vital questions are raised over who is responsible for financing investment for those who can't easily access or benefit (as in rental properties, it will be tenants who face higher energy bills if landlords do not make investments into making their homes more efficient).

In sum, the home is a vital domain for the successful transition towards decarbonisation. This has been exacerbated by the COVID-19 pandemic that has seen many Australians spending more time in their homes than ever before, and with an unclear future for work-from-home policies, may continue long into the future.

4.1.1 Access to safe housing in Australia

In Australia, 66% of households own their own home (with or without a mortgage), and 32% rent their home. According to the ABS 2016 Census, there are nearly 8.3 million households (AIFS, 2021). In the last 20 years, there has been a slight trend away from detached dwellings (down from 76% in 1996 to 73% in 2016). The increase is due to a rise in semi-detached row or terraced housing and townhouses (13%) and flats and apartments (13%) (AIFS, 2021). Intergenerational inequalities are leading Australians to opt for shared living in older age (Maalsen, 2018). However, in the longer term, from 1911 to 2016, household size dropped from 4.5 to 2.6 people. This has corresponded with a reduction in the number of families living in homes (71% in 2016 down from 77% in 1986) and an increase in single person households (19% in 1986 to 24% in 2016) (AIFS, n.d.;ABS, 2019).

In considering a just transition we must account not only for this majority. While the home is a sanctuary and safe harbour for many, women are particularly likely to feel imprisoned or persecuted within their own homes through domestic violence, and sadly, the home is the most likely place for a woman to be killed by an intimate partner or family member (UNODC, 2018). Moreover, the ABS estimates that in Australia over 116,000 people were homeless as of Census night 2016. Of these people, 58% were male, 21% were aged 25–34 and 20% identified as Aboriginal and Torres Strait Islander Australians (ABS, 2018). Overcrowding in dwellings is a key reason for homelessness (AIHW, 2021). Contrary to common assumptions that homeless people have no sense of home, research shows they engage in homemaking and create alternative versions of 'home' (Pleace et al. 2021) that must be considered in just transitions.

Persons by homeless operational groups, 2001, 2006, 2011 and 2016 (a) (Australian Bureau of Statistics 2018)

	2001		2006		2011(b)		2016	
	no.	%	no.	%	no.	%	no.	%
Persons living in improvised dwellings, tents or sleeping out	8,946	9	7,247	8	6,810	7	8,200	7
Persons in supported accommodation for the homeless	13,420	14	17,329	19	21,258	21	21,235	18
Persons staying temporarily with other households	17,880	19	17,663	20	17,374	17	17,725	15
Persons living in boarding houses	21,300	22	15,460	17	14,944	15	17,503	15
Persons in other temporary lodging	338	-	500	1	682	1	678	1
Persons living in 'severely' crowded dwellings	33,430	35	31,531	35	41,370	40	51,088	44
All homeless persons	**95,314**	**100**	**89,728**	**100**	**102,439**	**100**	**116,427**	**100**

Table: *- nil or rounded to zero (including null cells)*

a. Cells in this table have been randomly adjusted to avoid the release of confidential data. As a result cells may not add to the totals.

b. Homeless estimates from 2011 for the category 'Persons living in boarding houses' have been revised.

4.1.2 Building and energy efficiency and standards

There have been many attempts to ensure that housing in Australia responds to the unique and often harsh climatic and weather conditions, whilst also expecting considerable resilience from residents with regards to living with the country's environmental conditions. The classic "Queenslander" home, for instance, is an iconic housing style in Australia originating from the 1920s that responds to the subtropical conditions experienced in the North-Eastern state of Queensland through a combination of materials, techniques and preferences. Typically raised on timber posts, a distinctive feature of the Queenslander house is its ventilation design to capture summer breezes (Bell, 2002).

In the second half of the 20th Century, housing standards in Australia typically lagged behind other parts of the world due to the country's affordable energy and seemingly abundant water supply. Trends towards larger house size, open plan living, and master-planned estates with less than ideal orientation and efficiency features, meant that by the later part of the 20th and early 21st Century, there was a concerted policy effort to try to improve building standards. Rising energy costs and prolonged droughts have also placed pressure on Australians' ability to afford and access energy and water for their homes, on the scale they had previously been used to.

> Australia has been a very slow adopter of energy efficiency requirements, and the current minimum standards still fail to reflect international benchmarking regulatory practices. Australia's minimum energy efficiency requirements have not changed in over ten years, and current standards are not set to cope with climate change and accompanying temperature extremes, posing significant implications for household energy costs and health.
>
> *— Submission, Energy Consumers Australia, February 2022*

Australia's building stock has one of the world's worst carbon emissions per person (ASBEC, 2008). The residential sector makes up 50% of the carbon emissions of the building sector (Shiel et al., 2017). Moreover, 8 million Australian homes contribute to between 18-20% of Australia's carbon emissions. This is because these houses were built before energy efficiency standards were introduced into the Building Code of Australia in 2003 (PowerHousing Australia, 2021). For example, in Adelaide's CBD and surrounding suburbs, multi-story box like housing designs which have no eaves and positioned completely adjacent to other houses, has meant that these homes are forcing individuals to rely heavily on air conditioning in order to keep their homes cool (ABC News, 2018). ClimateWorks (2021) found that if Australia is due to meet the climate target of 1.5 degrees of warming, then it would need to retrofit roughly one million homes a year by 2030. Therefore, the development of sustainable residential building development is crucial to Australia's decarbonisation and this mobilisation of a just transition to decarbonisation (Foong et al., 2017).

The impacts of Australia's inefficient housing stock are unevenly experienced. For instance, up to 40% of Australian households who rent face energy hardship (Daniel et al., 2020). Renters and people

living in social housing are typically unable to afford more efficient housing and are commonly ineligible for energy efficient incentives or upgrades (Moore et al., 2017). Similarly, other vulnerable groups are more likely to face energy hardship at home, including people with low incomes, underlying health issues, lack of social support or people living with entrenched disadvantage, people living in dwellings with poor conditions, and older people (Daniel et al., 2020; Moore et al. 2016; Willand & Horne 2018).

> The prevalence of poor-quality and poor-energy efficient housing in Australia affects households very differently, bringing to light the inherent discrimination towards low-income households in the housing market.
>
> — *Submission, Energy Consumers Australia, February 2022*

Many First Nations peoples across remote parts of Australia live in very poor housing conditions. Among the 79% who live in large regional centres or in major cities, First Nations peoples were three times more likely to live in dwellings which were deemed poor quality housing (Anderson et al., 2018). As such, First Nations peoples are much more likely to live in dwellings which are inefficient in terms of energy usage due to this poor quality housing, alongside other issues such as poor quality appliances or overcrowding. In terms of decarbonisation, Race et al. (2016) identify the design and quality of housing as being critical components to mitigate the impacts of climate change and advocate for the improvement of energy efficiency of social housing and rented homes mirroring UK strategies for eradicating energy poverty. In central Australia for example, a high proportion of First Nations peoples live in public rental housing. Upgrading the energy efficiency of these rental homes could help housing tenants to meet the operating costs of electrical equipment such as air conditioning systems. Begg et al. (2019) argue that there are opportunities to improve Aboriginal housing by retrofitting the

building envelope, to improve internal heating and cooling. The Aboriginal organisation Original Power, have advocated strongly for these improvements and produced educational videos such as Power Story (2021) that share stories of energy (in)justice and insecurity to First Nations peoples.

4.1.3 Heating and cooling the home

Heating and cooling contribute significantly to energy demand in the home, and are a key driver for peak electricity demand. Trends towards open-plan living and intermittent heating and cooling, used 'when people need it', has contributed to the highly variable and weather-dependent nature of Australians' heating and cooling usage (Strengers, 2010; Strengers & Maller 2011). A strong ethos of not wanting to 'waste' energy, and a long history of using natural ventilation and living with local environmental conditions, has led many Australians to a pattern of heating and cooling rooms and homes in response to temperature and humidity changes (rather than working towards a regulated climate-controlled environment).

Research with Australian households shows that they are very resourceful and creative in making use of local weather conditions, drawing on a range of know-how, infrastructures and technologies, to stay warm and cool at home. The Australian summer is also characterised by days on the beach or by the pool. Many seek refuge from the heat in cool public or private spaces, such as libraries, shopping centres and cinemas. Shading, ventilation and clothing is also critical to how Australians approach comfort in their homes.

While Australians are largely adaptable and resilient to the climatic conditions, there is considerable variation in home comfort based on geographic location, the urban heat island effect experienced in less shaded and more built-up areas, housing style and efficiency, and the ability to afford and access heating and cooling retrofits and technologies (Farbotko & Waitt, 2011). These variations are inequitable, with wealthy households more likely to live in leafy shaded suburbs with efficient housing stock and access to heating and cooling technologies. Energy poverty, which is particularly impactful on home comfort, disproportionately affects disadvantaged and vulnerable Australian households (Moore et al., 2016; Willand & Horne, 2018). This is especially significant in remote communities with high rates of energy disconnections in the face of significant energy costs, with follow-on public health impacts (Longden et al. 2021).

Heat stress is a growing concern and problem in Australia, with heatwaves the biggest cause of mortality of all natural disasters (Maller & Strengers, 2011). Further, there is confusion and disparity between housing, health and energy policies in Australia when it comes to managing heat stress at home (Nicholls & Strengers, 2018; Strengers & Maller, 2011). Health policy recommends running air conditioning during heatwaves. However, energy and housing efficiency policies stress only using air conditioning when needed, whereas energy demand management policy is concerned with reducing peak demand during the afternoon and evening peaks, when heat stress is likely to be at its worst (Strengers & Maller, 2011).

Recent research suggests that Australians' expectations for heating and cooling are expanding to include a desire for healthy and safe air (Strengers et al., 2021b). New ventilation and purification technologies are becoming popular as households seek to ensure their air quality is safe and free of pathogens, smoke, pollen and viruses. This may change demand for cooling and purification appliances, and lead to further inequalities regarding who has access to healthy air in their homes. Low-income households, and people living in social housing or poor-quality housing already have poor access to heating and cooling technologies. They may face further inequities in accessing healthy and cool/ warm air as the impacts of climate change worsen (Moore et al., 2016).

4.1.4 Home-based sustainability

Australians, as for people in other affluent countries, have demonstrated deep commitment to what Hobson (2006) calls the "techno-ethics of sustainable living", by embracing devices and technologies to help improve the efficiency and sustainability of their everyday practices. This includes switching to energy-efficient light bulbs and water-efficient showerheads, embracing home composting and 'green bins' instigated by local councils and environmental groups, participating in household recycling, and purchasing energy-efficient appliances, technologies and housing upgrades. Sustainability programs are now part of Australian school curriculums, and a common lexicon for 'normal' living in modern Australia.

Studies have demonstrated Australians' ingenuity and resourcefulness in responding to climate change and other environmental challenges, through labour-intensive practices (such as collecting buckets of water in the shower to use for other purposes, or cooling down with wet towels draped over low-energy fans) (Sofoulis, 2005; Strengers & Maller, 2012). Research suggests that women, suburban-detached households and lower income segments of the population do the most extensive 'work' involved in these forms of environmental sustainability (Wait et al. 2012). This raises further questions about who is responsible for, and engaging in, the everyday labour involved in a just transition, and how this may exacerbate existing household and societal inequalities.

4.1.5 Home technology transitions

During the early 21st Century, government subsidies and incentives, combined with recognition of Australia's significant capacity for solar generation (due to the climate and prevalence of single-storey housing), led to a significant increase in rooftop solar installation (ACOLA, 2021) and more recently battery storage (CEC, n.d). Australia has the world's highest per capita solar capacity, overtaking Germany in 2019. However, like efficient housing, access to solar energy technologies is unevenly distributed, with many low-income households unable to afford or access solar schemes (ACOLA, 2021). In addition to individual solar schemes, households and communities are also embracing micro-grid opportunities, and other collective schemes that enable participation in decarbonisation efforts (Lovell et al., 2017; Ransan-Cooper et al., 2020; Temby & Ransan-Cooper 2021). However, as already identified, households without the appropriate housing style, ownership, or income are often excluded from these opportunities. A further complication are recent issues in some states and electricity distribution networks, where there is excess generation during the day from rooftop solar PVs. A range of policy responses are currently being canvassed that pose challenges to a just transition, such as turning people's solar off during the middle of the day if unused (ABC News, 2022), or charging people for returning excess solar generation to the grid during peak generation periods (ABC News, 2021a). Such schemes could undermine householders' return on investment for installing solar PV panels, or require further household investments (e.g. in battery storage) to store excess solar energy during the day, which not all people can afford. Off-grid solar systems have been deployed in remote communities for decades to address energy network infrastructure deficits and reliance on expensive and intermittent diesel fuel generators. At the same time, rooftop solar uptake has been limited in remote communities, in part due to solar tariffs being prohibited for households on prepaid energy cards.

Individual smart devices or fully automated smart home systems are also gaining popularity in Australia, most commonly in the form of off-the-shelf smart control devices. The energy industry and policy-makers are increasingly interested in promoting and incentivising smart technology to enable energy demand response and more efficient usage (Dahlgren et al. 2019; Strengers et al., 2022). However, this is difficult to achieve for a number of reasons.

First, initiatives led by the energy sector are often initially met with confusion or distrust by householders, particularly where they require remote control by third parties. Second, research suggests that Australians typically take up these devices for convenience and lifestyle improvements

rather than to solely pursue energy reductions or demand response (Dahlgren et al., 2019, 2021; Hazas & Strengers, 2019; Jensen et al., 2018; Nicholls et al., 2017; Tirado Herrero et al., 2018; Strengers & Nicholls, 2017; Strengers et al., 2019b; 2021b). For example, a smart controlled air conditioning system enables remote control in case someone forgets to turn it off before leaving the house, but it also enables pre-cooling before people come home.

> Policies that remove consumer autonomy, whether through automation or switching off a household's solar, require social licence and trust that are currently lacking in the energy sector.
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A third complication is that smart home automation becomes embedded into household routines and dynamics. Australian research indicates men typically instigate bringing smart devices or automation into the home (Strengers & Nicholls, 2018; Strengers & Kennedy, 2020). However, using automated technologies to make the home more efficient or demand responsive can often be thwarted by the routines and desires of other household members. Promoting advanced technology as the "solution" to a just transition not only risks overlooking the diverse members of a household, but is unlikely to achieve the desired outcome (Strengers 2013). In fact women, teenagers, children and pets all contribute to resource efficiency and demand responsiveness of a household, and require different modes of engagement with (and without) emerging technologies) (Gram-Hanssen, 2007; Johnson et al., 2020; Nicholls & Strengers, 2015; 2018; Strengers et al., 2016).

A further consideration in the just transition towards smart technology and smart homes, is access to reliable and affordable internet. In regional and rural Australia, and in many other parts of the country, households regularly experience blackouts and internet outages due to storms and weather events (e.g. bushfires). In research with Australian households, we've explored how these outages can 'reset' smart home devices, rendering their programming unworkable, and requiring reprogramming. This can cause complications in households where only one person has the technical skills to perform these fixes, or in households that have poor digital skills and rely on outside help (such as older households) (Strengers et al., 2021a; 2021b).

More broadly, digital inclusion is a significant issue for participation in a just transition. The 2021 Digital Inclusion Index shows that 17% of Australians remain excluded from access to or ability to use digital technologies and services effectively (Thomas et al., 2021). Highly excluded people "are most likely to have not completed a secondary education (38%); fall in the lowest income quintile (31%); live in a single person household (26%); have a disability (23%); currently be unemployed (21%); or not be in the labour force (22%)" (Thomas et al., 2021: 5).

ELECTRIC VEHICLES (EVS) AT HOME

This example draws on cases presented in the Monash Digital Energy Futures documentary film (Pink, 2022). The documentary takes us into the lives of five participating households, whose experiences contrast with each other to reveal both how people currently use and envisage themselves using EVs in the future, as well as the socio-economic and gendered inequalities, and place-based variations implicated in this.

What becomes clear is that while EVs reduce costs for some - those who have the financial and space assets that enable them to invest in solar, and to be able to cover the initial costs of purchasing an EV, stand to benefit in terms of cost and convenience. However those who have no access to solar energy at home because they live in rented accommodation or an apartment (or both) or cannot afford the initial financial outlay, will be less likely to afford an EV, and will bear higher financial costs and inconvenience in charging it.

The other key point to observe is how the contingencies and priorities of life make any ambition or steps towards transition for any household or individual, essentially uncertain, and likely to change rather than being on a linear trajectory towards reducing carbon emissions.

Ruslan and Olga: Ruslan and Olga were a young professional couple, originally from Ukraine, who lived with their 'Covid puppy' in a two bedroom apartment in a Sydney suburb. They would like to have solar and an electric car. At the moment they could not install solar because they were renting and because they lived in an apartment, but they were saving to buy their first home. They had a garage but no access to fast charging facilities for an EV. While they were committed to sustainability and highly literate around energy and costs, they felt they could not consider purchasing an EV due to the cost, because property prices in Sydney are very high and their first priority was to save for their own home.

In this case the participants were on a trajectory towards reducing their carbon emissions, but the costs of buying their own home would make it unlikely to either install solar panels (unless they were able to afford a house rather than an apartment, or buy into a sustainable apartment complex) or purchase an EV, in the near future.

Pamela: Pamela was in her 70s, she lived alone in her own three bedroom home in a coastal suburb of Sydney. Pamela had invested in a small number of solar panels and an EV. She charged her EV overnight at home in her garage, using a timer to remind her to go and switch it on at night and off in the morning. She was perfectly happy with her labour-intensive system. She also rarely used air conditioning, relying on the breeze through the house for cooling most of the time. Therefore we might see Pamela as on a progressive trajectory to reduce her carbon emissions, and her energy costs. However, life is more complicated than this, since when we interviewed her Pamela was about to leave this well designed set-up which worked for her, to move over to the other side of the city so that she could live nearer to her daughter and, now she had retired, spend more time with her grandchildren.

In this case while the participant had created a system that on the surface appears to be on a particular trajectory, her life was about to change. We might assume that she would set her new home up with solar panels, but we also need to acknowledge that there could be contingent circumstances that make this impossible.

— Digital Energy Futures Documentary, Sarah Pink 2022.

4.1.6 COVID and working from home

The COVID-19 pandemic oriented everyday life towards the home and during Australia's particularly long lockdowns, many people have been required to work and study from home. In response, housing has been retrofitted into offices, schools and workplaces.

The American Council for an Energy Efficient Economy (2018) ranked Australia as one of the world's worst countries for transport energy efficiency and, before the pandemic, full-time workers in Australia's major cities spent an average of 67 minutes commuting daily (The Productivity Commission, 2021). Working from home has therefore been seen as a key mechanism for reducing carbon emissions from everyday travel. However while this shift to working from home may appear to support decarbonisation, there are a number of ways that it does not support a just transition.

Even before the pandemic, unpaid work was disproportionately undertaken by women (Derndorfer et al. 2021) and women performed 'three-quarters of unpaid care work' (Charmes 2019: 3) and domestic services of housework, care of household members, and community services. In Australia, women spend 308 minutes daily completing unpaid care work, while men spend an average of 172 minutes. During the COVID-19 lockdowns, the volume of unpaid work increased with schools closed and the support needed by elderly friends and relatives, and this was mainly delivered by women (Richardson and Denniss, 2020). In the new hybrid working arrangements women may be disproportionately impacted (Nicks et al., 2021) because caring responsibilities are likely to oblige them to stay at home. This raises concerns that women in this position will be less likely to be promoted or get a pay rise (Partridge, 2021).

Home working for long periods can also create feelings of isolation which impact upon workers' wellbeing and relations with family members and co-workers (Preece et al., 2021) with possible effects, including loneliness, isolation and mental health (Productivity Commission 2021 and see Fell, 2020). The Australian Unity Wellbeing Index (Cummins et al., 2021) found social connectedness with work colleagues correlated to high levels of wellbeing.

Australian homes have also been modified to accommodate home entertainment, gyms and exercise, electric cooking devices, food deliveries and new hobbies. This involves shed retrofits, granny flats and alternative living spaces (Middha et al., 2022, Strengers et al., 2021b). Emerging digital technologies, such as air purifiers, are increasingly popular to ensure the safety and health of home occupants, and other emerging technologies are being incorporated into everyday life to provide security and comfort (Strengers et al., 2019a; 2021b). These emerging lifestyle benefits centred on the home, may undermine or complicate efforts towards decarbonisation.

Australia already had one of the highest rates of pet ownership in the world prior to the pandemic (particularly cats and dogs) (Newgate Research, 2019) and this increased during the pandemic. Pets left home during the day may be vulnerable to heat stress if left inside inefficient housing, or if unable to access a yard or shade (Strengers et al,. 2016; Strengers et al., 2019b).

4.1.7 Policies Towards Decarbonisation

There have been a variety of policy initiatives operating at a range of scales in Australia to address the need for increased efficiency and a transition towards decarbonisation in the Australian home. An important focus has been on the need to balance supply and demand by using or storing available rooftop solar generation, and by reducing peak demand during the afternoon/ early evening, particularly on hot summer days, when people typically run air-conditioners and other appliances at home. Outlined below are a range of projects funded through the joint Australian Renewable Energy Agency (ARENA) and Australian Energy Market Operator (AEMO) across Victoria, South Australia and New South Wales to free up temporary supply during extreme weather – such as prolonged summer heatwaves – and unplanned outages. This is followed by discussion of a range of other regional scale policy initiatives.

Some, but not all, of these policies and projects include a social justice dimension, as advocated by Energy Consumers Australia as an essential component of a Just Transition.

Various programs in the Demand Response Funding Round, Australian Renewable Energy Agency (ARENA)

In 2017 ARENA opened the Demand Response Round to fund projects that support the integration of renewable energy into the National Electricity Market (NEM) through demand side management. The aim of demand management is to improve the reliability, security and cost effectiveness of an energy system by managing energy loads (consumption), particularly during periods of peak demand. The Demand Response round distributed $35.7 million across 10 pilot projects intended to manage electricity supply during extreme weather.

This could include supporting policies that help overcome the barriers some consumers face in adopting new technology. It also includes ensuring that policies around how the cost of network infrastructure is recovered are fair, so the cost burden does not fall on a shrinking group of customers who can only access energy via the grid.

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Although the funding recipients included industrial and commercial trials, a number of projects trialled demand response in households (ARENA, 2017a). The programmes were wide-ranging and were met with varying degrees of success that are briefly evaluated below.

The **Pooled Energy Demonstration Project** (ARENA, 2017b) sought to automate the maintenance and heating of domestic swimming pools in order to reduce household power consumption, including during peak times. As of May 2021, Pooled Energy had over 2,000 connected systems, with a discretionary pool load peak of approximately 1 MW. Alongside demand response benefits, the emissions savings through more efficient operation were estimated at over 2 tonnes of CO^2 per pool per annum. When compared with air conditioning or other household services pool maintenance is a more discretionary load, and can therefore be flexibly scheduled away from times of high electricity demand. The program also operates on the idea of selling consumer benefits (in the form of improved water quality, and financial and time savings), rather than compensating for an impost as is commonly the case with demand response programs. There appear to be significant potential benefits of the program given the roughly 1 million backyard pools in Australia, and the successes of the initial trial. However, the program is also targeted at a specific subset of households with large discretionary loads, and as such there is the possibility that impacts of the program will be limited, or that efforts to make pool maintenance more efficient may ultimately overlook the bigger issue of energy consumption for private pools in light of high domestic energy demand.

Powershop Australia's Demand Response Program (ARENA, 2017c) was a $1.3 million dollar project aiming to deliver emergency reserve power through behavioural change and a smartphone monitoring app. The program was targeted at both residential and business customers in the state of Victoria. During peak demand events, such as those arising from high air conditioner use during heatwaves, Powershop asked customers to reduce their energy consumption for a period of time. Customers were rewarded with a credit to their power bill corresponding to their reduction in energy consumption during each hour of the peak event. The program managed to reduce consumption on average by 0.45 kW per site across the participating households. If the program were scaled up to 500,000 participants, Powershop estimates this could provide 225 MW of demand reduction, which would have a significant impact during peak events. Powershop has a flat credit rate of $10 per household for those who reduce their energy consumption by 10%.

Zen Ecosystems Demand Response (ARENA, 2017d) deployed smart thermostats across Victoria and South Australia to aggregate and control heating and cooling in both commercial and residential buildings. Households taking part in Zen's 'Save the Grid' trial were offered 2 movie tickets in exchange for intending to participate in the program by reducing their energy usage during peak demand periods. However, follow up surveys found that none of the customers in the initial trial actually used the movie tickets at the time of the peak event (which would have reduced home energy consumption by taking customers out of the house), but instead chose to use them later. The program highlights the complexities involved in both changing household energy consumption, and aligning the energy sector's interests (e.g. reduced peak demand) with those of households.

Wattwatchers' 'My Energy Marketplace' (MEM) is a consumer-oriented data platform that collects, processes and communicates energy data. The program has received $2.7 million in investment from ARENA (2017e). MEM seeks to improve the ability for households and businesses to access, analyse and act on their energy data, including by "using power at the best times", and "optimising rooftop solar (or right-sizing new solar investments)". Schools are also included in the project, which aims to educate children about energy. As part of the project, Wattwatchers has developed 4 consumer 'personas' intended to represent the kinds of motivations for participants engaging with their energy data. These personas are: 'Solar optimiser'; 'Bill stress' (cost conscious); 'Smart home tinkerer'; and 'Sustainability warrior'. The information provision model (i.e. access to energy data will lead to sustained and desirable behavioural change), and the use of consumer personas have both been critiqued in literature as unable to capture the diversity of domestic

energy consumption and deliver substantial, long-term savings.

Finally, the ARENA funded **Project Symphony** (ARENA, 2017f) is trialling the orchestration of distributed energy resources (DER) including rooftop solar, batteries and major appliances. Based in Western Australia, the virtual power plant project is designed to coordinate 900 DERs across 500 households and businesses in an area where almost all homes have solar systems. By orchestrating DERs Project Symphony aims to ameliorate challenges for the energy system arising from times when local solar generation significantly exceeds electricity demand, as occurs at times of the day in areas with high levels of solar installations. Previously, these periods of excess generation have required solar exports to the grid to be curtailed. One way Project Orchestration will seek to resolve the challenge of excess generation is by using the energy generated within the virtual power plant to provide essential network services, including smoothing grid variability resulting from the integration of weather-dependent renewable generation. The trial will offer households financial incentives to participate in the project, whilst also seeking to reduce the energy costs for consumers who do not have solar. Though the trial has not yet commenced, the real-world ability for non-solar households to share in the various benefits of increased solar generation will be important to understand.

State and regional based policies and programs

There have also been a range of region-specific policy initiatives that have been developed and deployed to improve residential energy consumption. Several examples are provided below. Some of these policy initiatives explicitly include justice dimensions. The ACT government's **Just Transition to Low Emissions Housing** policy, for example, is targeted specifically at lower-income households who are recognised as among both the most vulnerable to extreme temperatures, as well as the least able to respond through home upgrades like insulation. However, most of the policies listed below are less focused on considerations of justice or fairness in their

decarbonisation efforts, and instead are targeted more broadly towards various segments of the home-owning population. The state-based nature of the below policy initiatives also highlights a geographical dimension to decarbonisation efforts; smaller and wealthier jurisdictions appear better placed or more willing to implement decarbonisation initiatives. In the absence of more comprehensive, Australia-wide policies, there is thus an inherent unfairness to the nature of state-based policies which inevitably result in certain households missing out on potential benefits based only on their location.

The Victorian government's Solar Homes program (Solar Victoria, 2021) offers rebates to homeowners to install a range of solar technologies, including solar PV panels, batteries, and solar hot water systems. Depending on the technologies installed, rebates are worth up to $3,500. There are also provisions under the scheme for renters, landlords and community housing providers to apply for solar PV rebates, which are equal in value to those accessible by homeowners. However, under the current scheme only owner-occupiers are eligible to access the battery and

solar hot water rebates. Households accessing the solar battery rebate are also able to participate in a Virtual Power Plant pilot, which offers a higher rebate amount of $4,174.

The **Victorian government** is seeking to provide energy efficient heating and cooling for 250,000 low income and vulnerable homes across Victoria, through its **Home Heating and Cooling Upgrades** program (Heating Upgrades Victoria, 2021). The program's stated aims are to "increase the comfort, wellbeing and health of vulnerable Victorians while also creating new jobs and tackling climate change." Up to $335 million will be available through rebates of $1,000, which households can put towards purchasing highly efficient reverse-cycle heating and cooling systems. Households wishing to cap their old gas heaters or upgrade switchboards are able to access additional funding. The program is open to owner occupiers, landlords and renters (with the owner's consent), and community housing providers. To be eligible applicants must have either a valid concession card or a combined household income below $90,000; landlords must earn less than $500 weekly rent, or be renting the property to tenants fulfilling the previous requirements.

The **Victorian Energy Upgrades** (Victoria State Government, 2021) program provides financial incentives for all Victorian households to install or upgrade energy efficient products. Common upgrades include lighting, weather sealing, hot water systems, shower heads, and heating and cooling. The available rebates vary significantly depending on the number and type of replaced appliance, as well as the type of newly-installed product. For example, the indicative rebate for replacing an inefficient electric water heater with a medium-sized heat pump water heater is $1,500, while the rebate for replacing 2 incandescent lamps with LEDs is $60. Since 2009 the program has enabled over 1.8 million households to upgrade home appliances, saving an estimated 60 million tonnes of greenhouse gas emissions. The recently expanded program includes new incentives for households to replace gas appliances with energy efficient electric alternatives, to maximise their self-consumption of solar energy, and install smart appliances.

As part of the **Queensland government's** $3.6 million **Decarbonising Remote Communities** program, 4 Indigenous communities in the state's far north have installed renewable energy systems. The systems lessen communities' dependence on costly and emissions-intensive diesel generators, which until recently were the only source of power in these off-grid areas. The communities of Doomadgee, Mapoon, Pormpuraaw and the Northern Peninsula Area have each installed differing configurations of solar panels and battery storage. For example, Mapoon installed 160kW of solar and 32kWh of storage, while Doomadgee added 304kW of solar to 369kW of existing solar generation. Each project is expected to save the respective communities tens of thousands of dollars in power each year, along with providing temporary construction jobs in towns affected by a shortage of job opportunities and chronic unemployment (Queensland Government, 2022).

A Queensland government (2021) **Solar Rebate for Rentals** trial offered rebates of up to $3,500 for landlords to install **solar systems on their rental properties.** The program closed in mid-2020 and was targeted at the regional cities of Bundaberg, Gladstone and Townsville. In exchange for reduced energy bills tenants paid higher rent (though not more than the savings achieved through solar). A total of 670 solar systems (4MW) were installed. Tenants involved in the trial saved an average of $600 per year. The average estimated payback period for installing solar was halved from 18 years to 9 years after including the solar for rentals rebate.

Just Transition to Low Emissions Housing is a policy proposed by the Greens party (n.d.) in the **Australian Capital Territory** (ACT), who are minority members of a coalition government with Labor. The retrofit policy aims to fund efficiency and sustainability upgrades in ACT homes, with an emphasis on social and public housing, low income owner-occupiers, and the lowest performing rental properties. Energy efficiency upgrades would include measures like installing insulation (an estimated 20% of homes in the ACT have no insulation (Unions ACT, 2016)), draft sealing and improved glazing. The use of gas for heating and cooling is widespread in the ACT, and accounts for over 20% of the territory's carbon

emissions (ACT Greens, n.d.). As a means of reducing people's reliance on gas, the program also proposes increasing access to renewable technologies like solar panels and batteries, and swapping gas appliances for electric.

In 2016, the **ACT government** (n.d.) began a rollout of batteries across residential and business premises in the territory. **The Next Generation Energy Storage** (Next Gen) program reduces the cost of batteries by 50%, and is aiming to install 5,000 systems representing 36MW of storage capacity. Alongside developing an energy storage industry in the ACT, the Next Gen program aims to enable households to reduce their reliance on the energy grid by locally storing electricity generated from rooftop solar. Although geographically dispersed across the ACT, households participants in the Next Gen program are also connected via a Virtual Power Plant (VPP), meaning the batteries can be used to store excess energy during sunny periods, or collectively drawn on during periods of high energy demand. Households are financially remunerated for their participation. In terms of just transitions, there are connected equity challenges posed by the Next Gen trial. Even with significant subsidies, involvement in the program requires a substantial initial investment (several thousand dollars). Moreover, because battery and solar installations are considerable and permanent changes to the structure of a home, and also because of the long payback periods on the investment, the program is by its nature more accessible for affluent households and homeowners.

The **ACT government** (n.d.) is offering zero interest loans to homeowners seeking to improve the energy efficiency of their homes through their **Sustainable Household Scheme**. $150 million is available to provide 10 year loans of between $2,000 and $15,000 for households to install a range of eligible products, including rooftop solar, battery storage, electric heating and cooling, EVs, and hot water heat pumps. The scheme ties in with the ACT's drive to reduce gas usage and electrify services including heating, hot water and transport. The scheme is only available to homeowners in the ACT; landlords (but not trusts) are also able to access loans.

4.1.8 Possibilities

Everyday life in the home is a key site of opportunities for a just transition: Australians' eagerness to embrace rooftop solar PV and other home-based energy technologies, combined with their resourcefulness and innovative practices, have contributed to significant change at the local and community scale and indicate a promising desire on the part of residents to transition toward decarbonisation where it is affordable and accessible (Lovell et al., 2017; Ransan-Cooper et al., 2020; Strengers & Maller, 2011). Innovation in "green renovations" (Maller et al., 2011; Middha et al., 2022), adapting everyday routines in response to resource constraints (Maller, 2011; Maller & Strengers, 2013; Strengers & Maller, 2011), uptake and integration of new technologies and arrangements into the home (Strengers et al. 2021b), and participation in community-led projects (Lovell et al., 2017; Ransan-Cooper et al., 2020), indicate the potential of the home as a site for transition.

Equitable modes of access to infrastructures, technologies, skills and human services are needed to secure just transitions in homes. Access to the housing, land and technologies likely to support a just transition in Australian homes is unevenly experienced and distributed across the country. Many variables hinder or support a transition in homes, including location (rural, regional or urban), climatic conditions, housing stock, home ownership versus renting, shading, levels of digital inclusion, household income, pet ownership, household composition, homelessness (or risk of homelessness), being part of a systematically disadvantaged or vulnerable group, living with domestic abuse, and access to energy and other technologies. Concerted programs and policies are required to address these inequities.

Careful applications of emerging technologies, demand response programs, and targeted policies could support a just transition. The Digital Energy Futures research shows that Australians don't expect or want a fully automated home or energy system (Pink, 2022; Strengers et al. 2021b). Instead, they want to adapt and incorporate different technologies into their routines, and to change these as needed.

> [R]esidential energy efficiency policies need to be designed and implemented considering the just transition. Otherwise, retrofit poverty—as in "the inequality of opportunity to improve the energy performance of the home" [referencing Willand et al. (2020)]—reinforces energy poverty among those vulnerable households and undermines a just energy transition.
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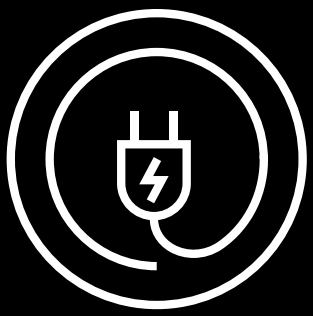

Incentives, technologies and demand response 'signals' (e.g. price or rewards) can be important in shifting energy consumption to certain times of the day (e.g. when rooftop solar is generating); however incentives must complement other everyday routines and social priorities. Further, such initiatives must be supported by targeted policies and programs involving those people and households who have so far been unable to participate in a just transition.

> Energy Consumers Australia's work in this area, framed by concepts of distributional justice, provides a reminder that policies are required to support these customers to ensure they do not miss out on affordable, clean energy. … As an example, recent research by Energy Consumers Australia found that most household consumers support policies that would help renters and apartment dwellers access solar and batteries. There was also strong support for governments to install solar on the public and community housing they own.
>
> *— Submission, Energy Consumers Australia, February 2022*

Trust must underpin a just transition to decarbonisation in the home. Householders' interest and willingness to take part in the energy transition is contingent on their trust of energy policy-makers, industry bodies and companies, and the emerging technologies coming into their homes. Research shows that when households understand the transition and what's required to get there, feel in control of the technologies and devices in their home, and have access to and the ability to afford the technologies they need to participate in the transition, they are likely to actively participate and also find their own ways of living with intermittent energy supply, peak demand, or battery storage (Strengers et al., 2019c; Temby & Ransan-Cooper, 2021).

A just transition must provide deliberate and focused research and effort on those households and people typically unable to participate - because they cannot access, afford or experience the benefits of decarbonisation efforts, through housing programs and technologies. These include Aboriginal and Torres Strait Islander communities, low-income households including those living in social housing, renters, culturally and linguistically diverse communities, older people living in retirement communities or independent living facilities, people living in shared housing, sole parents, and people who are homeless. Decarbonisation technologies, like electric vehicles and batteries, which largely benefit those people who can already access and afford rooftop solar PV generation, must be incorporated into programs and policies that make their benefits more equitable and inclusive.

Further research is required to make this possible. It needs to map out and co-design effective processes through which a just transition to decarbonisation might come about across diverse homes, in ways that are equitable and adjusted to suit the diversity of home dwellers in Australia outlined above. This should involve immersive and place-based social science and design futures-led design, testing and trialling the human services and technologies required to support such a transition. Our research has demonstrated that without this attention to detail of the diversity and uncertainties that form part of real everyday life in the home, a just transition is not a plausible proposition.

Future research must also be attentive to how property ownership and living arrangements are envisaged and hoped for in the future, and accommodate this to plan for and co-design inclusive, just and enduring transitions that people will be able to fully participate in.

4.2 Work and Industry

SUMMARY

A transition to decarbonisation implies a transformation of work and industry, providing key opportunities for Australian policy makers, industry, and worker and community groups to forge just transitions in the future. To achieve this, careful attention is needed to how diverse workers are positioned within transition processes.

In Australia this is framed by a context where digital transformation and emerging technologies are impacting working lives in complex and diverse ways, from the gig economy, to augmenting human labour in established sectors such as agriculture. Many jobs are being automated into obsolescence, with more at risk from automation in the future (Department of Industry, Science, Energy and Resources, 2015), leaving many without work and (in lieu of training opportunities) without meaningful opportunity to access employment in the near-medium term. Conversely, the automation and robotisation of work is creating new jobs and services where people, automated systems, and technologies work alongside each other. Moreover, the digital transformation of industries and workplaces across Australia (as elsewhere) is uneven, and does not necessarily imply a decrease in carbon emissions, or the carbon-intensity of already existing industries. For example, the Australian construction sector has been both slow to transform digitally and to engage with automated systems and technologies on construction sites, all whilst experiencing a labour shortage. In industries where production processes are streamlined and labour is made more efficient, this often results in the reduction of staff and costs, and increases in production of both goods and commodities, in addition to carbon emissions.

This context raises a set of key questions that are addressed in this section. What industries may be prime future collaborators, stakeholders and beneficiaries for transition? Who pays for retraining workforces? Who takes responsibility for the costs of investment in emerging workplace technologies and systems, and who enjoys the economic benefits job-transition may offer? How is innovation encouraged to produce new industries that can provide employment? How will the wages paid by these new jobs compare to existing work, such as highly-paid mining jobs? In the diverse world of work, not all jobs are equal, so simply replacing one job with another requires more than substitution. It reaches beyond the economic and into the hearts and souls of communities.

4.2.1 Work in Australia

To understand just transitions in work in Australia we selected a cross-section of primary, secondary and tertiary sector industries that are particularly dominant in the Australian economy and may be most immediately applicable for- or impacted by- just transition frameworks.

Agriculture, resource extraction, construction and manufacturing are four of Australia's most significant industries - constituting 21.8% of GDP, 20.7% of employment (Dept. of Parliamentary Services, 2021) and - including energy production from mined materials - 81% of greenhouse gas emissions (Dept. Industry, Science, Energy & Resources, 2020). They stand for a significant sector of employment and GDP, and are over-represented in relation to emissions. Furthermore, they are deeply reliant on each other. Thus, just transitions in these sectors require holistic approaches to industrial intersections and symbiosis, in addition to bridging industrial silos. The significant impact of Covid-19 on Tourism offers a prism to explore particular aspects of transition. The gig economy's meteoric growth centres it in 'future-of-work' discussions, including debates concerning worker exploitation.

According to the Australian Council of Learned Academies (ACOLA, 2021: 12), despite the Australian government's current reform, transformation in mining, transport, manufacturing and agriculture still requires attention since presently: "23 per cent of the Australian workforce are employed in emissions-intensive industries and will need to transition or upskill as those industries evolve." Analysis from Deloitte Access Economics (DAE, 2020: 19) estimates that the economic cost to Australia of staying on its current economic trajectory of almost unmitigated climate change would create losses of "$3.4 trillion in present value terms, or 6 per cent of GDP. This will result in the loss of 880,000 jobs in 2070". Alternatively, DAE has forecast that a growth recovery pathway towards a zero-emissions scenario could increase GDP by "2.6 per cent and add $680 billion (in present value terms) to the economy in 2070. This pathway would also add over 250,000 jobs by 2070" (DAE, 2020, in ACOLA, 2021: 12) We begin to address these challenges and opportunities in sectoral analyses below.

4.2.2 Agriculture

The Australian agriculture sector contributed close to 15% of Australia's emissions in the year to December 2020. Emissions from agriculture include methane (CH^4), carbon dioxide (CO^2) and nitrous oxide (N^2O) (Ernst and Young, 2021; Climate Council, 2021). The geography of Australia creates a tyranny of distance, where agricultural regions are separated from the markets they serve. The logistics involved in getting produce to consumers highlights the intertwined nature of different sectors, including transportation, food processing (including abattoirs), packaging operations, storage, and dealing with waste. Discussions over agriculture tend to rely upon what an interviewee called a 'farm centrism', rather than understanding Australian agriculture as a complex set of systems.

Approximately 42% of the emissions from the Australian agriculture sector are methane (CH^4) - created by livestock, crop fertilisers, manure and decaying vegetable matter (Government of Victoria, 2022). Carbon dioxide (CO^2) is released from the soil through plant decay, animal respiration and fossil fuel use (Climate Council, 2021; Government of Victoria, 2022). Nitrous oxide (N^2O) is released through soil disturbance, fertilisers, and livestock manure and urine (Government of Victoria, 2022).

There are concerns regarding how the agricultural sector account for emissions, due to the carbon dioxide, methane, and nitrous oxide each having different properties, strengths and lifespans that render aggregated 'carbon equivalent' emission rates as poor indicators (Lynch et al., 2021; Climate Council, 2021). Disaggregating carbon dioxide and methane emissions in reporting could lead to different approaches and outcomes (Lynch et al., 2021), as some emissions, like methane, are shorter lived than carbon dioxide. Whilst methane is more efficient at absorbing thermal infrared radiation and is "approximately 86 times stronger than carbon dioxide on a 20-year timescale" (Jackson et al., 2020:1), when removed from the atmosphere there is no cumulative effect, which means that harms

A farm should be understood in a much more networked way. There are these actually enormously long intersecting supply chains which pass through a farm, but the farm isn't really a privileged space. Inputs come into the farm, they're converted, they release some emissions and then the stuff goes off. It would be like saying the problem with a coalmine is contained within the walls of the coalmine, not so much.

— Interview, Professor Lauren Rickards, RMIT

caused will be quickly reversed (Lynch et al., 2021). Currently, emissions resulting from operating tractor and farm machinery can be counted either as food system emissions, or transport emissions within the accounting mechanism used by the Intergovernmental Panel on Climate Change (IPCC) (Lynch et al., 2021). Clarity will be needed in the future to accurately address emissions intensive activities.

Limited empirical research is available on the way Australian farmers navigate the complex new approaches to farming designed to enable a transition to decarbonisation (Gosnell et al., 2019). Placing the onus on farmers themselves for transitioning to decarbonised practices fails to recognise the complexities farmers face when negotiating the structural changes to business practices, entrenched farming techniques and farmers' personal lives (Hale et al., 2021; Gosnell et al., 2019; Geels et al., 2017).

Just transitions must consider lived experiences and recognise the role of cultural and symbolic capital (Hale et al., 2021). In particular, focus needs to be placed on the "subjective, nonmaterial factors associated with culture, values, ethics, identity, and emotion that operate at individual, household, and community scales and interact with regional, national and global processes" (Gosnell et al.,2019; see also Dubois & Carson, 2020).

Dubois & Carson (2020) identify a strong sense of tradition in the Australian farming community which understands good farming as "technologically advanced and market-oriented" (2020:510). This conceptualisation aligns with what Iles (2020) argues is the Australian government's strong neoliberal stance, promoting agricultural competitiveness at the expense of the environment.

> [I]t's the typical 'jobs and livelihood versus the environment' debate
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> — *Interview, ARC DECRA Fellow, Kaya Barry, Griffith Centre for Social and Cultural Research, Griffith University*

This market-focus has precipitated the loss of historical rural welfare systems, which in turn with increasing industry consolidation and the power of supermarket chains to place pressure on farmers for low-cost produce, has resulted in increasing farmer poverty (Iles, 2020). Pressure to compete and export along with the dwindling support and welfare mechanisms represent one of many 'lock ins' that make the wholesale change to lower carbon farming practices both difficult and expensive (Iles, 2020; Dubois & Carson, 2020; Hale et al., 2021).

New science-based knowledge and techniques are often met with scepticism by farmers who place more trust in watching and learning from their peers. Dubois and Carson (2020) note that most farmers would rather watch the way other farmers – early adopters of new technologies and practices – fare when testing new crops or techniques. Risk aversion is fuelled by the challenges of the Australian landscape, where much of the land is arid and is subject to soil erosion, poor fertility, droughts, bushfires and water scarcity (Dubois & Carson, 2020)

Australia's geography needs to be considered in developing approaches to decarbonisation, especially in terms of the very considerable climatic differences between different growing regions of Australia. Problems associated with centralised decarbonisation mechanisms and policies which apply a one-size fits all approach need to be context specific and tailored for different environments (Hale et al., 2021). With notions of justice being conceptualised differently in rural areas, further research into farmers' understanding of just transitions is needed.

Consideration needs to be given to the different types of farming and the way farmers and their communities occupy their space across regional Australia (Dubois & Carson, 2020). Extensive structural changes will be required that involve rethinking the way livestock is managed, the holding capacity of the land, and alterations to cropping practices, meaning a just transition will require significant interventions and commitment from government, business coalitions and society in general. This necessitates a shared understanding between all actors of what the future of agriculture could be, based on empirical evidence (Hale et al., 2021). In addition, there are a number of mechanisms being recommended within the agricultural literature for reducing wider carbon emissions, such as 'carbon farming'.

[Farmers and farm workers] get a very grounded feel for change because they are living it. The catchphrase is, 'They're the frontline' of seeing very extreme weather, more intense seasons particularly in Queensland. The region that I've been working in is the Wide Bay–Burnett, where Bundaberg is the centre. They produce over a quarter of the nation's fresh fruit and vegetables in that region and over the last like say seven to eight years, many farms there have all expanded to year round crops, whereas before it was very seasonal crops. Now you can work in Bundaberg all year round and that's because the climate's changing. It's kind of this really peculiar situation where you've got a country that has extreme droughts and fires and things like this but then you've got the farms, they're just rapidly expanding.

— Interview, ARC DECRA Fellow, Kaya Barry, Griffith Centre for Social and Cultural Research, Griffith University

CARBON FARMING

Australia's involvement in carbon markets provide an important space for First Nations peoples to participate in and lead decarbonisation processes in a way that can bring significant benefits. As Robinson suggests, "The capability of Indigenous organisations to realise these benefits is a critical issue that has been identified by Indigenous leaders across Australia" (Robinson 2014: 3). Carbon farming has been used to name a variety of practices that seek to reduce or store carbon. Cool season burnings or 'savannah burning' has drawn on First Nations traditional fire management practices (cultural burning) that use smaller regulated burns to help to protect from much larger late summer bushfires in the hotter months. Until recently, these practices had been marginalised by Western scientific management practices of forestry and conservation.

For every tonne of carbon saved from being emitted in a hot season bushfire, carbon farmers can raise carbon credits which they have been able to sell within the carbon credit market and through the Australian government's Australian Carbon Farming Initiative (2011-2015) which became the Carbon Emissions Fund (2015-). These have allowed companies such as the airline Qantas to offset their emissions by purchasing carbon credits produced by carbon farming communities. Carbon credits can be a way for First Nations organisations to raise capital for programs and other investments without having to take on debt.

While there has been some concern that carbon farming 'locks up' land for development – some areas reporting depopulation as other land uses or grazing activities makes subsistence difficult – there is also a great deal of support for the scheme. The Aboriginal Carbon Foundation suggests a wide variety of social, cultural, economic, health, political and self-determination benefits for First Nations communities, as well as benefits to ecosystems, as the North Australian Indigenous Land and Sea Management Alliance (NAILSMA) explain:

> *"Getting back to looking after country with fire can help tackle climate change and many local problems that arise when country is not cared for properly. It provides jobs and is good, healthy work. It helps with diet and exercise. It brings people together and gets them out of town. It makes opportunities for older people to pass on language and knowledge to young ones" (NAILSMA 2015: 4)*

State governments have been supporting carbon farming and land sequestration practices through strategies such as Western Australia's Carbon Farming and Land Restoration Program, and the Northern Territory Aboriginal Carbon Industry Strategy (NT Govt 2018). The NT's strategy identifies an existing successful West Arnhem Land Fire Abatement project, registered by Arnhem Land Fire Abatement Ltd (on the ALFA Ltd see Altman, Ansell and Yibaruk 2020), which reintroduced customary burning practices by Aboriginal ranger groups and successfully financialised First Nations property rights through carbon credits. The WALFA project became the model upon which Savanna fire management methodology was based (Ansell et al 2020), and recognised under the Carbon Farming Initiative Act *('Carbon Farming Initiative – Emissions Abatement through Savanna Fire Management)* Methodology Determination' (Commonwealth of Australia 2017)).

Supplementing cattle feed with .2% Asparagopsis (red seaweed) has been found to reduce methane emissions by 98%, with no changes to the quality of the meat. It also resulted in a weight gain improvement of 42% (Kinley, 2018), providing a clear business case for beef cattle farmers Soil carbon sequestration can be achieved through short duration grazing and monitoring that ensures grasslands are not overgrazed or bare, and therefore vulnerable to soil erosion (Gosnell, 2020). The use of non-chemical soil additives such as biochar, compost and manure further promote soil carbon sequestration by encouraging the growth of perennial species with deeper root systems that enable moisture retention. Australian farmers who have moved to regenerative farming maintain that there are significant benefits; the cost base is lower, lower use of chemicals results in better animal health, fencing costs are reduced, and drenching costs are lowered because cattle movement breaks the worm cycle (Gosnell, et al., 2020).

At the same time, if the farm can be understood as a network rather than an enclosed site, transitions within agriculture must account for the working conditions of its mobile labour, in the form of migrant and tourist workers, many of whom are vulnerable to exploitation and debt which they struggle to repay in a volatile climate and work environment.

[T]here are not enough Australians willing or available to do these jobs. Key to the visa expansion was low paid work, that's the only way that this has been able to expand is because this is below minimum wage work. [...] It's also quite generally young people work too. It's very demanding in physical ways. The visa conditions set time limits. The Working Holiday Maker visa expanded out to three years.[...] Then the Seasonal Worker Programme and the Pacific Labour Scheme, they range in duration but they have to be sponsored by an employer to come through those schemes. Whereas the Working Holiday Maker visa, you're free to take up work but to get the next year visa, to get a second year visa you have to do 88 days minimum farm work to be ticked off, [...] Realising that 88 days on paper is actually five, six, seven months when you add in bad weather, when you add in dodgy employers who won't sign off your work. They're there temporarily and if they get lucky, if they get a job that they can withstand and perhaps even enjoy, they'll stay for months to a year or more. But because of the nature of the visas they have to keep moving and they have to do other things. Queensland like much of Australia, has a lot of bad weather so it only takes one heavy storm, hail, and the crop is gone. So then you're forced to find another job. Yes there's year-round harvest but it's not guaranteed that you have a job for long.

[...] The other thing that I need to mention is, and this happens mainly through the hostels but there are migration agents involved, is people who are doing seasonal work rack up debt. Say you are in a job, in a hostel that found you the job, and there's bad weather, you don't get paid for a week so therefore you can't pay your rent. Therefore you owe the hostel. People have to keep working often to pay off this debt and it can be a few grand we're talking about.

— *Interview, ARC DECRA Fellow, Kaya Barry, Griffith Centre for Social and Cultural Research, Griffith University*

MINING AND AGRICULTURAL ENTANGLEMENTS

Despite conflict between mining and agricultural workers, there is overlap between the two communities. This overlap was made clear during research undertaken in the Hunter Valley region of NSW into the complex and intertwined relationship between agriculture and resource extraction. Ben, (quoted below), is a farmer whose property lies in close proximity to a mining and extraction operation. Ben's farm has been handed down through five generations - and his aim is to pass it down to his own children - however, during times of extreme drought Ben felt his only option was to seek employment at the local coal mine.:

> *Some people work at the mine who are anti-mining in order to make money […] I did work on the blasting crew [with] a lot of the people in town. Probably 15 of them who now own their houses [because they worked in the mine]. (Ben, farmer, NSW)*

This demonstrates an understanding that working on the mine can financially benefit community members. While Ben no longer works at the mine his sons juggle farm work with mining shifts – a financial necessity as farming in close proximity to an open cut coal mine can be difficult. Coal mining operations also provide benefits to farmers through apprenticeship opportunities which keep young school leavers in the community. Jane, whose partner works at the local coal mine, explains:

> *Agriculture is just not going to cut it anymore and it's not going to keep young people here in town when they leave school […] It's alright saying we all want to be diesel mechanics but if there's no apprenticeships for them then they're not going to stay in town – then they're not going to be diesel mechanics (Jane, community member, NSW).*

Jane's comment touches on an issue facing many rural agricultural communities - that without the opportunity to gain agricultural skills, school leavers are moving to the cities for further education and employment.

The benefits of coal mining operations for farming communities extend to sponsorship of community events. Justine points out:

> *We were awash with money and grants. And so, […] for example at a parent committee trying to raise money for the school for the benefit of the children it would just be 'well, we'll apply for a grant for that from [the mining proponent]'. It was normal, it was there, don't even think about the implications. It just becomes normalised. (Justine, community member, NSW).*

Plans to transition away from coal mining in rural farming communities would, on the one hand, be welcomed by farmers and residents alike for the reduction of the negative impacts of mining operations. However, on the other hand, the economic benefits that are gained, even by those who most steadfastly oppose mining and extraction, must be considered.

— Fieldwork report from NSW mining and agricultural communities, Susan Wright

4.2.3 Resource Extraction / Mining

Natural resource extraction has a long and complicated history, forming part of the bedrock of Australia's national identity and contemporary industrial output. Whilst broader resource extraction (of iron ore, LPG, Gold, etc) is an integral part of the Australian economy, coal has proved one of the most controversial and one of the country's most prolifically extracted resources (Dept. of Industry, Science, Energy and Resources, 2019). Coal mining communities are facing a number of compounding challenges that may be addressed through transition. These include reduced coal reserves, local landscape rehabilitation, air quality, health impacts, and climate change. As demonstrated in the Hazelwood mine fire of 2014, these transitions are interconnected, with bushfires catalysing a mine fire in the midst of economic and labour crises which cannot be disentangled from the climate. The experience of the Latrobe Valley has been one of recurrent economic, environmental and emotional shocks (Duffy & Whyte 2017), as an interviewee discussed the Hazelwood community's feelings in the aftermath of the fire.

> [It was as if] no-one was listening to them, even in thinking about how to put out this fire. So the mine was part of originally the State Electricity Commission and it was privatised. So there's that whole context of the community feeling that they've been abandoned. And that even during the fire, they just felt well Melbourne doesn't care for us so there was this real feeling that they're just there to support Melbourne but when something happens to them, no-one is there. […] So there was this real sense of we're abandoned, you know they're fearful, they don't know what's happening. There's a lot of mistrust and there's still mistrust going on. So we were really interested in those aspects of the impact of the fire.
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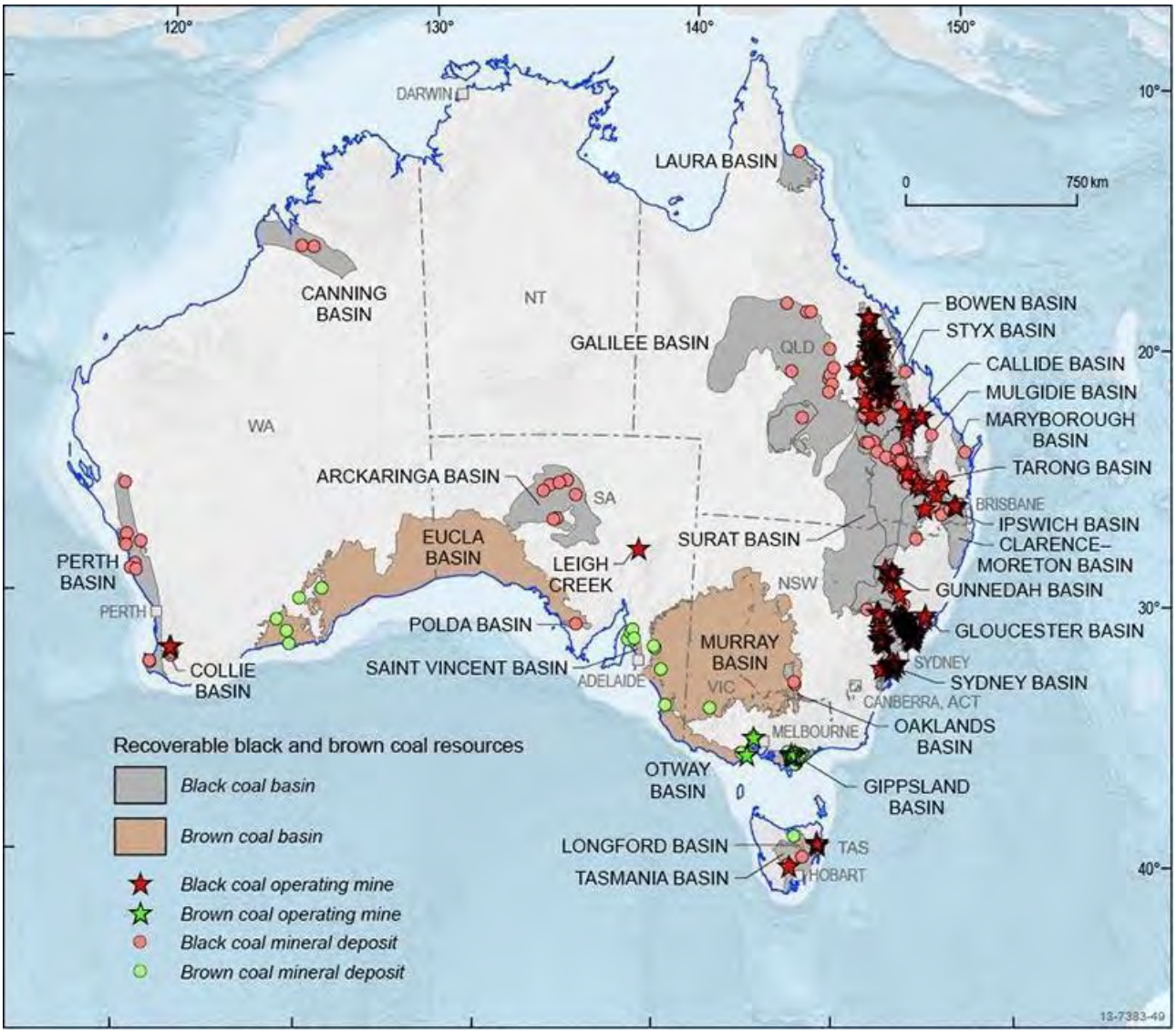
> — *Interview, Associate Professor Michelle Duffy, University of Newcastle*

As the map below demonstrates, Australian coal mining centres around three significant areas that represent the diversity of Australian coal's deposits and activity - Victoria's Latrobe Valley (Gippsland Basin), Queensland's Bowen Basin, and NSW's Hunter Valley.



Australia's operating coal mines as of December 2012 (Source: Commonwealth of Australia © - Geoscience Australia, 2019)

The role Australian coal currently plays in the economy is largely dependent-upon its quality and type. Brown coal is burned for domestic energy production. Black coal is more versatile, often used for thermal power generation or as coking coal in steel production (aka metallurgical coal). Its high quality makes it a dominant player in Australia's export market.

The International Energy Agency (2020) reported Australia was the fifth biggest producer and second biggest exporter of coal in the world. The Department for Industry, Innovation and Science (2019) reported that 88.3% of all thermal coal exports and 57.7% of all metallurgical coal exports went to only 4 Asian countries (Japan, China, South Korea & Taiwan). Whilst this export market fuelled the coal boom of 2008-2012, future market demand is less clear as many economies are announcing transitions away from large scale coal consumption. This creates long-term vulnerability, whilst simultaneously exposing The Treasury (and by extension, coal miners) to shorter-term volatility in the market. As a CFMMEU representative puts it in Dahlgren (2019):

"There is acceptance globally that climate change is real…None of our mines have shut because of climate change; they're shut because of the oversupply of coal causing the price to collapse… We see economics as a bigger pressure than climate change."

Other extracted resource commodities accounted for 7 of Australia's top 10 exports - 51.3% of all exports - in 2018-19 (Dept. Foreign Affairs and Trade, 2020). Meanwhile, mining only accounts for around 1% of Australian jobs. Transitions may offer the opportunity to diversify exports into less carbon intensive products, yet interviews have been sceptical that the elimination of coal will simply lead to new industries arising on their own.

> It's not as if we can get rid of all these awful things, and then the wonderful new things are going to spontaneously come and fill in the space. We don't quite explain how but it's implicit that we have to destroy coal and the quicker we destroy it the quicker the new things will come and take its place. In the regional places we're talking about in Australia, nothing is going to come and take its place unless the government co-funds something to go there. Not even a McDonald's because the population will decline and McDonald's will leave as well.
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> — *Interview, Associate Research Professor in Economic Restructuring, Sally Weller, University of South Australia*

MINING, IDENTITY AND COMMUNITY:

"It was a regular Friday night in the Central Queensland coal mining town of Moranbah. I was out at the local pub, The Black Nugget, named after the valued commodity. I was having a few beers with my female friends. We chatted and began 'checking out' the men around us. One man caught our collective eye, "He's cute" my friend Melissa said. To which another friend, Caitlin replied, "Yeah, and he's a dragline operator!" as she raised her eyebrows in a flirtatious manner.

This man was attractive, not merely because of his physical appearance, but because of his labour. The dragline is the largest piece of mining equipment on an open cut mine. To be its operator, thus, is to exhibit a masculine power, but also a hard-working and diligent character, for one must work one's way up to receive this coveted position. He also was notably young to have achieved this prestige. This simple aspect of what piece of mining equipment he operated marked a strong sense of achievement and positive characteristics which made him instantly attractive in the community. It's also very important to note that being a dragline operator did not mean he made more money than any other operator. All operators under the same enterprise bargaining agreement are paid the same no matter what they operate. So his attractiveness had nothing to do with his wage. His responsibility, diligence, masculinity, power, even sexuality were all entangled in the social reputation of his employment. What job envisioned in the 'just transition' can replace all of that? Such broader values around mining labour help to explain the resistance amongst miners to alternative jobs that are proposed under just transition policies."

— *Fieldwork report, Kari Dahlgren, November 2021*

Mining is deeply connected with identity and community status in mining regions. The job of being a miner, and the broader connotations it holds in social and community life must be considered as part of any just transition. Whilst transitioning the miner out of the mine may be a relatively simple process, there are myriad challenges in transitioning the mine out of the miner (and indeed the social communities and identity performances that have emerged out of them). The fieldwork extract above highlights the way a miners' job follows them into social and cultural spaces.

Coal workers today face a myriad of employment challenges; the most prominent among these being the ongoing transition toward workforce casualisation and automation that currently poses an existential threat to job security in the sector. While large international mining operators and their shareholders reap the benefits of Australia's coal exports, workers that were previously enrolled on secure, union negotiated contracts are now facing greater precarity than ever before.

As contract and casual jobs increasingly become the new normal, there has been a corresponding increase of long-distance commuting practises like Fly-In-Fly-Out (FIFO) (Australian Centre of Excellence for Local Government, 2012). These commuters intensify the carbon footprint of extraction (by adding air miles) whilst simultaneously resulting in fewer individuals and families being permanently based in mining towns, threatening local economies, while creating the often overlooked fractures and disorientations in the home life, familial bonds and personal relationships FIFO workers are frequently disconnected from (Bissell & Gorman-Murrary 2019). To combat this, the Queensland State Parliament passed a law in August 2017 that made 100% mandatory FIFO workforces illegal, but this legislation does not challenge the casualisation which encourages FIFO when it is not mandatory.

CASUALISATION, WAGES AND THE BHP GROUP:

The CFMEU (Construction, Forestry, Maritime, Mining and Energy Union) and McKell Institute (Wheelan, 2020) reported the impacts of casualisation in BHP group mines. BHP - the world's largest publicly-listed mining company - owns and operates Mount Arthur Coal (NSW Hunter Valley) and manages nine mines in Queensland's Bowen Basin. 56% of all workers in BHP's Australian operations are contractors, rather than employees. Of the 12,800 workers in nine Queensland mines, only 3000 were directly employed. BHP owns and operates subsidiaries such as 'Operations Services PTY LTD' that supply contract labour to these sites through non-unionised work agreements. At Mount Arthur, workers contracted under Operations Services are being paid $106,000 per year without access to accident pay or bonus entitlement. For comparison, workers on traditional employment contracts (negotiated and agreed by the union) doing the same work earn $159,200 per year with full benefits.

In this sense, resource extraction could be seen to be acting as a petri-dish for multinational corporations to experiment with employment and human resource structures that undermine the Fair Work Ombudsman and neglect their duty to pay workers' benefits, including superannuation programmes. If left unattended, this may contribute toward looming pension insecurity for Australian citizens, and necessitate future financial intervention by the Australian government.

LATROBE VALLEY:

The Latrobe Valley in Victoria is the only region in Australia which currently mines the significantly polluting brown coal. It is not exported because its low quality renders it of little value on the international market. Instead, it is burned at local coal-fired power stations Loy Yang, and Yallourn - the highest emissions intensity power station in Australia (Berger & Phelan 2005). Until 2017, it was also mined and burned at Hazelwood (which closed in 2017 after only a five month notice period).

The Latrobe Valley has experienced significant job losses and dramatic increases in the cost of power (Australia Institute, 2020), a trend exacerbated by the privatisation of the State Electricity Commission. Combined with the short-notice closure of the Hazelwood site, these changes have seen the region suffer economically, with the remaining mines and power stations at risk of closure in light of their carbon intensity. As a result, the Latrobe Valley has received significant interest in planning for the region's transition away from coal, and is a crucial site for enacting just transition.

There has been significant government investment flowing into the region, including $43 million from the Federal government and $224 million from the State government to support the wider Valley. There are also a number of projects currently working to create more just transitions, including the Latrobe Valley Authority which manages funding for economic diversification projects. This includes the 'Worker Transition Service' that helps people access training for new jobs or manage retirement and other community services and associations. They also administer grants for businesses that will create jobs in the Valley. Some SMEs have been founded to transition mine workers into environmentally sustainable work, including the Earth Worker Cooperative - an organisation of former coal industry workers making solar hot water systems. Our interviews also highlighted the important role of community organisations such as 'Voices of the Valley', networks, and neighbourhood houses, in emphasising the role of people and communities in transition, and not just technologies.

The political necessity to get support from coal mining communities (which in Australia tend to overlap with marginal electorates) means that transition planning can focus on those who already enjoy entrenched privilege, rather than taking into account those who have historically been excluded from the high wages and stable employment of mine work - in particular women and Indigenous populations, who had been excluded from mining employment until relatively recently. While some women began working in mines in the 1970s, they were only legally allowed to work underground from 1989 in NSW and QLD (Layman 2014). Women still represent a minority of miners (only 11.6% of the entire coal mining workforce). Women are primarily employed in clerical and administrative roles, where they represent 76.3% of these positions, and constitute 100% of the workforce in 'community and personal services' in the industry (Workplace Gender Equality Agency 2018).

Similarly, the push towards automation and smart control in the mining sector is driven by the male-dominated fields of computer science and engineering, potentially generating further exclusions (even though women are often prioritised for jobs involving the operation of advanced machinery). This has particular relevance for future visions of automated extraction, which represent a set of futures underpinned by automated operation and delivery that perpetuate hierarchical, gendered and racialised divides between low- and high-skilled workers, with managers most likely to be able-bodied white men. Transition policies that focus on those currently employed in mining do not take into account this history and are likely to perpetuate gender inequalities in employment opportunities emerging from this transition.

4.2.4 Construction

The construction industry is of particular interest due to its contribution to carbon emissions, its importance to the Australian economy and labour market, and its potential to contribute to decarbonisation. The Green Buildings Council of Australia found 'the emissions generated during the manufacture, construction, maintenance and demolition of buildings – made up 16 per cent of Australia's built environment emissions in 2019' which if left without intervention "will balloon to 85 per cent". Whilst the goal - of reducing construction emissions -" is clear, the decarbonisation of the construction industry involves negotiating a number of intersecting challenges that are not only technical but related to the industry's inherent complexity: a fragmentary and gendered workforce, a shortage of workers, and a characteristically slow take-up of new technologies and processes that often require heavy investment.

In 2018-2019 "the value of construction work done was equivalent to 11.2% of Gross State Product across the eight states and territories", directly employing 1.18 million Australians (or 9.6% of total jobs). It also supports "992,000 full-time jobs across the Australian economy, more than any other sector". During 2018-19, "the value of wages and salaries paid to those working in construction totalled $66.2 billion, a sum larger than every other sector apart from professional services" (Master Builders of Australia, 2020).

However, the construction industry is simultaneously massive and multiple, with a tapestry of small local operators and sole-traders dominating the market. This fragmentation makes for an interesting and challenging context for change. For example, there were 395,000 active construction businesses in June 2019, "about 100,000 more businesses than the next closest sector (professional services)." Moreover, 98.5% of construction businesses are typically "small businesses employing fewer than 20 people." Furthermore, "59.1% [of all construction

businesses] do not have any employees at all" (Master Builders of Australia, 2020). This poses a series of discrete challenges and opportunities that directly complicate any efforts to transition towards decarbonisation in the sector.

The dominance of SMEs and sole traders in the sector gives a business landscape of relatively modest financial statements. In 2019, the annual turnover of most construction businesses (56%) was less than $200,000, and for 15.5% it was less than $50,000. This means companies do not have the capital to invest in new materials, work practises or training to keep-up with industry advancements. Environmentally sustainable technologies are often expensive, requiring the hire or purchase of machinery and investments in human resources to provide training to reshape working practices. Close consideration of who should pay for the vital investment needed for just transitions in construction is required for transition in the construction industry to be a 'just' one. Government should carefully consider the role of state intervention and investment in the sector to protect the large proportion of SMEs that will be made vulnerable by any policy decisions that require investment.

The future of the construction industry in Australia can be envisioned from two perspectives, that of automation and robotisation and that of decarbonisation in an effort to meet net zero targets. There is a clear desynchronisation at present between technological development and reducing emissions, with future developments at the structural level needed to bring together ambitions relating to decarbonisation and automation in such a way that also addresses materials and e-waste, the circular economy and resource extraction. For workers, the key challenge concerns how to realistically enable participation in such a transition through daily working life, how to provide training programmes that are correctly situated, accessible and inclusive within a work and learning ecology and how to ensure that training and just treatment of workers is a consideration when structural shifts towards decarbonisation and automation underpin change in the industry (WWF, 2020).

There is currently ambiguity surrounding the question of 'who will take responsibility for training in the industry in the future?'. Much of the current debate is focused on how to retrain and reskill a workforce for future automation and robotisation in the industry, with a mix of recommendations: that it should be offered by Universities, Technical and Further Education (TAFE) in Australia, or large companies. In practice the very limited evidence is that training for working with robotic technologies has been undertaken successfully by companies that have developed the technology and that safety training is successful when participatory and worker-focused (Pink et al 2016).

Construction is Australia's second most male dominated industry (behind mining). According to the Workplace Gender Equality Agency (2020), women comprise only 18.1% of the construction workforce, and only 2.7% of industry CEOs (18.3% averaged across all other industries). Similarly to mining, women are only over-represented in clerical and administrative work, where they comprise 77.7% of the workforce. The reasons for this are likely manifold, however the 26.1% gender pay gap (contrasted with 20.1% gender pay gap in the rest of the economy) and low-rates on offer for paid primary carer and parental leave may be instrumental. For any just transitions moving forward, the gender balance of the Australian construction industry must be addressed to bring all stakeholders and a variety of voices to the table.

BUILDING 4.0 CRC:

One initiative targeting industrial change in the construction sector is the Building 4.0 CRC (Cooperative Research Centre) which was established as part of the Australian Government's Cooperative Research Centre program in 2020. According to their mission (Building 4.0 CRC, n.d.):

> *"Through deep collaboration and new technologies of the 4th industrial age, Building 4.0 CRC will catapult the industry into an efficient, connected and customer-centric future. The CRC aims to capture new opportunities across the whole value chain in cooperation with government, research and industry organisations"*

By forging new links across industry and research the CRC purports to deliver:

> *"The next generation of highly-skilled and innovative building professionals and transforming the culture of construction together".*

Construction - along with manufacturing and mining - will be a core industry for moving toward a decarbonised future. It is clear from the four other domain reviews that Australia will need significant infrastructural investment if it is to initiate a just transition toward decarbonisation. Consider, for example, the work involved in rolling-out electric vehicle infrastructure, erecting wind farms; retrofitting already built domestic and commercial properties to better deal with heat-stress. If properly managed - there appears to be enormous opportunities for the construction sector to spearhead Australia's transition into a decarbonised economy.

We are likely to see considerable investment poured into construction over the coming years. However, for transitions to be 'just', construction must be managed sustainably to reduce future emissions from premature demolition or obsolescence. Furthermore, construction booms often have knock-on impacts to associated industries, such as the steel industry and - by extension - the mining industry that produces metallurgical coal that is consumed in its production. As such, it must be proactively managed if the full extent of the opportunities on offer are to be realised.

4.2.5 Manufacturing

According to Manufacturing Australia (2021), the sector employs more than 1.3 million people directly and indirectly and accounts for more than 5.6% of GDP, 22% of exports and 27% of R&D expenditure. Manufacturing maintains a particular relationship to mining and agriculture in light of its dependency upon these other sectors - being both intrinsically reliant on resource extraction to provide vital resources, and to fuel the nation's coal fired power generators from which it draws the energy to produce. The symbiotic relationship between manufacturing, extraction, construction, and agriculture means that if there is to be meaningful transition in any one of these industries, then change must take place across all three industries (WWF, 2020). As such, manufacturing is simultaneously a site of opportunities and challenges that intersect with other industries.

According to Ben Eade (CEO of Manufacturing Australia, 2021): "Australia has clear competitive advantages in clean energy resources, technologies and capabilities, alongside strengths in energy-intensive manufacturing industries. Combining the two will create lasting benefit for the nation long into the future". Indeed, "to achieve deep and lasting emissions reduction", Eade suggests, "we must scale breakthrough technologies and dramatically lower the costs of new technologies until they converge with the cost of existing processes." This has already begun with emissions intensity in Australian manufacturing reducing by 1.1% per year since 1990 as Australian manufacturers invested in short, medium and long term emissions reduction projects (Manufacturing Australia, 2021). However, the simultaneous decline in manufacturing makes disentangling decreases in emissions due to technical improvements and, decreases in emissions due to declining total activity, difficult. Between 2010 and 2020 manufacturing value added declined by approximately $10 billion (ABS 2020). This has been matched by sustained declining employment, with about 100 000 workers leaving the sector between 2010 and 2020. By May 2020, manufacturing employed just over 863 000 Australians (ABS 2021). This decline must be taken into consideration alongside declining emissions figures if attempts to ascertain the relative efficiency of manufacturing are to be made.

Efforts to boost manufacturing have been spearheaded by central government support schemes addressing 'priority' manufacturing sectors. The 'Modern Manufacturing Initiative' (Australian Government, 2021) issued grants of $20 million to $200 million to support industry in the following six priority areas; resources technology and critical minerals processing; food and beverage; medical products; recycling and clean energy; defence; and space. Whilst all funding has been granted, its success is unclear, given the disruption caused by COVID-19 and the relative infancy of the scheme.

Evidence from previous institutional support of the manufacturing sector points toward continued decline. In 2021, the Australian Productivity Commission reported that Australia's manufacturing sector continues to shrink despite its

"disproportionate share of assistance. In 2019-20, when it accounted for less than 10% of value added and employment, the sector is estimated to have received $2.6 billion in net combined assistance (22% of the total), of which 44% came from tariff assistance" (Productivity Commission, 2021b:5).

This may be due to the globalisation of production - a phenomenon that has reduced the manufacturing sectors of many global north nations, as factories move abroad and imports of already manufactured goods increase. A just transition may seek to re-nationalise manufacturing to improve prospects for workers, reduce the associated carbon costs of transportation, and reduce the possibility of goods being manufactured under sub-standard labour conditions elsewhere. According to one interviewee:

> [T]here's a real push now to have manufacturing 'brought home' as part of a much wider tapestry of geopolitics with China. 3-D printing is a possible way forward for decentralising manufacturing, particularly when there are supply chain issues, such as during the pandemic and in relation to transition through reduced transportation costs and the opportunity to use locally generated renewable energy.
>
> — *Interview, Associate Professor Thomas Birtchnell, University of Wollongong*

The decline is also thought to be precipitated by a shift towards services. As such, "the relative decline of manufacturing has not held back living standards in Australia. On the contrary, once we began to reduce manufacturing protection, and the burden it placed on more efficient and productive activities — within manufacturing itself, as well as other sectors — Australia's exports took off and per capita incomes have risen faster than the average for the OECD, taking us back to 6th in world rankings from 18th in the late 1980s" (Banks 2008:11). Whilst increasing per capita incomes, these shifts do not necessarily represent just transitions, nor do they prevent nostalgia for a transition that has passed by for which the automotive sector - represented by brands such as Holden - is often held up as an example. Improvements in efficiency may precipitate manufacturing redundancies, so that just transitions must additionally consider the fate of workers rendered redundant by advancements in technology, as one interviewee considered:

> The Australian car industry closed in 2017. The government had given those firms massive amounts of money [...] so the firms really had not much choice but to cooperate with the orderly closure and obviously because it's such a big industry with such big impacts there had to be an orderly closure [...] One of the things that was funded was transition centres within the firms. Ford's was called the Drive Centre [which] kept people away from the social security system and that's really important. [...] People think the union movement is not doing anything but actually the union got the redundancy provisions in 2008, 2009. So all of that anxious time as we rolled on towards closure, the workers knew they were safe. [...] some of the blokes that have been there 40 years were taking up to half $1 million in cash and we have compulsory superannuation here so they were retiring as well. They probably had $1 million in their pocket the next day. That was a 'just transition' I think everyone agrees
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> — *Interview, Associate Research Professor in Economic Restructuring, Sally Weller, University of South Australia*

This points to the complex relationship manufacturing has with other industries, technological change, government schemes, and economic change over time. One potential industry for the transition of autoworkers, is EV manufacture (see Mobilities domain (4.3). Currently, EV ownership in Australia is low, and infrastructure is poor. However, financial incentives and support are being offered for EV infrastructure development alongside upcoming tax breaks for EV owners and a resource extraction industry currently exploring the possibility of domestic battery production. As such, EVs may provide the catalyst for Australian manufacturing to develop battery production and EV production for international and domestic markets alongside generating a new industry of tech start-ups which occupy a new space in the economy. More research is needed to understand the implications and impact of this regarding a just transition, however there is a possibility that new jobs will be generated through transition which were not available in the earlier context of a diminished car manufacturing industry.

In relation to developing EV and manufacturing capability for EV, Angus Taylor, minister for Energy and Emissions Reduction stated that they will take an "approach to reduce emissions the Australian way through technology, not taxes." (Department of Industry, Science, Energy and Resources, 2021b). This attitude points to a broader attitude toward technological progress, emissions reductions, and just transition taken by the Australian Government, specifically an approach that prioritises future technology developments over present-day solutions to imminent problems. What is clear today, is that these low tax technologies are not always serving the interests of just transitions toward decarbonisation. A recent PwC report into Industry 4.0 in Australia recommended the following:

- Commonwealth Government to facilitate the development and release of a manufacturing Industry 4.0 strategy.
- Develop a new online portal that provides consolidated and easy to access information on government incentives and programs for manufacturing businesses.
- Establish hubs for Industry 4.0 commercial manufacturing activity focused on priority industry sectors.
- Continue to remove barriers between Vocational Education and Training (VET) and Higher Education in Australia's tertiary education system to facilitate collaboration opportunities and seamless learner pathways.
- Establish a workforce transformation leadership program.
- Create funding and accreditation models to support lifelong learning, reskilling and upskilling throughout the work lifecycle.
- Enhance the integration of manufacturing business supply chains through strategic procurement.

Over-emphasis on industry 4.0 agendas may lead to "low-tech" (Hansen & Winther, 2014, 2015) and "high-touch" (Friedman & Byron, 2012) manufacturing techniques being over-looked despite the opportunities for quality employment and meeting local demand. Low-tech, high-touch manufacturing typically employs labour-intensive production processes in the manufacture of high-value, design-driven products. It tends to be low in R&D expenditures, predominately including craft and cultural manufacturing industries that deliver specialised products such as ceramics, food, furniture, and jewellery to name a few (Rosenfeld, 2018).

There is a distinct lack of policy or academic literature about transition to decarbonisation and the Australian manufacturing industry; a phenomenon that warrants further investigation. However, If transitions are to be made, and are to be made justly, then government may need to consider a departure from a strategy of low-tax and low-intervention, in favour of a more collaborative approach where responsibility for- and rewards from- R&D into sustainable technologies and manufacturing practises are shared by private enterprise and state actors.

4.2.6 Tourism and Travel

The Australian tourism industry has been deeply compromised by the COVID-19 pandemic, with the loss of 182,000 jobs from the sector between 2020 and the end of 2021 (ABS 2020c; 2021). According to Pham et al. (2021) the hardest hit by these job losses have been the 'low-skilled and basic-skilled' groups of workers that comprised 57% of the tourism related workforce. The pandemic also posed significant challenges to the airline industry as passenger numbers fell by 97% forcing cost cutting measures at all Australian airlines. Virgin Australia went into voluntary administration and shut down its low-cost subsidiary, Tigerair Australia, with a total loss of 10,000 staff and 6000 contractors (Zhang and Zhang, 2021). Meanwhile Qantas made 6000 positions redundant, and stood down a further 25,000 workers (Rural, 2021). Prior to COVID-19, tourism contributed $138billion to the Australian economy ($107billion from domestic Australian tourism and $31billion from 9 million international tourists, Government of Australia, 2020). The decimation wrought by the pandemic offers a unique opportunity to rebuild the Australian tourism sector to be more sustainable, offering just transitions to workers and business.

The Australian tourism industry is vulnerable to non-COVID related exogenous shocks and changes, such as socio-political instability, economic downturns and extreme weather events including cyclones, floods, heatwaves and bushfires. Frequently, those regions that most rely upon tourist spending to sustain their economies are often the most impacted by the effects of climate change yet contribute the least to carbon emissions, including small Island communities and remote areas, such as Uluru. Action must be taken for the long-term sustainability of the industry and the biodiverse areas of interest that attract millions of tourists year on year.

Whilst the pandemic has illustrated the economic vulnerability of disaster events, the tourism industry is currently exposed to other economic risks. While the World Tourism Organization (UNWTO) lobbies for the interests of the sector, promoting "tourism as a driver of economic growth" (UNWTO 2019, in Becken, 2019:422), caution must be taken in how tourism is enrolled into local economic outlook. Particular concerns are held about the relative bargaining power in decision-making between tourism dependent regions and external interests such as investors and tourism organisations (Brouder et al., 2020). The development of a region in terms of tourism generally begins with local entrepreneurs (Becken, 2019). However, as the region grows in popularity and visitor numbers increase, external tourism operators, developers and investors inject capital to drive growth. Local operators and communities become faced with competition from new businesses and a loss of control over their local environment, economy, and the future of their region (Becken, 2019). This produces power inequalities, removing the ability for communities to make decisions about their own futures (Jamal and Higham, 2021; Brouder et

al., 2020; Guia, 2021). Notably, of the businesses that provide tourism and hospitality services in Australia, 95% employ fewer than twenty people, and in many regions these businesses predominantly underpin the economy (Pham et al., 2021). These small companies struggle to compete against larger operations due to considerable financial asymmetries. Typically, small operators have limited staff numbers, limited financial capital and a "lack of formal disaster management plans" (Pham et al., 2021: 211), thus rendering them vulnerable to fluctuations in demand and making it difficult to respond to business shocks.

The overreliance of tourism in some local economies - and indeed some economies on tourist labour (discussed in agriculture above) - on external markets for economic sustainability make them vulnerable to changes in the demand for their product, whether those changes emerge as a result of climate change, decarbonisation, overtourism or other forces (Schmallegger & Carson, 2010). However, the impetus for the degrowth of tourism in tourism dependent economies is problematic. Whilst the reduction in visitor numbers to such destinations might benefit the environment, the reduction in visitor spending will impact economies without alternative industries to sustain them.

The industry that sustains regions reliant on tourists for economic sustainability contributes to its ecological, environmental and social degradation. With growing visitor numbers, tourism destinations often suffer the impacts of 'overtourism' (Mihalic, 2020; Koens et al., 2021). To mitigate this, environmental frameworks must be deployed to bring together socio-economic and environmental elements to foster future sustainability. This will likely involve degrowth of the tourism industry, or other strategies that will need careful, active management if tourist regions and their populations are to be justly transitioned.

Some of Australia's most visited tourist destinations are dependent upon the maintenance of a very fragile ecosystem that is directly under threat from climate change. The Great Barrier Reef, for example, plays host to 26 million visitor nights, contributing $3.9 billion to the Queensland economy and supporting 33,000 jobs (Deloitte Access Economics). However, it is being eroded by coral bleaching that is destroying the ecosystem - and damaging the allure for tourists to visit it - in the process. Whilst coral bleaching is due to climate change taking place at the global scale, it seems that Australia's best route to reducing this will be to lead by example. Afterall, Australia can only pragmatically control their own emissions, and cannot reasonably expect other regions to reduce emissions if they are unwilling to do so.

TOURISM IN ULURU, NORTHERN TERRITORY

The distances and difficulties posed by the unique Australian environment has created hardship for tourism dependent communities near to remote attractions during the COVID-19 pandemic. Uluru, in the Northern Territory lies 335 kilometres south-west of Alice Springs, where the tourism industry is serviced predominantly by regional and remote small family businesses. Visitor numbers to Uluru reduced by 313,000 (77%) in 2020 (Gordon, 2021) as a direct result of the Covid-19 induced border closures and travel restrictions. The traditional owners and joint managers of the Uluru-Kata Tjuta National Park are the Anangu people who live in Mutitjulu, which lies at the base of Uluru. The local economy is driven by tourists visiting the arts centre, souvenir shop, café, and accommodation services (ABS, 2021b; Gordon, 2021). There is no alternate industry that can underpin the local economy when tourist numbers decline due to the implications for the travel industry associated with just transition to decarbonisation (Gordon, 2021). Any just transition must consider either diversifying economic inputs in the region, or protect the livelihoods by other means through close discussion with the Anangu people as stakeholders of the transition process.

While much of the literature concerned with the decarbonisation of tourism focuses on the airline industry (specifically on aviation fuel and possible sustainable alternatives) there are concerns that the carbon emissions resulting from the rest of the sector are not accounted for in emission estimates (Gossling et al., 2005; Lenzen, 2018; Becken, 2019) that focus exclusively on the carbon footprint of the commercial airline industry. These lead to under-estimates of tourism's carbon footprint and resulted in a lack of attention to the carbon footprint created at the travel destination through hotel construction, and maintenance, retail, food and entertainment (Gossling et al., 2005; Becken, 2019). Notably, international travel emissions (for air travel and shipping) are not counted in the emission quotas for travel destinations, raising questions of who should take responsibility for airmiles: the departure or arrival country, or the country in which the airline is registered? Responsibility for mitigating such emissions is currently delegated to the International Civil Aviation Organisation (ICAO) for air travel, and the International Maritime Organisation (IMO) for shipping (Gossling & Humpe, 2020).

4.2.7 Gig and Platform Work

At its most basic, the gig economy describes a situation where for-profit companies create online platforms that facilitate the connection of workers and jobs. Work is distributed via a digital technology (a smartphone app or website) and tasks (or 'gigs') are undertaken by the worker on a piece rate basis. Gig work therefore refers not to a specific industry, but as a way of organising labour and administrating markets via a platform. This can relate to many wide-ranging forms of work, from graphic design to pizza delivery. To manage this complexity, scholars Woodcock & Graham (2019) split gig work into two primary forms for analysis: 'geographically tethered' and 'geographically untethered' work. Geographically tethered work relates to jobs that must be done in-place, such as taxi driving or food delivery.

Workers produce value for the platforms they work on through the provision of a service (for which they are remunerated) and the production of data alongside that service provision (for which they are not). Staff turnover in the gig economy can reach up to 500% in some markets whilst a lack of skills training means workers leave the gig economy without beneficial personal development (Akhtar, 2019). The growth of the gig economy has been mooted as a possible 'future of work' in Australia. However, it is not suitable for just transitions for multiple (and often overlapping) reasons, including but not limited to: the rural/urban geographies of the work, reducing pay, conditions and benefits, limited opportunities for skill development, and the misclassification of workers as bogusly 'self employed'. Taken together, these factors all increase the precarity of workers, rather than offering a sustainable transition for workers leaving carbon intensive industries.

Qualitative studies show gig work is often done by people at the margins of society. The Queensland University of Technology (QUT, 2019) found that in Australia: "temporary residents are three times more likely to be a current platform worker and twice as likely to have been a former platform worker. Permanent residents are 1.7 times more likely than Australian citizens to be current or former platform workers". Furthermore, unemployed people were twice as likely to participate in gig work and students were 1.3 times as likely to participate than traditionally employed workers. Aboriginal or Torres Strait Islanders were more likely to participate in gig work too, whilst those living with disabilities, and those with lower levels of formal education were also more likely to take part. Crucially, these demographic groups were more likely to be dependent on the gig economy income for their survival, leaving them with lower-leverage to access other, non-gig opportunities (Cant, 2019; Schor, 2020; Woodcock, 2020).

Geographically tethered gig work is relatively easy to locate, with workers being made visible in the urban areas in which platforms operate (consider Uber drivers or Deliveroo couriers zooming around the city). Remote work is harder to locate because it takes place predominantly in the home or at the

workplace of another job (Irani, 2013). According to QUT (2019), 55.3% of respondents worked their gig-jobs from home. Whilst driving ICE vehicles clearly leads to increased carbon emissions in geographically tethered work (see The Actuaries Institute, 2020, report that the gig economy has increased demand, rather than displaced existing industry), home working increases the hidden emissions tied-up in keeping homes cool all year round.

The gig economy in its current state fails to represent a viable just transition for workers in carbon intensive industry. For example, average coal mining salaries are $121,740 per year (equivalent of $62 per hour, PayScale, 2021a) whilst the average power-plant operator's salary is $100,000 per year (equivalent of $51 per hour, Payscale, 2021b). Research by the TWU (2019a) found ride-share drivers currently earn $16 per hour on average, before fuel, insurance and other costs. Transport and food delivery together average $20.19 per hour before costs. The minimum wage when this data was collected was $18.93 per hour (TWU 2019b). Because gig workers are classified as self-employed, they are not eligible for employment benefits such as holiday and sick pay or superannuation contributions.

Beyond significant wage decreases, the gig economy is eroding protections at work, including health and safety. For comparison, five miners died in industrial accidents in 2020 (AMSJ, 2020) with many more suffering injuries of varying severity at work. Meanwhile in the ride-hail sector, an emergency taskforce was established in NSW to investigate deaths, following five food delivery worker fatalities in just three months in 2020 (Zhou, 2020). Earlier investigations by the Australian TWU (2019c) showed nearly 50% of workers reported being injured at work with official figures being unattainable – in part because low union density and self-employment classification means data evades capture.

> [T]he way Australia is structured all the political stuff is structured for agency to be exercised at a higher level. So if you're a union movement – I mean, if you wanted a just transition, to me, go and join your bloody union. The most influence you could possibly have would be to join your union because it has a direct control of Labor which will be in government if enough people vote for it and if it's in government it can do it.
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> *— Interview, Associate Research Professor in Economic Restructuring, Sally Weller, University of South Australia*

Transitioning workers from one industry into an empirically more dangerous industry does not reflect a just transition for workers. In the geographically untethered gig economy, workers undertaking basic online tasks such as data classification, sentiment analysis, etc. are not required to develop skills for the work that are easily transferable. In the more 'professional' and 'creative' sectors of the gig economy, such as design, content creation and copy writing, workers are expected to deploy skills they already have to fit the contracts on offer. Any skill development is often undertaken at the workers' own expense rather than borne by the company. Workers may expand and diversify their portfolios to make them more employable in the future, but on balance this does not represent a site for just transition, or the re-skilling of workers in non-carbon intensive industries.

There is an ongoing debate among policy, legal, and academic circles regarding the employment classification of gig workers. A recent Parliament of Australia report (2017) explored the widespread 'sham' wherein gig platforms intentionally misclassify workers as 'self-employed' - rather than employed - to avoid paying them their rightful benefits. According to the Victorian Government (2021), "concrete actions are required to assist and protect 'gig' workers who often have little or no bargaining power". However, they are challenging to implement because companies deploy "business models that for the most part operate beyond the reach of beneficial work laws" (Victorian Government, 2021: 2). For Adams-Prassl (2018), this corporate legal manoeuvrability is buried in the contractual misclassification of workers. For the Australian Parliament, this amounted to 'corporate avoidance of the Fairwork Act' as gig firms undermine hard fought labour regulations in Australia. Court decisions such as Diego Franco v Deliveroo Australia (Fairwork Commission, 2021) support this in practice.

CORPORATE IRRESPONSIBILITY - THE CASE OF FOODORA AND THE FAIRWORK OMBUDSMAN:

Foodora is an international food delivery platform, owned by German company Delivery Hero. It operated extensively in Sydney, Melbourne & Brisbane. Workers were contracted as 'self-employed', however they were investigated for 'sham contracting' in 2018. When the Fairwork Ombudsman commenced legal proceedings concerning wrongful classification of two Foodora riders in Australia, Foodora exited the market (Australian Associated Press, 2018), dismantling their operations in Australia to avoid the cost to their service re-classification would bring. The Fairwork Ombudsman were forced to discontinue their legal action against the firm (2019b) following their exit, however some back-pay was subsequently won through the TWU (Transport Workers Union). Ultimately it was found that $8million were owed: $5.5million to riders to reimburse wage theft; $2.1million to the Australian Tax Office, and; $550,000 to Revenue NSW.

Gig'ification' of existing industries?

The State of Victoria (2020: 1) asserts that "there is no distinct 'platform economy'. Rather, [gig] platforms are a tool through which on-demand work is accessed." Whilst the nature of gig work has grown and changed over time as platformisation and casualisation of work has advanced, what has remained the same, is its role as an experimental petri-dish for employment relations and work arrangements. It is important to remember that whilst today, it mostly represents workers doing deliveries (of people or food) or undertaking online project work, it is rapidly expanding into new territories and disrupting the way we organise our societies and labour (Srnicek, 2017). Indeed, in the past decade the gig economy has moved into care, and cleaning, security among other sectors. As such, gig work in Australia should not be simply conceived of as taxi rides or pizza delivery, it is a way of organising labour that short-circuits the current policy environment to shift disproportionate amounts of power from workers to employers (from labour to capital). This includes the 'gig-ification' of minework but also in Melbourne taxi services which have undergone intense competition from rideshare services such as Uber (see Technology and Data domain). Between 2017 and 2019 the number of registered vehicles for taxi or ride share hire increased from 8,460 to 66,894 (cited in Bissell 2021: 482), putting many taxi license holders, who had paid $500,000 per license (compared to the just $55.10 annual fee under the new legislation), in considerable debt and financial distress.

> [T]here's a whole bunch of people who lose out in transitions, who are left in their wake. So talking to some of these taxi investors who had lost, many had lost vast sums of money – not all – I was really interested in the various I suppose kind of affective transitions that they have felt in that wake. [...] [Moreover] the loss of financing, is only one side of the equation. There is actually a whole kind of hinterland of affective losses that were kind of happening in parallel. So as I talked about with some people it was a kind of loss of faith in government, a loss of faith in the idea of a supportive community. So various figures of abandonment I guess we could put it.
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> — *Interview, Associate Professor David Bissell, University of Melbourne*

The Australian Chamber of Commerce & Industry estimate that life expectancy rises will double the over 65 population by 2035. This brings two very pressing demands. Firstly, the Australian employment sector needs to push workers towards careers in health and social care in the future (an industry at risk of 'gig-ification'). Secondly, given that self-employed gig workers often survive on poverty wages or are under-employed (Woodcock, 2021) the Australian welfare system will likely face a pensions crisis if adopted en masse (Lefort, 2020). Articulating this clearly, the Actuaries Institute (2020: 6) outlined that: "With no employer contributions to superannuation for a period of their working life and minimal personal contributions, many gig economy workers risk accruing low retirement savings. These gig economy workers are more likely to be reliant on the government-funded Age Pension scheme to fund their retirement income." In sum, mass-uptake of the gig-economy, or a continued 'gig-ification' of otherwise established industries without broader change to the way gig labour is regulated will create a ticking-time-bomb of pension issues in the medium-long term. If the Australian government cannot meet the pension needs of those who have been employed in the gig economy, it is likely these workers will need to continue working gig jobs long into retirement to meet their living expenses.

4.2.8 Possibilities

Just transitions in the workplace represent a challenge of significant magnitude, involving diverse industries and stakeholders. However the outcome of steering a just transition of work in Australia would lead to enormous financial, social and cultural opportunities for government and private enterprise. For instance, the prospect of aligning a manufacturing and construction boom with widespread uptake of electric vehicles, energy efficient building design and sustainable tourism, with renewable energy and digital transition would be complex. However once accomplished it would reap environmental, economic and everyday life benefits.

The evidence presented above demonstrates that private industry alone is neither willing, nor capable, of instituting just transitions toward decarbonisation for Australian workers. At times, the interests of business and the interest of just transitions are diametrically opposed - with businesses currently moving toward greater productivity, reduced wages, and increased production at reduced costs. Meanwhile just transition advocates call for the curtailing of overproduction and upward pressure on wages and welfare protections. However, this does not need to be the case. If Australia is to transition toward decarbonisation in the future, workers will need to be involved and engaged in this process justly and fairly.

We must acknowledge that technological developments do not occur in a vacuum, but rather in the socio-economic systems that impact people's working and non-working lives deeply. The evidence cited above from reports on the perspectives of multiple stakeholders (workers, but also the unemployed, community members, women, minorities and indigenous peoples, and the disabled, etc.) shows how unjust transitions have come about for many millions of workers and industrial communities. In place of hopes of technological solutions, just transitions must approach change through the lens of 'people over profit', rather than currently held approaches that favour 'technology, not taxes'.

The question of 'who takes responsibility' is fundamental to just transition in work and industry. Across all sectors, important decisions must be made around 'who takes responsibility for the costs of investment? And who reaps the benefits of this investment in a transitioned future?' In the past, and in other international contexts, there has been governmental responsibility to pay costs and fund investment, whilst private industry and shareholders have reaped the benefits (often in lieu of local residents, workers, and communities experiencing the benefits they deserve). Australia must look to avoid this pitfall in future workplace transitions. If done sustainably, this may have the benefit of protecting small businesses who will be unable to invest in new technologies and machines that will allow them operate in the most emission efficient manner possible in the future. This could include state support and grants, or very low (or no) interest loans that will allow small businesses to invest.

The futures of Australia's diverse industries are entangled and interdependent. Acknowledging this creates the opportunity to make visible, account for, and address the 'hidden' emissions that fall between sectoral reporting gaps. Economic and employment vulnerabilities are entangled with environmental vulnerabilities. Acknowledging this creates unprecedented opportunities to address economic vulnerabilities, mitigate risk, and thus to achieve just and prosperous transitions by taking responsible environmental decisions. For example, the tourism industry relies on environmental and ecological preservation, whilst also being responsible for emissions that lead to its demise. Agricultural workers are at the mercy of ever-more extreme environments, hostile to many farming practices.

4.3 Mobilities

SUMMARY

Mobility systems are central to the 'Australian dream' of self-sufficiency and suburban life, yet this is a dream that currently has a heavy reliance on fossil fuels and flexible automobility systems and practices, in the form of the private car. This means that a transition to decarbonised mobility confronts a number of challenges. Yet there is great potential for a 'just' decarbonised future, with expansive renewable resources, opportunities for new jobs and industries, and scope for cheaper, cleaner, and more accessible forms of transport. However, at present, the country lags behind others in moving towards this future, with vehicle emissions higher than in the EU and the USA (Smit, 2019), and continuing to rise (Australia's Vehicle Fleet: Dirty and falling further behind, 2019)—with the percentage of electrified vehicles in the national vehicle parc well behind countries with established incentive schemes like the UK, Norway, or California. Australia itself has no target date for banning internal combustion engine (ICE) vehicles, no mandatory CO2 emission standards, and no national electric vehicle (EV) incentives.

To achieve a just mobilities transition, Australia urgently needs national policies for alternatives to private ICE vehicles, covering investment, incentives, regulation, and infrastructure, whilst expanding active travel and public transport—potentially taking lessons from places like the Netherlands, which heavily emphasises active travel (Bloomberg.com, 2019). A move away from a technocentric approach reliant on general market forces, and towards policies that offer clarity on a transition strategy, would also allow third parties to make informed decisions based on future anticipated changes. Regionally, there is a greater degree of action, but this is uneven. Where some states like NSW (NSW Electric Vehicle Strategy, 2021) and Victoria (Department of Environment, Land, Water and Planning, 2021) are starting to introduce incentive policies for EVs and focus more on public transport and active travel, others echo the federal hands-off approach to transition. Yet as this section highlights, there are many possibilities in a just transition beyond reducing emissions, ranging from building new industries centred around batteries and hydrogen, to reducing the country's reliance on imported fuels, to creating more liveable urban areas and improving the health of citizens, to reducing inequalities around access to transport. A more proactive transition strategy at the national level would help ensure these benefits are achieved.

4.3.1 Approaching Mobilities and Just Transitions to Decarbonisation

> I don't think we can solve some of the transport issues without attention to the equity issues
>
> *— Interview, Anthony, Transport for NSW*

A just transition to decarbonised mobility in Australia is likely to involve widespread electrification of transport—with energy coming from renewable sources—alongside efforts to enhance the accessibility of mobility options, whilst encouraging moves towards other forms of mobility beyond the dominant private motor vehicle. This may include active travel and public transport, which both have benefits for the environment, as well as for health, congestion, and accessibility. Yet a just mobilities transition in Australia also needs to account for a number of other key factors: the impact on the labour market; 'distributive justice', given technologies such as EVs tend to bring benefits mainly to wealthier groups (Schwanen, 2021); inclusivity in procedural justice to ensure that all voices are heard; epistemic justice to ensure that institutions respond to such insights; and sociocultural aspects (the actors, relational structures, and shared meanings and values) (Sonnberger & Graf, 2021). Yet there is a technocentric view of mobility transitions—epitomised by hopes that emerging sustainability and mobility technologies will solve environmental and societal problems—that means social, cultural and experiential dimensions of a mobilities transition are often bypassed. This has led to suggestions to "rethink the very meaning of mobility in cities, communities, and societies" (Nikolaeva et al., 2019). One way to approach action towards a new, more just, future may be to articulate powerful visions of a future; to create something to aim for. Sovacool et al. (2020), for instance, suggest that visions of mobility transition can be a powerful force, but the prevalence of unimaginative status quo visions that depict entrenched automobility risk letting powerful actors "hide serious problems". In contrast, articulating new and alternative visions can highlight and

push society towards a new vision of a just future (Sovacool et al., 2020).

Discussions with interview participants highlight these sorts of issues, particularly when it comes to shifting towards active forms of transport like walking and cycling, and public transport. For instance, while there is a risk of falling back on techno-optimism, there is also a risk of too-siloed thinking at the expense of a wider and coordinated responsibility. One interview discussed mobility transitions in the context of coordinating responsibility and ambition across a city's public transport and road networks.

> [I]f we simply said we want more people riding the train, that would be a transport planner's problem, and it would be a problem for people operating train networks, but how do we support the people who are managing intersections who have decided that the intersection will run for 2 minutes before a pedestrian's allowed to cross the road? Whereas if we say, we've actually got a target and the target is vehicle travel, then it is about how much time do you give to pedestrians, how much road space do you give to bikes, do we have bus lanes down the middle, do we have full priority for the trams?
>
> *— Interview, Anthony, Transport for NSW*

Suitably overarching targets potentially build an impetus for change. Instead of saying 'we want more cycling'—which in itself is not an inherent good and limits action to groups focused on cycling—by 'naming the devil' and saying 'we need to limit car use', for example, more groups and areas of government can be brought into the conversation and work towards a broader target. But that alone is not enough to ensure a just transition. It is important—particularly in the Australian context—to bring these equity issues into conversation with mobility decisions.

4.3.2 Australian mobility transitions

Although Australia's energy system is dominated by fossil fuels and coal, it holds enormous potential for renewable energy. Yet to achieve the Paris agreement target of a global temperature rise of no more than 1.5 degrees, Australia will need a fully renewable electricity supply in the 2030s, alongside a range of measures to tackle emissions in the transport sector (Aboumahboub et al., 2020). However, the route to an Australian mobility transition remains unclear: while there are calls for policy interventions, many of these may not be realistic. For instance, there are calls for subsidies or tax incentives for EVs, for promoting efficient and price-competitive public transport systems, for carsharing, and for improved infrastructure for bicycles and e-bikes. Other policy proposals have called for attention on the way that emerging digital and platform-based mobility systems—from ride-hailing to home deliveries, to near-future carsharing, EV charging, and autonomous technologies—will change street use, potentially risking the "role of streets as places for people as well as sites of curbside transactions [being] lost in the competition for access" (Marsden et al., 2020). Others call for government incentives towards EV uptake (Broadbent et al., 2019) and suggest rebates on EV purchases and energy use (Gong et al., 2020). This comes in the context of high purchase costs for EVs and the lack of a comprehensive charging network. These are seen as significant barriers to EV uptake, especially when 'range anxiety'—perhaps an engineering imaginary—is touted as a major hurdle—despite the vast majority of journeys being well within the capabilities of modern EVs (Ryghaug & Toftaker 2016).

Suggestions for policy interventions often fail to connect with a social and cultural context shaped around the 'Australian Dream' of home ownership and suburban lifestyles, which is dependent on car ownership (Willing & Pojani, 2017) and a powerful Australian car culture. In Australia some of these norms are very potent and embedded in notions of identity, bound up in cultures of automobility—especially around masculinity and maleness, the heteronormative family, status and the practices of outdoor leisure. But just as the pickup 'hog' has become a status symbol for well-heeled construction and resource workers with little sympathy for low-carbon transitions—at least in their vehicle choice—our interviews have also identified the carbon intensive truck as a symbol of resentment within pay disparities amidst the economy. They also reveal the agency and strength of unions within just transitions. As one interviewer explained in their research experience of the Hunter Valley:

> [T]here's hogs everywhere. There's a lot of resentment out there and they earn all that money because they have a union. Same with the auto workers. The reason they've got that money is because they were in the union. So we've got this unbalance here in Australia as well because those little sectors of the culture where unions have survived, skilled males with big trucks, those places, the workers are all getting a really good deal. It's everywhere else that its not.
>
> — *Interview, Associate Research Professor in Economic Restructuring, Sally Weller, University of South Australia*

Yet Australians may be willing to use new mobility technologies, including EVs, ride sharing, and autonomous technologies—though the reasons why are contextual, contingent and complex. Webb et al.'s survey of Brisbane residents showed that just 16% of participants were not open to these new mobilities. For those in favour, cost was the principal factor, and while participants were highly dependent on cars they were open to alternatives to private ownership such as electric, shared and autonomous forms of mobility (Webb et al., 2019). An evaluation of e-scooter use in Brisbane found that the introduction of these micro-mobilities was

"a contested arena in which [the] state-market relation is continually negotiated", and that there is a need to engage more with local communities in this process (Field and Jon, 2021: 369)—but during the COVID pandemic, electric bicycles, scooters, and motorbikes became a viable mode of COVID-safe urban commuting or outdoor leisure activity for many people, and electric skateboards and scooters became popular with children and young people (Strengers et al 2021: 41). It is also notable for a mobility transition that, in Victoria, "young adults are taking longer to get a driving license and are less car-dependent than past generations" (Delbosc and Naznin, 2019).

Many researchers also highlight the social benefits of public transport policies that go beyond EVs. These policies bring benefits in relation to accessibility, fitness, safety, efficiency, and equity—alongside the health and healthcare cost savings for a city such as Melbourne (Brown et al., 2019). However, introducing public transport systems alone is not a complete solution, since there is "international evidence that harassment and subsequent fear of crime may increase car use over public transport use"; fear of crime could compromise Australian efforts to encourage more public transport use in a situation where the safety of women and marginalised groups is a major issue (Gardner, et al., 2017:8). Likewise, seniors' use of public transport has been associated with their right to independence, with research undertaken in Sydney suggesting that efforts to address decarbonisation and congestion in cities, through increased public transport use, may "work against just transport options for senior travellers" and constitute new vulnerabilities (Harada, Birtchnell and Du, 2021).

EXCERPT FROM ADM+S TRANSPORT MOBILITIES SCOPING STUDY REPORT

She's a Crowd is a Melbourne based social enterprise, empowering people to share their stories of gender-based violence and providing a database of evidence that can be used to influence decision makers to take action. With innovative data capturing technology, She's A Crowd gives women (and people of all genders) all over the world a platform to share their experiences and link them to a specific place. She's a Crowd target four key barriers to reporting gendered violence, namely: discrimination, safety, lack of understanding and poor prior experiences.

Historically, men have predominantly designed city transport and how they operate – currently, it's a male-dominated field. The past and current projects She's A Crowd have contributed to have had an explicit focus on mobility. For example, previous projects undertaken with the Department of Transport Victoria and Transport for NSW aimed to promote the safety of women and gender diverse people while traveling on public transport as well as Uber, rideshares, and taxis.

On the subject of mobility justice Mimi Sheller (2018, p. 104) writes that 'greater attention to justice in transportation decision-making and participatory processes'. Working with organisations like She's a Crowd is necessary for achieving a gender-just transition to decarbonising mobility because as Sheena Wilson (2018: 378) argues "energy transition is a feminist issue" because decarbonizing our energy supply "could provide opportunities to develop more socially just ways of living that put the concerns of those most exploited – women, people of color, and the global 99 percent – at the core of energy transition politics". This is why this organisation was selected. Firstly, to ensure active and meaningful participation from a group of women was included in our project and secondly, to put women at the core of just transitions.

— Submission, ARC Centre of Excellence for Automated Decision-Making and Society, Jan 2022

4.3.3 National Policies for a Mobility Transition

The country's transport system accounts for 18% of Australia's total emissions, as of 2019 *(Australia's Vehicle Fleet: Dirty and falling further behind, 2019)*. Unlike the rest of the world, this figure is rising—thanks in part to the country's lack of mandatory vehicle emissions regulations and national transport decarbonisation policies. There are no plans to bring in a ban on internal combustion engine (ICE) vehicles, for instance. Yet there are many (just) benefits of concrete plans: clean air, healthy bodies, liveable cities, reduced costs, less congestion, more employment, and a lithium industry. Despite this, ClimateWorks notes that transport has seen the most significant sectoral growth in recent decades, with emissions increasing >20% since 2005 and >60% since 1990, meaning there is an urgent need for policy action (ClimateWorks Australia, 2020). For EVs in particular, there needs to be investment, incentives, regulation, and infrastructure, with vehicles charged using renewable electricity. The report also recommends wider mobility actions alongside electrifying vehicles, including reducing overall vehicle demand through investing in public transport and active travel.

Yet the current transport system is some way from transitioning to electric power, let alone embracing wider changes—and indeed, is lagging behind the rest of the world even with ICE vehicles. A report on Australia's current vehicle CO2 emissions suggests they are higher than in the EU and the US—despite the US being similar in some ways to Australia, with large distances and a preference for larger vehicles (Smit, 2019). Similarly, The National Transport Commission highlights how significantly Australia lags other countries (NTC 2020), noting that whereas in Europe over 90% of cars emit under 160g/km of CO2, in Australia, less than 50% of cars manage this. In part, this disparity is due to more efficient cars simply not being available in Australia. According to Smit, "the most efficient variants of top selling models offered in Australia were on average 27% per cent worse than the most efficient model variants offered in the UK", suggesting that a lack of mandatory emissions (Smit 2019:7) standards and regulation in Australia harms consumer choice and vehicle efficiency. Likewise, a PwC white paper finds Australia is ranked second to last in the world for transport energy efficiency (PWC, 2020), thanks in part to a lack of incentives for EVs, poor charging infrastructure, misinformation on EV range, and emissions reductions currently "not effectively prioritised" in planning (ClimateWorks Australia, 2020). These sorts of concerns are also echoed in our interviews, and hence assumptions that worldwide technology advances in vehicles will necessarily improve the situation in Australia may not be valid, some calling for national electric vehicles mandates and a far more ambitious national strategy (Whitehead, et al., 2021).

What action has been taken on transport emissions reductions appears to have been implemented by states, rather than the federal government. An analysis by Climate Analytics finds that emissions are due to be reduced by 30-38% by 2030, which exceeds the Federal Government's 2030 Paris target—but critically, this is not due to its own climate action (Climate Analytics, 2021). Instead, the report says that states "are leading the way by increasing renewable energy, rolling out strong electric vehicles policies and dealing with land clearance issues" (2021: 5). Conversely, at the federal level there "appears to be hostility towards EVs", and the "Federal Government's claim that it is "meeting and beating" its targets is a falsehood because it is doing little but claiming credit from the hard work of Australia's states and territories" (2021: 5). A report on urban transport innovation notes that Australia's national responses to worldwide innovation are uneven and fragmented, and frequently stuck in the present (Dodson et al., 2021). This highlights an overall theme from independent policy documents, which is a lack of national vision. There is a need for new, urgent action on infrastructure, regulations, incentives, investment, and for the country to articulate shared visions of net zero transport that considers wider energy, mobility, and infrastructure systems.

Despite this, the state governments are taking action towards a transition, but the scalar disjunction from state-level action is potentially limiting the country's response. According to one interview:

> [The state government is] doing a fair amount in terms of deployment of infrastructure as rapidly as it can, but the problem is, again, Federal Government are really holding back everything in that space. They're so far behind in terms of innovation, in terms of vision, behind a lot of other countries, that state governments are trying their best in some respects, but we need to work as a country and not as individual locations, so that's part of the problem, I think.
>
> *— Interview, Chris, Transport for NSW*

This disjunction in ambition can be seen in the federal government's new Future Fuels and Vehicles Strategy (Department of Industry, Science, Energy and Resources, 2021b). The strategy "sets out how the Australian Government will support a technology-led approach to reducing emissions in the transport sector" (2021b), which appears reflective of a faith in technological advancements to drive uptake of EVs, with a lack of vision compared to many states. Rhetorically, the government claimed it would put Australians 'in the driver's seat', and in part the strategy has been seen as a 'backflip' from the Coalition Government who had criticised the Labor opposition party's own EV policy of "ending the weekend". While technologies are in focus as solutions then, they rely upon cultural imaginations of how they will be used within Australian lifestyles and social practices. In 2019, the government had previously framed electric vehicles as unable to tow trailers or boats, and hence unable to permit the autonomy of Australians to enjoy their own leisure pursuits, choose their own vehicles, or live practically with EVs without bringing them into conflict with deep-seated familial ideas of outdoor recreation. Interview participants described popularised tensions in the perceived shortcomings of EVs.

> [Y]ou can't have an electric vehicle that's a four wheel drive. You couldn't necessarily, [...] start … you know, lobbying for electric vehicles without impacting the 'Australian weekend' and making it boring [...]. And it just points to, again, this point about Australian identity: how it's so tied up in this transition.
>
> — *Interview, Associate Professor Thomas Birtchnell, University of Wollongong*

As with other contexts, the frequent association of mobility and especially the private car with (national) identity and values of freedom and personal autonomy, presents a potential challenge for a mobility transition.

> We're the seventh-highest per capita owners of vehicles in the world ... It's essentially a frontier country, where to a large degree in people's mindsets, people are tied to their freedom, their opportunity, their vehicles, their boats, their internal combustion engine vehicles, and their big utes, their big trucks! So it is going to take more time, necessarily, unless there's an economic incentive to change rapidly.
>
> — *Interview, Chris, Transport for NSW*

Hence, whilst the Future Fuels and Vehicles Strategy opens with a promising message from a Minister (2021) ("[the strategy] sets out our vision to accelerate the uptake of these technologies"), and highlights the fact that EV sales are increasing in Australia, it misses the fact that this increase is from a very low base, and comes with a range of cultural challenges. Indeed, in the first half of 2021, both EVs and plug-in hybrids (PHEVs) together accounted for just 1.57% of the market—and the strategy predicts that EVs and PHEVs will together account for 30% of sales in 2030. For context, this contrasts with the UK which aims to ban sales of all non-electrified new cars in 2030 (UK Government 2020). The strategy's main focus on attracting private investment, communicating the benefits of EVs, and focusing on a $250m future fuels fund to invest predominantly in charging and hydrogen trials therefore risks neglecting a range of justice issues and cultural identity factors. The lack of a vision that includes in complex cultural factors—and an approach that prioritises issues such as "grid readiness" or "technological improvements—could potentially sow the seeds of resistance if the public's priorities don't match with the result of this approach.

This minimal style of policy approach also comes across in another federal policy—the Long Term Emissions Reduction Plan (Department of Industry, Science, Energy and Resources, 2021a). Like the Future Fuels strategy, it begins with a Minister statement highlighting Australia's progress: "Australia's story so far is one of consistent achievement [in reducing emissions]". The plan is to reach net zero by 2050. But it again relies on the assumption that technological progress will be sufficient; they note five key principles underlying the strategy, "the most important of which is technology not taxes". Thereby implying no financial costs for highly-polluting technologies, and no incentives for low-emission technology. The Government has claimed that: "Not one job will be lost as a result of the Government's actions or policies". This suggests that the government's vision remains focused on maintaining a particularly narrow kind of government role in mobility transitions in order to preserve jobs and, to abstain from more redistributional policies or more transformational shifts in how Australians move.

Transformational shifts in mobility—and connected domains, such as energy, and industry—are arguably inevitable, however. For instance, given that electric cars use large amounts of rare earth minerals in their batteries, mining for these elements is going to become increasingly significant in the future, and hence mining policies could play a significant role in a mobility transition.

In Australia, the Critical Minerals Strategy highlights the way that technological change is driving increasing demand for rare earth elements (Australia's Critical Minerals Strategy, 2019). Given that Australia is the world's largest producer of lithium, and has the world's second largest cobalt resource, "there are significant economic opportunities for Australia" (2019). The strategy has goals of attracting investment into Australia's critical minerals sector, of spurring innovation in the critical minerals sector, and of investing in infrastructure—and therefore reflects one side of the economic potential that a growing EV market offers. It is curious, therefore, that the government is not more supportive of a national transition to electric mobility, given that this could support new types of mining jobs at home.

Similarly, the National Hydrogen Strategy has potentially deep links with a mobility transition, particularly for heavy long-distance freight which offers unique challenges for technologies. Compared to the mining strategy, it is larger, with more obvious support, with an aim of developing the sector to help Australia become "a leading global hydrogen player [by 2030]" (Australia's National Hydrogen Strategy, 2019). There are many positives in this strategy, with promising implications for transport systems fueled (either directly or indirectly) by hydrogen given the potential for zero emissions. There is also the potential for resource extraction/production industries and related jobs with hydrogen projects, and improved fuel security that decreases reliance on foreign oil. However, 'clean hydrogen' doesn't always mean renewable; clean hydrogen is made "using renewable energy or using fossil fuels with substantial carbon capture and storage (CCS)." This is termed a 'technology-neutral stance', (Australia's National Hydrogen Strategy 2019) which is a stance that could result in continuing coal use and CO2 emissions, altering the distributional benefits of a transition. Given Australia has such quantities of renewable energy available, this is a curious approach; indeed, the strategy itself notes that "Geoscience Australia estimates about 11% of Australia (872,000 square kilometres) could be highly suitable for renewable hydrogen production" (2019: 9).

But 'clean hydrogen' that is made from coal would neglect the decarbonisation aspects of a transition—and many justice benefits. Coal is a shrinking industry, and trying to support the coal- and resource-dependent communities who rely on coal jobs through coal-based hydrogen production is potentially only going to slow a transition. Having a clear transition strategy for these communities post-coal could give certainty and jobs to these communities in the more immediate and longer-term future. Hydrogen could be a part of this, though current pilot projects suggest the emphasis remains weighted towards coal. The Hydrogen Energy Supply Chain (HESC) Pilot Project, (https://www.hydrogenenergysupplychain.com) for example, is purportedly the biggest hydrogen demonstration project in the world, supported by Japanese and Australian governments, with Australia putting in $150m. By way of contrast, Jemena's Western Sydney Green Gas Project is a project that creates hydrogen from wind and solar power, and injects it into existing gas pipelines in the Jemena Gas Network, but notably, it has just $15m in funding.

Not all ideas of mobility transitions will be substantive steps towards decarbonisation, nor will all transitions necessarily bring wider justice benefits. The Australian Renewable Energy Agency's (ARENA) Biofuels and Transport report, (CEFC and ARENA 2019) for instance, is potentially indicative of a non-transition to decarbonisation, and instead a transition away from diesel. The report recognises that emissions must decrease, but suggests that creating a biofuels industry could be a route towards this goal, being particularly suitable for long-distance freight (CEFC and ARENA 2019). The main benefit appears to be that biofuels can be used with existing fueling infrastructure and engines. Yet whilst emissions are reduced, they are still produced with this technology. Hence, biofuel appears to be a mix between non-transition (predominantly the same infrastructure) and an intermediate stage of transition to greener mobility, be it an ultimate destination of hydrogen and/or battery electric.

In contrast, the 2019 Transport Infrastructure Audit reflects an awareness of broader mobility issues in a decarbonised transition, looking at motor vehicles as well as public transport and active travel (Infrastructure Australia, 2019). It notes an 'uneven performance' across the country, where "[a]ccess conditions remain uneven, regional infrastructure is poorly maintained, and costs, while remaining stable, have impacted some groups more than others" (2019: 264). For instance, people in outer suburbs have lower incomes, yet little access to public transport—and the challenge of 'transport disadvantage' will likely expand due to an ageing population. Another issue it notes is increasing congestion in cities, and despite an infrastructure boom, there is a risk that the transport sector becomes "financially and environmentally unsustainable". One approach to addressing larger mobility issues like these would be for transport networks to move towards an integrated Mobility as a Service (MaaS) model, with EVs to reduce transport costs, improve air quality, reduce emissions, lower traffic noise and promote better public health outcomes. Maximising these benefits would "depend on policy intervention by governments", but the report suggests that with sufficient support, EVs could make up 40% of sales in 2025, in contrast to 6% under a business-as-usual approach. And yet, the audit still appears somewhat disconnected from the longer term cultural and social values around car ownership and use discussed so far.

‘IT’D BE VERY HARD TO LIVE WITHOUT A CAR’:

[C]ulture is largely driven by the fact that we’ve planned for it. If the opportunity to walk or cycle or take public transport was just as convenient and easy, a lot more people would choose it. But there are some people that just have that car and they’ll drive the car regardless of whether something else is just as convenient and easy. So you’ve got people at that end, then you’ve got the people at the other end who are like: “I really need to walk and cycle all the time”. Those are the two extreme ends. But then you get the majority in the middle that are like: “I just want to do whatever is most convenient and easy, cheapest for me to do.” At the moment, because we’ve designed most of our cities to facilitate movement by car, well they just choose that because that is the easiest. If we had designed it more to facilitate walking, cycling and public transport, I’d say the majority of that middle group of people would do that. (James)

I think some of it is cultural. People have always been really into their cars here. We used to have the Grand Prix and we’ve got the Bay to Birdwood and the historical motor museum, and we used to be the home of Holden and all those sorts of things. So, people are really into their cars, almost as a cultural thing historically here and that identity as being a car place. I think some of it, particularly because not everybody here comes from that particular background and culture, I think some of it is also driven a little bit by the availability of alternative transport arrangements. (Mia, State Dept Transport Employee)

James and Mia’s quotes capture one of core issues with industry visions of future mobility which is the dominance of car-centrism. The car as a symbol of freedom originated in the early 1960’s in America. Jeff Sparrow (2019:18) states that ‘car culture will only be defeated by destroying its foundations. Once it is cheaper and more convenient to catch the train, the car will no longer represent freedom’. I would argue that ‘defeating’ or transforming the symbol of the car will require a lot more heavy lifting. Since the foundations of this symbol are both cultural and structural, framing the shift as an issue of economic and convenience misses the complex social and cultural factors at play.

Gender – or masculinity to be more precise, is a dominant factor. Weber and Kroger (2018:16) highlight that in ‘countries of the Global North, driving has traditionally been considered a masculine skill, and the main promises of the automobile are articulated in masculinised forms and codes’. The concept of gendered driving also applies to the Global South, countries such as Australia, which have been explored by researchers such as Vick (2003) and Walker, Butland and Connell (2000).

— Interview participant excerpts, Submission ADM+S, contributed by Dr Thao Phan, January 2022

Given these cultural factors in shaping mobility choices, the Transport Infrastructure Audit is interesting in the breadth it displays in considering transport systems, in contrast to the limited scope in national transport policy. But it also raises the question as to why there appears to be a general absence of addressing mobility justice issues in transport futures, alongside decarbonisation. That said, a report on future cities—also by Infrastructure Australia—demonstrates an awareness of the need to address wider justice issues when it comes to the liveability of cities (Future Cities, 2018), noting the potential of innovative scenario planning tools to address longer-term futures—thereby foregrounding a greater range of possibilities and involving greater public discussion. An Australian Parliament Select Committee report also highlights a range of economic, environmental and health benefits that EVs could bring (Parliament of Victoria, 2018).

Overall, national policy strategy largely centres around minimal investments in charging infrastructure and a wait-and-see attitude with respect to technology development. This contrasts with calls from elsewhere within government for concrete action to accelerate a transition to renewable forms of mobility and for this transition to factor in alternative forms of mobility alongside wider sets of just principles.

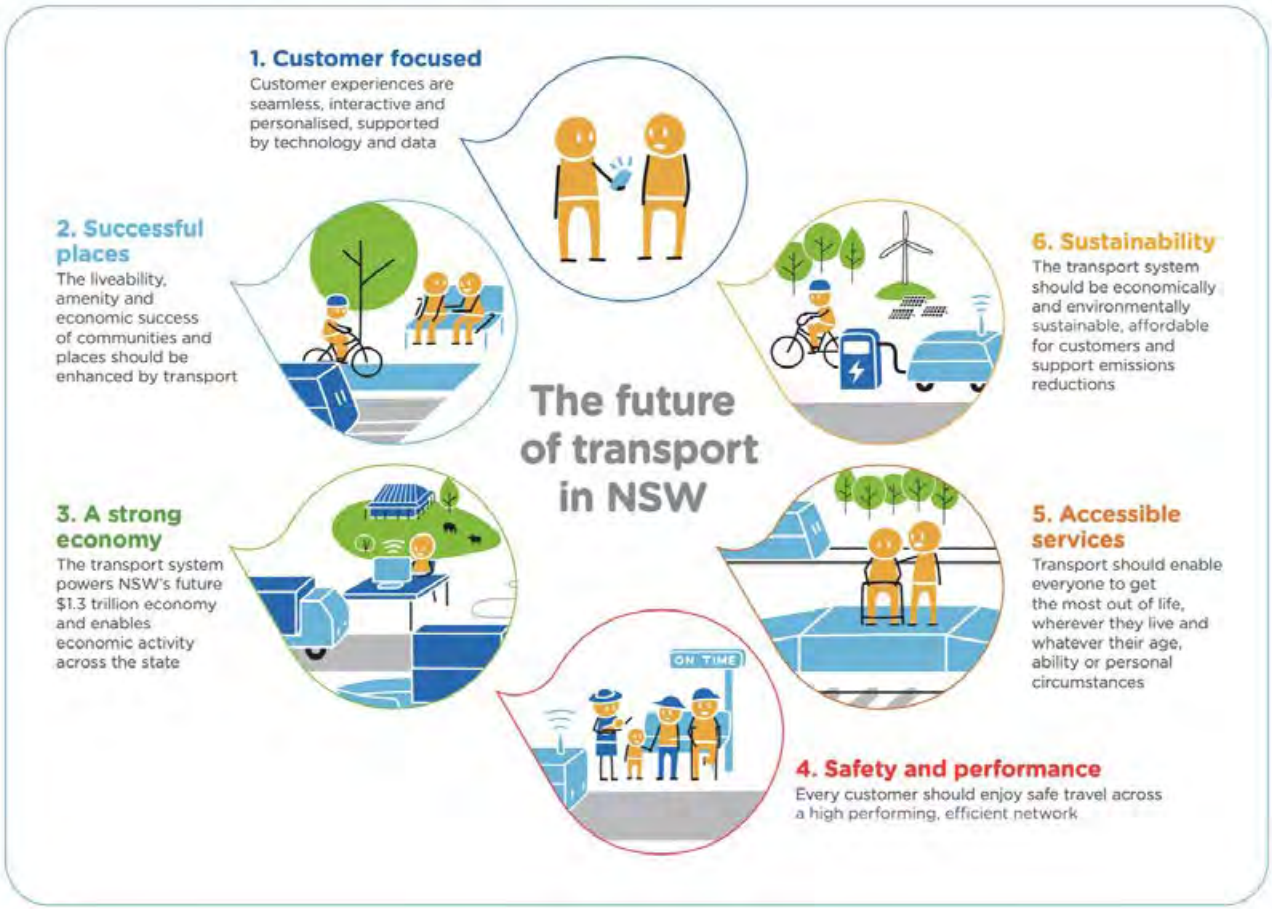
4.3.4 Regional Policies for a Mobility Transition

With the scalar disjunction between national and regional levels, a focus on these regional state policies is a core part of our analysis of the Australian mobility transition. Taking Victoria, their Zero Emissions Vehicle Roadmap begins with a strong Ministerial foreword, with the Minister for Energy, Environment and Climate Change noting that in a transition to zero emissions vehicles, "Australia is falling behind the rest of the world – risking future jobs, productivity and sustainability". And, "[d]ue to a lack of national policy leadership, Australia has a limited range of affordable ZEV models to choose from and is behind other

countries on ZEV uptake." (Department of Environment, Land, Water and Planning, 2021). This sets up Victoria's policies, which go further than national policies do in working towards a transition to decarbonised transport. The roadmap includes investing $100m—a significant amount in comparison to the national $250m future fuels fund, for example—and allocates $46m to Australia's first public ZEV (zero emission vehicle) subsidy program. The policy will involve replacing all Victorian Government vehicles with ZEV ones, with new buses to be emissions-free by 2025. More broadly, private sector-run bus services are moving to electric vehicles, but the changes have been very recent due to state procurement panels offering diesel only specifications even up to 2019—and bus companies can only procure vehicles to a state's procurement specification. And whilst Victoria's target is for 50% of cars sold in 2030 to have zero emissions technology, this goal is not ambitious on a global scale, with the 'zero emissions technology' definition potentially including a wide range of hybrid powertrains that still burn fossil fuels. Beyond this, the policy has been criticised for introducing a road usage tax for EV drivers,

introduced in 2021. This is being challenged in the high court (Cox, 2021), and has been labelled the "worst electric vehicle policy in the world" by a coalition of car manufacturers, industry groups, infrastructure companies and environmentalists (Kurmelovs, 2021).

New South Wales's Electric Vehicle Strategy also proposes a road usage tax on EVs, but not until 2027 or when EVs make up 30% of new car sales (NSW Electric Vehicle Strategy, 2021). Whilst there are benefits to a road usage charge—with higher-usage road users paying more towards upkeep—there are also drawbacks. If this is applied just to EVs, for instance, this may harm uptake, and because of other social structures, many people do not have a choice to move onto public transport, and may still be priced out of electric vehicles, or even lack the infrastructure to use them conveniently—especially at home. (Currie 2004, 2010 and others have identified a distinctive public transport and social needs "gap" in Australian cities)). Yet overall, this strategy is more progressive than many, and reflects a broader awareness that mobility systems will change in both the long-term—potentially with hydrogen and autonomous technology—and in the short-term, with EVs. It acknowledges that EVs will bring greater fuel security, quieter roads, lower emissions, and an ability to balance out electricity supplies through smart charging and battery buffers. And whilst EV uptake remains low in NSW, currently making up just 0.68% of new car sales in comparison to 55% in Norway and 7% in the UK, the strategy's five key actions centre around improving this figure. These include helping customers purchase EVs by removing stamp duty and offering rebates, improving the charging network through infrastructure investments and regulations, and easing EV usage by allowing use of 'transit lanes'. The strategy also considers employment, with a focus on skills training, assisting mineral mining, and promoting EV-suitable routes and destinations across the state, whilst also acknowledging the new jobs in mining and energy industries.



This approach contrasts with national policy approaches that are more limited in their scope. Yet this contrast is even more apparent in NSW's Future Transport Strategy, which is a 40 year vision of the future of transport that gets frequently updated (NSW Government, 2018). With this extended temporal horizon, it is potentially easier to consider the justice implications of a decarbonisation transition, to agree on an overarching target to work towards, and to consider the impact on future generations living with the result. Indeed, the central focus of this vision is on enhancing the "liveability, amenity and economic success of communities" (2018), given that transport is central to the creation of 'successful places' and 'new economic and social opportunities'. There is a focus on safety and on improving the accessibility and sustainability of transport systems, achieved by taking a 'whole-of-life' approach that considers future needs, challenges, and opportunities. This potentially opens up a space to complicate future transport mobilities with the contingencies of everyday human life or to represent the actual diversity of Australia's population. Yet despite the possibilities here, there are many factors that hold back visions of greater change, not least of which is historical legacy. An interview with Transport for NSW highlights these sorts of barriers that stem from a highly car-dependent transport system:

> We have a kind of highly land-intensive transport system, so all the impacts that go along with high levels of car dependence, in terms of suburban expansion and materials consumption, and just energy inefficiency, is really the big challenge for the transport sector as a whole. But we have a system that's enormously car-dependent. And we have, for the most part, been perpetuating and reinforcing that car dependency, in terms of our big investment programs, over I would say the last … really the post-war years.
>
> *— Interview, Anthony, Transport for NSW*

This is not to say, they emphasise, that there hasn't been investment in things like public transport. But rather, the balance has been—and often still is—weighted towards investments in, for example,

urban motorways rather than urban and light rail. A key factor then becomes how justice and equity concerns are integrated in a transition. In particular, how infrastructure investments and pricing structures can build social equality. Interviews suggest that regional transport policies and investments, especially on infrastructure, may be directed towards coal and industrial communities facing the challenges of transitions away from those carbon intensive industries.

Government action towards mobility justice can also be made more complex by a range of other, more hidden factors that may come into play, further complicating transitions. At the micro level, for example, this might include pre-existing contractual obligations to motorway financers, which could potentially limit the scope of government action towards adding bus lanes or cycleways. Hence, surfacing the complex dynamics in mobility systems, and being aware of the legacies of car-dependency, is crucial in efforts to shape a more just transport network.

Where NSW is Australia's most populous state, with the majority concentrated in urban Sydney and a relatively heavy focus on big infrastructure projects, Tasmania is one of the smallest and least populous states. However, it achieved net zero emissions back in 2016 (Tasmanian Government, 2020), and by 2022 is on track to be entirely self-sufficient in renewable energy. Their goal is also to have the "lowest-cost regulated electricity in Australia for residential and small business customers". For EV users, this means not only will the power be 100% renewable, it should also be cheaper for people to run their vehicles—potentially broadening access to electric mobility. And from 2030, the state also aims to be a producer and exporter of renewable hydrogen, kickstarted by a $50 million 'support package'. On EVs specifically, they will also introduce more limited policies that include a stamp duty exemption for EVs and hydrogen fuel cell vehicles, for a two-year period, alongside public charger grants and a transition of the government fleet to 100% electric by 2030 (Tasmanian Climate Change Office, 2021).

The Australian Capital Territory offers another example of transition, yet with more focus on other forms of mobility. Their 2018 Transition to Zero Emission Vehicles action plan notes that alongside measures like allowing ZEV vehicles to drive in transit lanes and Government leasing only ZEV vehicles from 2020-21, they will think about incentives for electric bicycles (ACT Government, 2018). And in their Climate Change Strategy, they have specific actions for a 'just transition', focused on low income residents and workers affected by a transition (ACT Climate Change Strategy 2019-25, 2019). In terms of transport, the strategy involves more public transport, and will encourage active travel by 'continuing to improve cycle paths and walkability'. For public transport, this would involve a zero emission bus fleet by 2040, and a focus on improving accessibility to help encourage greater active travel. They will also improve active travel infrastructure, from paths to bicycle parking, and encourage electric bike usage. A part of this encouragement involves increased tree canopy cover to improve the shade on active travel routes in hot weather, reflecting the broad range of policies that can encourage a mobility transition. On EVs, the state will explore the need for further incentives for EVs "such as increased registration discounts, rebates and low interest loans", and will plan for compact cities that reduce travel distances and reliance on private car use. Finally, there is also an awareness that future changes to automobility—from mobility as a service, to autonomous vehicles—will further transform travel and reduce private car use. Hence, these actions reflect a more overarching approach to a transport transition from the ACT, and comes alongside an electricity supply that met its target to be 100% renewable by 2020.

In South Australia, there is a focus on supporting the uptake of EVs and the hydrogen industry alongside increasing public transport and active travel (South Australian Government, 2020). Their climate change plan wants to both cut emissions and create urban environments that reduce the need for car travel, thereby creating more liveable spaces. For roads, the plan is to allocate greater priority to pedestrians, bikeways, and public transport—which the government will make "more efficient, more accessible and more frequent". This is crucial when transport is the largest source of emissions for South Australia. Plans in South Australia recognise that a focus on technology alone is not enough to achieve the required degree

of change: “a combination of behaviour changes and technological innovation” is needed to “shift to low and zero emissions vehicles and fuels, reduce transport demand and improve transport efficiency”. Hence, decarbonisation is wrapped up in a wider plan for a just transition, which is attentive to people—not just technology—and includes a focus on broader urban design. Meanwhile, the state’s separate EV plan notes that, given that the federal government has “primary responsibility over the entry of new motor vehicles into Australia” (Government of South Australia 2020: 27), the South Australia government will “advocate for a national policy and taxation framework calibrated to enable electrification of the transport sector” (Government of South Australia, 2020: 27). They will aim for all new passenger vehicles sold in the state to be fully electric by 2035, and will have a statewide charging network by 2025.

The Western Australian Climate Policy focuses on their public transport ‘METRONET’ rollout, aiming to “create a framework for sustainable growth and reduced car dependency” that includes more active travel like cycling (Western Australian Climate Policy, 2020). EVs and hydrogen fuelled cars will play a part in this, as reflected in their Electric Vehicle Strategy (Western Australia Government, 2020). This notes Western Australia’s competitive advantage, boasting the “world’s largest reserves for all the critical battery minerals”, alongside the “skills, infrastructure and standards” to become a key player in the global battery value chain. They also focus on growing the renewable hydrogen industry, and have invested $21m in this EV strategy, as well as charging infrastructure. In some ways this greater focus on jobs and industry more closely mirrors the federal approach, albeit with a more apparent focus on public transport and active travel, and a call for emissions regulations.

In the Northern Territory, “there were 12 electric cars in March 2019 and 38 in December 2020” (Northern Territory Government, 2020). The NT aims to support EVs with reduced stamp duty and registration fees, but notes some NT-specific challenges to EV technology given its small and dispersed populations, and challenging and extreme climate. The territory has suggested that government “support is needed to ensure that the Northern Territory is not left behind as Australia transitions to electric mobility”, given the infrastructural, social and environmental particularities compared to other states.

Finally, Queensland is working on a new Queensland Zero Emission Vehicle Strategy which aims to provide detail on their plans. Currently, their Climate Transition Strategy contains very little on transport, aside from a goal to “develop a zero net emissions transport roadmap” (Queensland Government, 2020). However, a report from the Queensland Department for Transport on trends and scenarios to 2048 does reflect an awareness of the potential scale of upcoming changes, ranging from “automated and electric vehicles, drone deliveries, new ways of travelling such as through ride-sharing and car-sharing, growing and aging populations and changed work practices” (Naughtin et al., 2018: 5).

Overall, these regional transition policies highlight the prominent role that individual states are playing in the Australian transition to decarbonised mobility—and also the varying recognition that this can be tied up with wider forms of transition that are more just. However, these regional approaches also highlight large differences across states, with the harms and benefits of decarbonising transitions unevenly distributed across the country.

4.3.5 Urban, suburban, and rural mobilities

Australian cities have demonstrated the potential to play a significant role in a transition to more just mobility systems, in many cases over and above states and the federal government. For example, the Sydney Metro public transport project, as a light rail system which opened in 2019, will "transform Sydney for generations to come" *(Sydney Metro, no date).* Metro West is a forthcoming 24km autonomous and electric metro line that will connect the Central Business District of Sydney with Greater Parramatta to the west, and aims to connect a range of communities through a fast and accessible form of mobility—some of whom have never had rail options previously. It will expand mobility options for those communities on the route, whilst also creating 10,000 jobs directly connected to the construction, and 70,000 indirect jobs. While the project has been criticised for missing some communities on its routes for economic gain (Brook, 2019) the network offers many benefits relating to productivity, social equality, and the environment. However, there is a challenge in keeping up with urban and suburban expansion. Indeed, conversations with Transport for NSW highlight the extent to which the Australian economy is driven by housing construction and speculation, and the difficulties that suburbs present for a mobility transition:

> [I]t's well and good to be extending Metro lines to new suburban areas, but when those suburban areas are expanding on the urban fringe at a kilometre a year, you're never going to catch them with a rail expansion program that puts one corridor in one direction. Meanwhile you've got hundreds of square kilometres of relatively low-density urban subdivision
>
> *— Interview, Anthony, Transport for NSW*

Melbourne offers another example of the beginnings of a mobility transition, with the Victorian Government conducting a 12 month trial into the use of e-scooters. Currently, it is illegal to use the small electric scooters in the state, but the government "recognises that e-scooters can connect the community to public transport and provide a sustainable alternative to short journeys" (VicRoads, 2021). As part of the trial, people will be able to hire the scooters, and ride them on bicycle lanes, 'shared paths', and lower speed roads (<50kph). These E-scooters present some challenges however; in Brisbane, for example, the government had to bring in new rules after a spate of injuries (Druce, 2021). Yet wider use of e-scooters potentially opens up new mobility options for a large number of people in urban areas and smaller cities, with the Mayor of Ballarat—also taking part in the trial—commenting that when "you're in the CBD [Central Business District] itself, it does make a lot more sense to park the car and then … use other forms of transport such as scooters, walking and cycling" (ABC News,

2021b). Beyond this, there are clear environmental benefits, and for politicians, they are potentially a way to transition to more just forms of mobility that don't require large infrastructure investments. For Melbourne, these e-scooters are then wrapped up in a wider transport strategy that aims to transform the city into Australia's leading bicycle city, creating new bike lanes and taking road and parking space away from cars, giving it over to forms of active travel instead.

Outside cities, in suburban areas and rural towns, transitions to low-carbon mobility need to be qualified within people's lifestyles and routines, where transitioning to public transport may be unthinkable or difficult to contemplate in the context of people's social structures, habits and obligations. In a workshop on EVs (see box below), senior participants were explicit about the autonomy and convenience cars offered to their lives. Transitioning to EVs would also place important considerations on household energy budgets and their management, over which participants would look to gain control.

Workshops undertaken as part of Monash's Digital Energy Futures project also saw the privileging of aspirations for EV ownership, which contrasts with interest in pay-as-you-go service models elsewhere, and the weaving of electric vehicles into already existing household systems and practices—particularly over energy use: "people preferred to personally manage and control their mobile devices and vehicles and many participants created routines and set up timers to assist them in this. They valued the flexibility that this gave them, it enabled them to align it with the availability of solar or cheaper energy tariffs, and they did not see any benefit in having automated charging" (Strengers et al 2021: 37).

ELECTRIC VEHICLES IN RURAL AUSTRALIA

In rural Australia car culture is part of life in towns, and this was no less so for our participants. They cannot imagine using public transport instead in the future, seeing it as something mainly used by school children and students. Car ownership and driving enables people to move around in their own town, neighbouring towns and the hinterland. They use cars to access everyday places and services - like shopping, medical services, hairdressing, sports and parks, and to perform services and care for others, including childcare. Thus driving is central to how people organise their everyday lives, and it is likely that their daily routines and rhythms of driving to use local shopping services and health and leisure facilities and spaces would equally apply to their use of EVs, and that they will want to charge EVs in such ways that support these uses.

People want to be in control of their everyday lives in the future - they will decide how much time to dedicate to childcare, and they will want to decide when and where they will charge their EVs, if they will sell their energy back to the grid, and if they will use their EV batteries to put electricity back into their home energy systems. People are open to certain features of the future automation of EV charging, as something that increases convenience for them, and when they are able to research and make decisions themselves.

Participants envisaged most future EV charging happening at home, optimally using solar energy (which supports findings in the Digital Energy Futures Future Home Life report (Strengers et al 2021) and Digital Energy Futures documentary (Pink 2022)). They could be incentivised towards cheap top-up charging and selling back their electricity from their car, via schemes like supermarket loyalty cards when going about their usual everyday shopping routines, or at pubs.

However they were not convinced that there was a viable future for public charging stations in their towns. They felt that they might be usefully located at supermarkets, medical centres, and leisure centre car parks, but were 'bulky', would be an 'eyesore' in local parks and the town, and would reduce the availability of their treasured free parking which was already under space pressure.

This transition to EV futures, invoked a series of previously invisible inequalities. These were already visible in existing Digital Energy Futures research which has demonstrated the limitations urban apartment dwellers face in terms of the costs and charging facilities available for EVs. In the rural context likewise, not all participants had equal access to car parking or charging possibilities at home. For example people living in retirement villages have less access to car parking spaces, no garages, and no space where charging facilities might be installed. Some older (and other) people might need to gain access to medical facilities, which could be at distance, and if charging is not available prior to leaving or at the health centre car park, may be disadvantaged in terms of access. Existing inequalities, as well as unanticipated inequalities which come about due to inaccessibility of charging infrastructures to some people will create uneven access to EVs for retirees and seniors. There are design implications here for retirement villages and communities and health facilities where charging infrastructures and services would be beneficial

— *Workshop report, from the Digital Energy Futures ARC Linkage project, Sarah Pink, December 2021*

4.3.6 Possibilities

Technology and the social are deeply intertwined, with "the sociocultural [...] an integral part of mobility transitions". Despite this, "the sociocultural dimensions of mobility transitions seem to be frequently overlooked leading to reduced significance in agenda-setting processes of policy making" (Sonnberger and Graf, 2021:174). There is a dominant technocentric view of mobility transitions epitomised by hopes that technological development alone will bring about the needed sustainable changes. Moving beyond the technocentric view is an important process if the just aspects of a transition are to be addressed. This could involve 'commoning' mobility—a way of collectively shaping fairer and greener forms of mobility, bringing decarbonisation transitions together with mobility justice (Nikolaeva et al., 2019).

One factor that may encourage wider participation in the 'just transition' cause is the economic argument. A Deloitte report on future cities highlights this economic potential from reimagining transport systems, beyond the health, wellbeing, and climate benefits (ImagineSydney, 2018). For example, a '30 minute city' concept for Sydney where people live a maximum of 30 minutes from work should, they suggest, significantly improve liveability—epitomising what a just transition could look like for many. But in using new public transport investments to reduce commuting times, the report suggests that New South Wales could see an annual $10bn benefit from the productivity benefits of 'clustering' and shorter commutes. Hence, even if climate goals and other justice issues aren't forefront in all minds, the economic benefits of a just transition can also be convincing. Electric vehicles in particular potentially offer significant economic benefits, which can be put in terms of avoided costs stemming from improvements in emissions and pollution. Achieving net zero in 2050 could save $230bn compared to no action, whilst achieving that target by 2035 might save $490bn (Deloitte, 2021). Similarly, an EY report suggests that—thanks to impacts on government revenue and indirect costs and benefits—the average net benefit to government and society of replacing an ICE vehicle with an EV comes to $8,763. For each bus replaced with an EV, the figure is $40,051 (Electric Vehicle Council, 2020).

Despite the compelling nature of dollar figures, there is a potential risk that in compressing benefits down to simple economic numbers, larger—more just—transitions could be lost. **Reducing car use, and expanding public transport and active travel, would both contribute to a just decarbonisation transition in the transport sector, with broader improvements to liveability and wellbeing.** But these improvements may not materialise if a transition focuses on only replacing each ICE vehicle with an EV, following economic modelling. Hence, driving down the number of private cars should be central to initiatives focused on improving the liveability of urban and suburban areas. This doesn't mean neglecting the motorcar entirely, however, with car sharing and mobility-as-a-service (MaaS) models both compelling options for EVs. However, switching away from private cars may be a challenge when Australian cities are among the most geographically spread out, and

private automobilities are so embedded within peoples' identities (Dixon et al., 2018).

To begin shifting away from private automobility means emphasising the benefits beyond economic arguments. Here, Australia's resources mean it is well positioned to capitalise on a shift to decarbonised transport systems, according to a Climate Action Tracker report (Climate Action Tracker, 2020). The country has vast potential renewable energy sources, and green hydrogen—produced with renewable energy, not coal—could be a major opportunity both nationally and internationally, where it could be used in aviation, shipping, and road freight transport (and it could also be used to make products like green steel). By switching to zero emissions transport, Australia would also increase its fuel security, reducing its dependence on oil imports. And EVs would offer benefits for the nation's electricity network, with cars potentially acting as a nationwide battery buffer when plugged in, allowing two-way exchange of power. With sufficient numbers, EVs could stabilise the peaks and troughs of Australia's renewable energy generation (Climate Council, 2021).

Other possibilities stemming from an electric transition can be seen through examination of an already established electric vehicle, found in the contested mobilities of older adult mobility scooters. This was highlighted in interviews, where the contrast between some visions of future mobility—involving autonomous pods moving freely around shining cities—and the lived reality of current electric mobility scooters was brought up. We focus on this as a possibility of alternative automobility practice **that is alive to the social and creative ways people undertake mobility, and which can make visible the holes in techno-centrist planning assumptions.**

> [W]e were fascinated by these strange visions of the future which had mobility scooters at the centre and then the actual reality is that they're [current mobility scooters] seen as these kind of crazy, disruptive—you know—problems in society.
>
> *— Interview, Associate Professor Thomas Birtchnell, University of Wollongong*

Users of mobility scooters need to get around, and despite hurdles and stigma, they find ways of circumventing obstacles, like a lack of footpaths and roadway dangers, to use their vehicle in sometimes unanticipated ways. This highlights a potential disconnect between the people who need this form of mobility and the people in positions of power who determine how it may be used and who may use it—but who may not be aware of ultimate user requirements.

> Pre-electric Vehicles: mobility scooters and elder mobilities They're the most visible electric vehicle on the streets in Australia and they're linked, or tied, into the provision of services to the vulnerable and they're often used by the aged, disabled and vulnerable, people who have, or are, mobility impaired as they say in policy. And they're used for, or as, an alternative to the motor car. And so they're usually for people who have lost their licence or can't drive anymore, and they're given a mobility scooter as an alternative to get around.
>
> And so the policy framing around them is really interesting for us because they're classed as pedestrians and this seems to be the trend or way it's going. And so we see mobility scooters, this electric vehicle, they're moving around on footpaths, though in Australia there's a caveat because in most places outside of major cities there's no footpaths or the footpath, you know infrastructure, is very hit and miss. Everything just stops and you get grass and so on. They are seen a lot on the road and a lot of the media around mobility scooters and electric vehicles more generally, has claimed that they're disruptive and they're a problem.
>
> They represent the first real kind of exploration with electric vehicles I think that we have and I don't think they should be understated for that.
>
> *—Interview, Associate Professor Thomas Birtchnell, University of Wollongong*

This tension between anticipated and unanticipated use of a mobility technology is highlighted in our interview with the academic Thomas Birtchnell and in a related paper, where it's suggested that before a niche like electric mobility scooters can gain traction, "users must first experiment and learn how to function effectively through trial and error with little support (and not too much resistance so as to trigger attrition) from the built environment and socio-cultural norms" (Birtchnell, Harada and Waitt, 2018). The technology needs 'mavericks' to experiment with use cases and adapt practices; these mavericks can then catalyse "system wide change". Hence mobility scooters are an example of a disruptive technology that challenges current frameworks through different manners of experimentation—what Birtchnell and Harada call 'loop-holes'.

This idea of mavericks finding new ways of using mobility technology may offer lessons for wider mobility transitions. **Greater openness to possibilities—centred around mobility practices, user needs and choice—may shape a mobility transition that is more likely to be 'just' and adaptable to people's mobility needs.**

With electric cars, the rhetoric about their capabilities appears to shut down the space for possibilities—that they aren't suited to the Australian way of life; despite this, there remain possibilities for adaptation. In the short-term, for instance, plug-in hybrids could bridge the gap until more heavy-duty EVs are available—yet in the USA, larger EV pick-ups like the Rivian R1T and Ford F-150 Lightning are already available, with large range and large towing capacity. Another possibility is to install destination chargers at leisure destinations, say, that allow smaller EVs to recharge, and which could also bring other benefits by seeding communities and tourism work around these charging locations. And if there are fears of being stranded with a depleted battery, the NRMA can help by carrying emergency battery power. There is the potential, in short, to find ways of adapting systems and practices to electric mobility that fits with the Australian national identity.

To put this idea of adaptation in context, the Dutch 'Stop de Kindermoord' campaign in the 1970s

proved pivotal in transitioning the Netherlands towards a more just mobility system centred less around the private motorcar, and more around cycling. This was stimulated by 'mavericks' who initiated "protest movements, civil unrest, legislative pressure and eventually political support and policymaking" (Birtchnell, Harada and Waitt, 2018: 127). 'Mavericks' in Australia, assisted by supportive regimes, could similarly shape mobility by identifying new ways of using emerging mobilities like EVs that help build a more just transition. This will include electrified private automobiles, but there are many other possibilities beyond this technology. Building on electrified mobility with infrastructure and investments that increase walking, cycling, and public transport would distribute the benefits of a transition to more people, whilst new models of vehicle use—such as carsharing and ridesharing—and new types of electric vehicle—like e-scooters—could be significant factors in shaping a decarbonised future that addresses the justice issues of a mobility transition. There are, in short, many possibilities for a mobility transition that is just, decarbonised, and that also brings economic benefits to Australians.

4.4 Renewable Energy

SUMMARY

The expansion of renewable energy to date indicates an ongoing tension between top-down renewable energy investment unfolding within business-as-usual structures of privatised energy provision, and bottom-up transitions centred around alternative social value propositions and collective organisation made possible by renewable energy technologies. The need to decarbonise energy systems as a key driver of catastrophic climate change not only requires substitution of energy resources with cleaner alternatives, but invites a fundamental rethinking and renegotiation of value in the economy, the built environment, everyday practices and livelihoods, and relations between society, markets and the state.

In this domain we pursue an investigation into energy transitions in Australia primarily through the lens of energy justice. We unpack energy justice through three lenses: 1) how energy is produced, supplied, and consumed and the past and present inequalities and injustices implicated therein; 2) the way publics are able to participate in decision making over energy provision, use, management and its regulation; and 3) parity in the way energy resources, and the costs and benefits, are distributed. We look at issues of energy justice in relation to both fossil fuel-based energy as well as renewable energy, because renewable energy systems also come with justice challenges and solutions. Hence, this domain report looks beyond the more common approach to just transitions in Australia focussed on impacts on coal communities.

This section uses these lenses to examine the provision and regulation of energy in Australia, especially within domestic markets, and the inequalities of that provision. We highlight groups that are currently marginalised from the benefits of renewable energy, in particular those that may be the most vulnerable to the extremes of heat or cold, energy insecurity and disconnection, and unfair pricing and payment structures. The role of First Nations communities in renewable energy transitions is explored in terms of the opportunities of renewable energy developments at different scales, the challenges of representation and negotiation, and prospects for self-determination in participatory and locally-owned renewable energy projects.

Throughout, we consider government policies, ambitions, and imaginaries around energy transitions at the federal, state, and local levels with attention to changing governance arrangements for energy provision and intended roles and responsibilities of actors across sectors. Based on these insights, we conclude by outlining emerging possibilities for realising just transitions to renewable energy production and consumption in Australia.

4.4.1 Justice in renewable energy transitions

Recognising its origins in labour and environmental activism, the concept of "just transition" prompts a reconsideration of how all of society can thrive and achieve a "good life" within the biophysical limits of the planet. This orientation has highlighted the prospects for substantial government intervention and investment to direct and shape the economy while meeting social and environmental objectives – such as those proposed under Green New Deal type policies – as well as continued grassroots mobilisation and collective action around these concerns. The expansion of renewable energy to date indicates an ongoing tension between top-down renewable energy investment unfolding within business-as-usual structures of privatised energy production and services provision, and bottom-up transitions centred around alternative social value propositions and outcomes made possible by renewable energy technologies with collective social organisation. The need to decarbonise energy systems as a key driver of catastrophic climate change not only requires substitution of energy resources with cleaner alternatives, but invites a fundamental rethinking and renegotiation of value in the economy, the built environment, everyday practices and livelihoods, and relations between society, markets and the state.

Decarbonising energy production and consumption remains a significant imperative for climate change mitigation as Australia's largest source of emissions (DISER 2021a). Australia is a net energy exporter and the vast majority of energy produced in Australia comprises black coal (64%) followed by natural gas (30%) (DISER 2022a). Renewable energy production accounts for 24% of electricity generation (9% solar, 9% wind, and 6% hydro) with an average increase of 28% for small-scale solar generation, and 14% for wind generation, per year between 2010 and 2020 (DISER 2022b). Energy consumption is dominated by oil (38.8%), coal (29.1%), and gas (25.7%), with a national average for renewable energy consumption of 6.4% (varying by state and territory) (DISER 2022c). The Liberal-National Coalition Government made a nominal commitment to net zero emissions by 2050 ahead of COP26 in 2021, while the current 2030 emissions reduction target remains 26-28% below 2005 levels. Australia's current Nationally Determined Commitment (NDC) under the Paris Agreement on climate change is projected to be insufficient to limit global warming to 1.5 degrees celsius, characteristic of a broader lack of progress on implementation of the Agreement globally (UNEP 2021). Meanwhile, combined emissions reduction targets of all states and territories (legislated in Victoria and the Australian Capital Territory (ACT)) represent a stronger mitigation commitment at approximately 37-42% below 2005 levels by 2030 (ClimateWorks Australia 2021:6-7).

In this context, a key challenge for a just energy transition in Australia is a prevailing national focus on emissions reduction as technological

development and speculative "breakthroughs" in the future, propped up by carbon offsets (DISER, 2021). Despite the urgency of climate action, national energy policy thus focuses on the development of immature technologies such as hydrogen and carbon capture and storage with much less emphasis on scaling up existing and commercially viable solar and wind energy technologies. Further, the Coalition Government's priority to expand fossil fuel natural gas production and exports is in direct conflict with climate change imperatives and likely to generate more stranded assets in a carbon-constrained future. Rhetoric around gas supply as reliable and affordable for consumers (DISER, 2019) is indicative of how the intermittency of renewable energy technologies has been politicised. Calls for "green" stimulus in response to the economic impacts of COVID-19 (e.g. from WWF-Australia [2020] and supporters) failed to mobilise national renewable energy investment, already limited following the reduction of the national Renewable Energy Target (RET) in 2015 (CER 2018) and general instability and uncertainty around national climate policy (Geddes et al. 2018). The national Coalition Government has indicated that no further intervention is needed given renewable energy has become cost-competitive with other energy technologies, thus shifting responsibility for accelerating renewable energy production to the market (Diser, 2019:13).

Energy justice provides a critical evaluative lens for understanding and centering the implications of energy systems change for people and the environments they inhabit and rely upon. Three core pillars of energy justice provide an important roadmap for evaluating current and future energy systems in transition:

- The recognition of current and past inequalities and injustices implicated in how energy is produced, supplied, and consumed;
- The degree of democratic participation in decision-making and non-discrimination in how energy provision and use is managed and regulated; and
- The fair distribution of energy resources and associated costs and benefits.

Energy injustices occur unevenly across space, time, and different scales in relation to wider systemic and intersecting inequalities and injustices in terms of race, class, and gender (Bouzarovski and Simcock 2017; Bulkeley et al. 2013; Doyon et al. 2021; Jenkins et al. 2016; Sovacool et al. 2017). Identifying and interpreting these relations and geographies are complex, yet essential processes for policymakers, practitioners, and advocates to understand in order to achieve socially and ecologically beneficial transitions to renewable energy.

Importantly, in the context of settler-colonial states like Australia, there is a need for just transitions research and practice to confront energy injustice and the (il)legitimacy of renewable energy transformations relative to contested and unrealised Indigenous sovereignty, land and water rights, and self-determination. Engaging with Indigenous perspectives also requires valuing and amplifying local Indigenous knowledges in how energy transitions are understood and envisioned[1]. Energy justice perspectives underscore the limitations of a narrow focus on technological innovation and substitution of fossil fuels for renewable sources.

The following sections examine forms of energy (in)justice in the transition to renewable energy production and consumption in Australia.

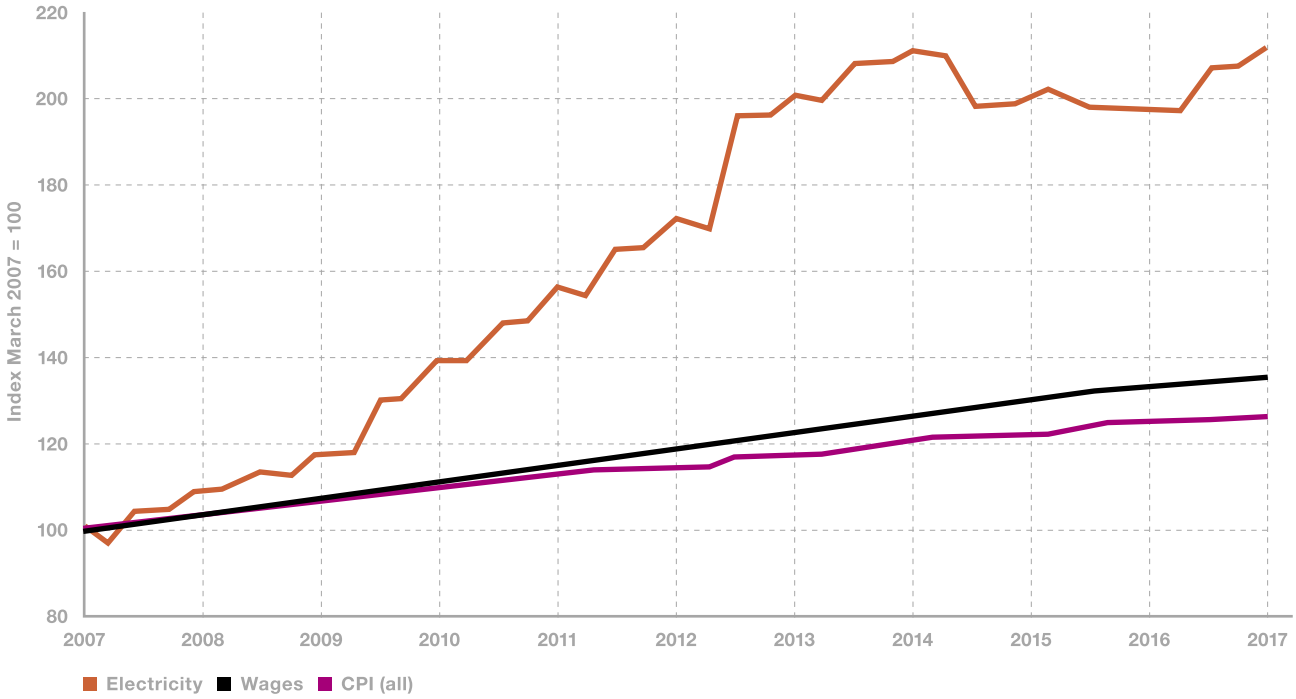
1. We acknowledge that Indigenous scholars have not been engaged in the preparation of this report, representing a methodological and ethical limitation of this study in how Indigenous perspectives are presented. We do not claim to speak on behalf of Indigenous communities.

4.4.2 Identifying and responding to energy needs

As a ubiquitous and foundational component of contemporary life, the incumbent energy system generates uneven experiences of energy (un) affordability, (in)accessibility, and (dis) advantage. The limitations of adequate energy supply and consumption – the symptoms of which are evidenced by various measures of social hardship – inhibits the energy system's functions as an essential service. This context brings both energy needs, and the role of government and/or the private sector in responding to those needs, into focus as part of a just transition to decarbonisation.

Significant increases in electricity costs across Australia have drawn attention to financial hardship and poorly designed housing (discussed further in this report under Home) alongside discrepancies in infrastructure access and services provision between homeowners and renters, and between urban centres and remote communities. As shown in **Figures 1 and 2**, Australian energy prices have significantly outpaced wage growth and the Consumer Price Index (CPI) for over a decade (ECA 2020), albeit tapering since 2018 (AER 2021:30; SVDP 2021), with some variation between states and territories. Measures of energy hardship include household energy debts and disconnections which undermine adequate energy consumption to maintain basic needs and thermal comfort, hitting First Nations communities in remote areas with prepaid power card systems especially hard (Longden et al. 2021). Advocates also identify "silent hardship" among consumers paying energy bills but "rationing their energy use to an unhealthy level or going without other essentials" (ECA 2020:47). The privatisation and liberalisation of energy provision, as well as regulatory and climatic differences between subnational jurisdictions and regions, unevenly exposes households to variable market prices and unreliable energy services. Energy insecurity undermines the capabilities of households and remote communities dealing with extreme temperatures, poorly shaded and insulated housing, and low incomes (Godden 2020; Hunt et al. 2021; Longden et al. 2021). How authorities and communities respond to these compounding conditions have implications for public health and wellbeing and provide a critical context for understanding the prospects of socially just transitions to decarbonisation.

1. We acknowledge that Indigenous scholars have not been engaged in the preparation of this report, representing a methodological and ethical limitation of this study in how Indigenous perspectives are presented. We do not claim to speak on behalf of Indigenous communities.



CPI for electricity compared with other sectors and wage growth

Figure 1: *Australian Consumer Price Index (CPI) for electricity and wages between 2007 and 2017, sourced from ECA (2020:10) (reproduced with permission).*

CPI for electricity compared with other sectors and wage growth

Changes to electricity prices in Australia July 2009 to July 2021 as estimated annual bills (nominal, incl GST) for electricity regulated/standing offers, 6,000Wh per annum single rate16

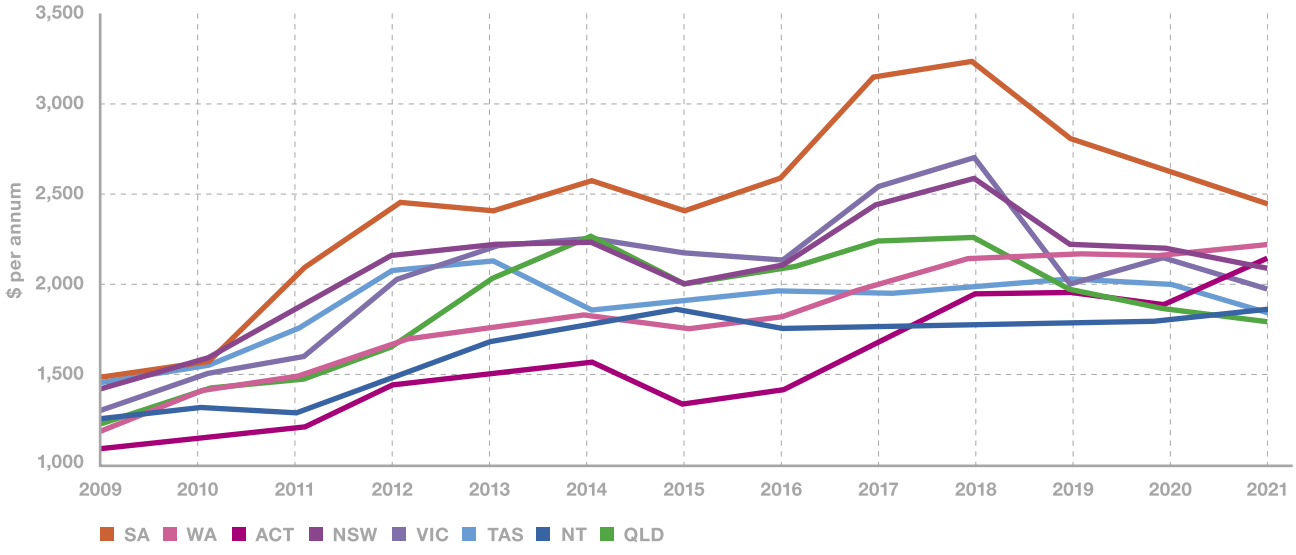


Figure 2: *Changes to electricity prices by state and territory based on estimated annual bills between July 2009 and July 2021, sourced from SVDP and Alviss Consulting (2021:7) (reproduced with permission).*

According to a National Energy Market (NEM)[2] review by the Australian Energy Regulator (AER), there has been an "increasing number of residential customers in debt, and greater average levels of debt, in 2020-21 compared with the previous year [where] approximately 183,000 residential customers were in debt, with an average of $1,000 of debt per customer" (AER 2021:3). Low-income households in NECF jurisdictions "typically spent double the percentage of their disposable income on electricity and gas as average-income households" (AER 2021:300). Nevertheless, the ban on energy retailers disconnecting non-paying customers during COVID-19-related stay-at-home orders effectively reduced the rate of disconnection (AER 2021:3). Small energy users in Western Australia are charged a uniform rate for electricity supply, but experience higher costs in remote areas associated with distribution (Government of Western Australia 2021). In the Northern Territory, residential energy customer debt (averaging $743) as well as the percentage of residential customers on hardship programs (0.7%) "more than doubled" in 2019-20 (Utilities Commission Northern Territory 2021:vi-vii). Moreover, disconnection rates are higher than NECF averages and are characterised as significant in duration and frequency for customers with pre-paid meters (Utilities Commission Northern Territory 2021:vi). 74% of Indigenous households on pre-payment meters in the Northern Territory experienced power disconnections up to ten times during the 2018-19 financial year, compared to 1% of those in the NEM (Longden et al. 2021).

Researchers and advocates have demonstrated the deficiencies of government responses to unmet energy needs. National energy policy defines "fairness" for energy consumers in terms of consumer choice, access to information, and utility transparency (Department of Environment and Energy, 2019). This agenda is limited to "protecting" consumers from the shifts in and interests of the market while assuming consumer access to data will lead to competition between service providers and thus better prices (Department of Environment and Energy, 2019:9).

2. The NEM comprises Queensland, New South Wales, ACT, South Australia, Victoria, and Tasmania jurisdictions. The National Energy Consumer Framework (NECF) has been adopted by all NEM jurisdictions except for Victoria, whose Victorian Energy Retail Code aligns with NECF. The AER (2021) review focuses on NECF jurisdictions with some insights on Victoria. The Northern Territory and Western Australia have separate energy systems.

> Prepayment may in many cases be preferred by residents over the accrual of debt, but it reverses responsibility from what we typically understand, which is that providers have obligations to protect customers from disconnection – and that disconnection from energy is only ever a last resort. Prepayment abdicates that and says that the responsibilities and obligations are primarily upon the resident themselves, and then secondarily upon the network of Aboriginal community-controlled organisations that surround the resident, and then thirdly the health sector [...] Why can we not simply say we're going to stop constantly turning refrigerators off on remote Aboriginal communities because of known harms? [...] it's just about what's the minimum energy service level that we're prepared to accept for all citizens.
>
> — *Interview, Research Fellow, Brad Riley, Centre for Aboriginal Economic Policy Research (CAEPR), ANU.*

In this context, a notable form of government regulation of the energy market has been the introduction of electricity price caps or the Default Market Offer (DMO). The DMO (Price safety net, n.d.), calculated by the AER for South Australia, New South Wales and South East Queensland, and the Victorian Default Offer (VDO), calculated by the Essential Services Commission, came into effect from 1 July 2019. Default offers replace "standing offers" and provide a reference price for consumers to compare retail offers. St Vincent de Paul Society (SVDP) and Alviss Consulting (2021:4) highlight that while default offers resulted in decreases in standing offers by "23% in South Australia, 19% in South East Queensland and NSW, and 27% in Victoria [...] the reduction to average market offer bills has been lower." In fact, "the best value offers in each network area, post July 2021, are market offers and not DMO/VDO offers" which are more likely available from smaller retailers than the "big three" (AGL, Origin Energy, Energy Australia) (SVDP and Alviss Consulting 2021:4).

Further, SVDP and Alviss Consulting (2021:5) raise concerns about the "increasingly complex and confusing retail market and the decline in switching rates" necessary to realise cost benefits of market competition (see also **submission from Dr Ron Ben-David, Monash Business School, January 2022)**. In-depth ethnographic research with energy consumers has long since demonstrated that energy consumers make decisions, and sometimes no decision at all (following habits), with impartial and incomplete knowledge. Nets of relations, obligations, and social practices – especially within the home – shape the capacities of households to act, in distinct contrast to the "smart", "ordered", "deliberative" or reasoning micro managers of energy imagined within the sector (Strengers 2013; 2014).

LIMITS AND RISKS OF ENERGY TRANSITIONS MEDIATED BY THE MARKET

History has clearly demonstrated that energy consumers are not the rational, calculating, ever-discerning shoppers they are required to be in order for the market to work as per its designers' intentions. In the future, as in the past, we know consumers will make "wrong" decisions (including "choosing not to choose" – ie. shop around) [...] Customers in markets for essential services who are not willing or able to respond vigorously [to price signals, choice, and information] cannot exit the market to avoid exploitation. This means there is no risk of lost custom (for the supply side of the market) and the risk of dissatisfaction is transferred entirely to consumers.

— Submission, Dr Ron Ben-David, Professorial Fellow, Monash Business School January 2022

State governments typically take an "after-market remediation" (Bell et al. 2020:10) approach in the form of consumer concessions to support households struggling to pay their energy bills. Focusing on the "capability and freedom to heat a home adequately," Willand and colleagues (2021) highlight the limitations of isolated policy interventions in addressing vulnerability. Levels of income represent an incomplete measure of energy insecurity and thus a "blunt" threshold for provision of financial support across the population. Current energy concession schemes cannot account for inequalities in the energy efficiency of dwellings (with flow on effects such as higher energy use), household expenses, disparities in network costs passed on to consumers, climate variability, and competency in negotiating with both private providers and the concession system (Willand et al. 2021:1117). Likewise, information provided by governments typically associates improved energy affordability with behaviours intended to reduce energy consumption. However, disadvantaged households are more likely to be experiencing underconsumption relative to need (Willand et al. 2021:1119). The authors (Willand et al. 2021:1119) nevertheless note that:

> *"In response to concerns about an energy affordability crisis due to the COVID-19 lock-down during the winter of 2020, the Victorian Government is trialling initiatives that take more integrated and customised approaches. These include the training of community workers to improve people's energy self-management capabilities (D'Ambrosio 2020b) and asking charities to negotiate energy contracts, broker hardship plans and facilitate access to concessions and retrofit assistance (BSL 2020). The overview of initiatives is offered in ten languages (DELWP 2020b)."*

State-based energy market reforms may also be improving fairness, such as prohibiting indirect penalties for hardship customers that are unable to pay bills on time to receive so-called pay-on-time discounts (Willand et al. 2021:1120).

There are signs that the objectives of energy market regulators are shifting beyond economic efficiency to capture a "[broader] concept of consumer vulnerability" (submission by Energy Consumers Australia, February 2022) as advocates highlight the need for equitable decarbonisation. In February 2022, the Australian Council of Social Services (ACOSS) and Total Environment Centre (TEC) with support from Energy Consumers Australia (ECA) launched ourPower as a shared vision and actionable principles for advocacy and policy change to achieve "clean, affordable, dependable energy for all." Informed by consultation with the energy sector and energy user groups, ourPower centres energy as "an essential service [that] plays a critical role in the health and wellbeing of people and powers the economy" and advocates for "the energy futures that users want (the vision, values and principles), how to ensure that people and communities are heard in the process, and how to reflect their interest in policy development, planning and service design" (ourPower 2022:2, 4). Under "people focused" and "just and fair" principles, ourPower extends the "consumer protection" approach to market regulation by advocating for universal access to clean and affordable energy, participatory co-design in decision-making, progressive taxation over cost transfers through energy bills, and complementary non-market measures (ourPower 2022:5, 7).

The energy market has been designed with the expectation for consumers to "self-manage" energy supply and use through their participation in the market (e.g. by finding the best price) (Chandrashekeran 2020), while remote areas energy market activity is limited or absent (e.g. private utility monopolies). These insights call for a policy agenda that addresses multiple conditions affecting household energy capabilities including, but not limited to, individual financial resources (Willand et al. 2021; see also CALC [2019] on the need to increase national welfare payments). Such an agenda extends beyond the usual remit of energy market governance. Consideration of "broader socio-economic issues, such as income distribution, education and housing tenure [...] have traditionally been dismissed as 'out of scope' of decision makers in the energy market" (submission by Energy Consumers Australia, February 2022) but highlight the limitations of siloed policy and governance.

4.4.3 Access to renewable energy technologies

Decentralised energy systems provide unique opportunities for "end users" to actively engage in energy production processes and access energy generated in close proximity to where energy is consumed. In the context of compounding experiences of energy unaffordability, rooftop solar PV systems are often characterised as a means of reducing energy costs for households and businesses alike, alongside their low-carbon credentials. However, as rooftop solar becomes mainstreamed (CSIRO 2021), inequalities in access to solar and associated benefits of on-site renewable electricity generation have become more pronounced. The capacity for households and businesses to realise cost savings is circumscribed by access to capital, tenure, and users' energy demand profile. These barriers underscore the limits of a cost-benefit rationale for renewable energy investment from an equity perspective as well as the centrality of funding and revenue streams in how broad accessibility can be secured.

Besides upfront cost barriers, the material and scalar requirements of solar PV systems generate hard spatial limits around where solar PV can be installed to meet energy demand. These conditions inhibit substantial solar uptake in dense urban environments, particularly for apartment dwellers without direct roof access or shared spaces (Lan et al. 2021; Poruschi and Ambrey 2019), as well as barriers associated with shaded, poor quality, or unfavourably oriented roofs (relative to the direction of the sun). In addition, both small- and utility-scale solar systems necessitate corresponding network capacity to allow electricity export or sharing of unused electricity generated (discussed further below). Relations of property ownership and the degree of autonomy building occupants have to make alterations are also a well-recognised barrier for renters. Low uptake of rooftop solar PV systems among rental properties is typically attributed to the "split incentive" between private landlords (who would pay for the solar system) and tenants (who would potentially benefit from reduced energy costs). Nevertheless, recent research into landlord retrofit behaviour demonstrates that incentives to retrofit are more diverse and include social concerns for tenants' needs, suggesting a need to consider the role of housing agents in mediating between tenants' needs and landlords (Lang et al., 2022).

In light of these kinds of challenges and energy infrastructure regulation more broadly, research has long argued that solar PV subsidies in the form of feed-in-tariffs (FiTs) (in Australia and elsewhere) represent a regressive form of taxation (Nelson et al. 2011; Simpson and Clifton 2016). Electricity distribution infrastructure costs and other government levies, including environmental charges, represent socialised costs recouped via household electricity bills across the network. As a result, cross-subsidisation occurs between households receiving solar subsidies and those without. Consumer advocates highlight how levies for state and federal rooftop solar PV subsidies differ between state jurisdictions and have increased over time (**Figure 3**) and how average electricity bills for solar customers are substantially lower than non-solar households as well as varying between distribution networks (**Figure 4**) (SVDP 2019). These figures illustrate the broader effects of unequal access to solar where excluded segments of the population potentially face heightened bill stress. Other forms of cross-subsidisation between energy consumers are also implicated in the energy transition, particularly in the use of air-conditioners. Because they are energy intensive, air-conditioners increase "demand peaks" and associated network charges for all users in an area, which some estimate are more significant than network cost transfers associated with solar PV (Passey et al. 2018). Meanwhile, uneven shifts towards full electrification of home space and water heating and cooking risk burdening remaining households (especially low-income households and renters) with higher gas prices as private gas providers seek to recoup infrastructure costs, noted in a submission from Energy Consumers Australia. Similarly, it is uncertain whether developers will be

allowed to pass outstanding costs and promised revenues of prematurely stranded assets onto consumers (submission from Dr Ron Ben-David, Monash Business School, January 2022).

Chart 3 Annual costs of SRES and FiT for a household consuming 6,000kWh/annum from 2017/18 to 2020/21

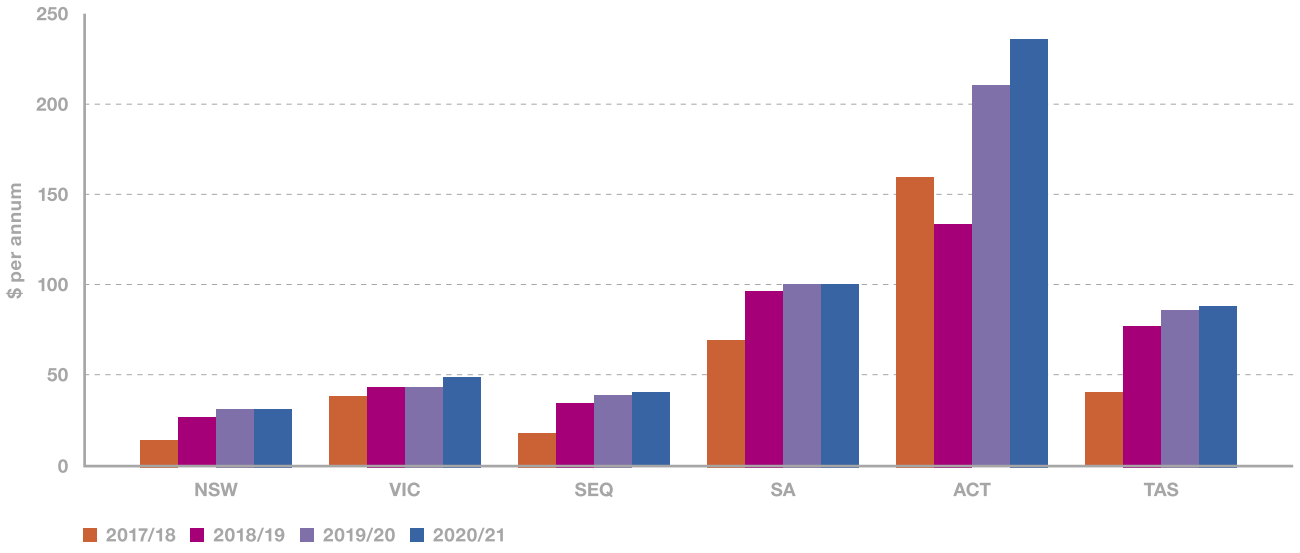


Figure 3: *Estimated annual levies for combined national and state solar PV subsidies on household energy bills, sourced from SVDP (2019:4) (reproduced with permission).*

Chart 4: Household electricity bills as annual bills for solar and non-solar households consuming 6,000 kWh/annum as of July 2018, market offers inclusive of discounts, single rate, GST inclusive (solar households with 3kW installed)[9]

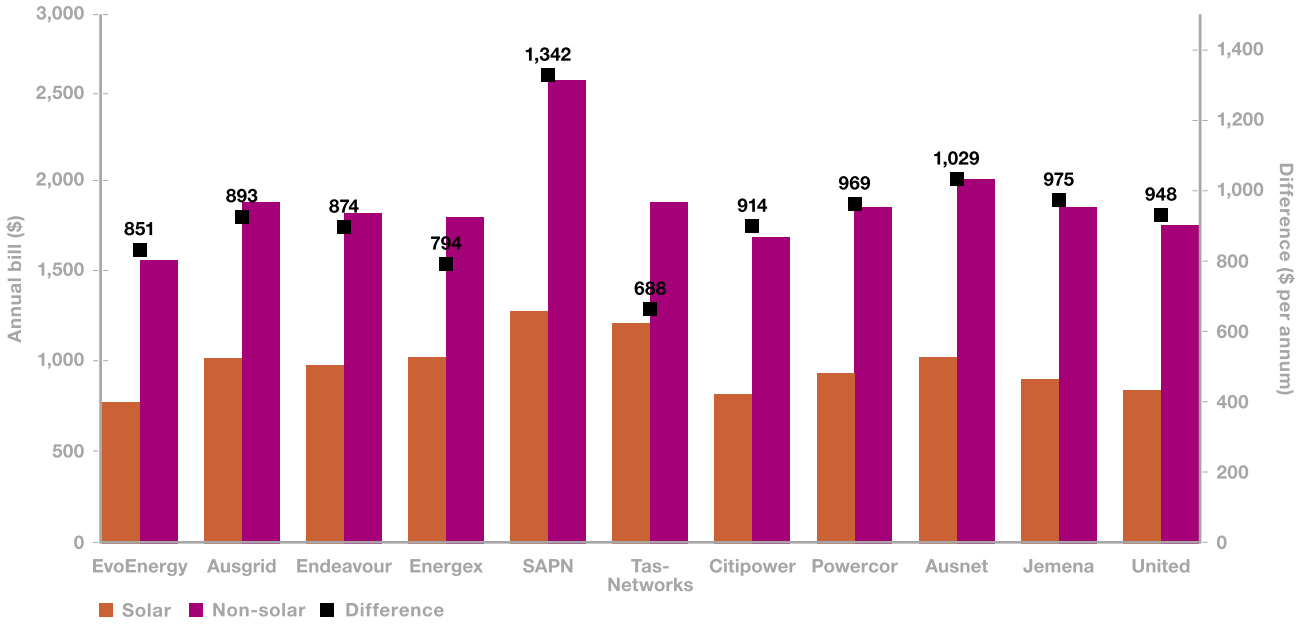


Figure 4: *Estimated annual electricity bill cost differences between solar and non-solar households by distribution company in the NEM, sourced from SVDP (2019:5) (reproduced with permission).*

Adaptive market mechanisms have been tested to expand renewable energy access. A well-recognised example is the Solar Saver(s) local government finance scheme first established in 2013 by Darebin City Council in Melbourne's inner-north and later expanded across Victorian local governments with state government funding, which sought to improve solar access among low-income residents vulnerable to both weather extremes and energy costs. The program (which received the Premiers Sustainability Award for Environmental Justice in 2015) involved the provision of interest-free credit by local government for rooftop solar systems to be installed by households – typically aged and disability pensioner homeowners (though later expanded) – via a special rates charge or property tax (Darebin City Council 2017). Modelling of household energy use and estimated cost savings, incorporating loan repayments over 10 years, established a threshold for participation to ensure households would be at least $100 better off each year for the term of the loan, often targeting those with high daytime energy usage. This case offers an important demonstration of how financing mechanisms for household solar uptake can be structured to minimise financial burdens while attending to household wellbeing and capabilities, where local government plays an important intermediary role in the market (Hadfield 2021).

Governments have more recently sought to address the exclusion of tenants and other low-income residents as hard to reach groups in the energy transition (e.g. through incentive schemes elaborated in Section 3. 1 under The Home).

These efforts include Australia's state investment bank, the Clean Energy Finance Corporation (CEFC) through the provision of concessional (below market rate) finance for renewable energy and energy efficiency developments in social housing:

> We've run investments into social and affordable housing, with a view to ensuring that when that new housing stock is built, it's built to much higher energy standards, so it's performing, the residents incur less cost. When we did those, we provided to the bodies that are running and establishing that social housing infrastructure, concessional finance, but we required that the concession that they receive on the finance, they actually applied to retrofitting to their existing stock. So that actually funded things like solar panels on the roofs of their existing social and affordable housing stock. Why did we invest there? Well, we think investing in social and affordable housing gives us a large footprint of evidence that energy-efficient housing can make sense and is affordable, which is the social fabric, but also doing some good in that social scene. Social good as well, to reduce costs to the owners, or the occupier as well [...]
>
> It's always troubled us over time that renters in properties probably can't get the same benefit [of rooftop solar] unless the landlord is willing to invest. So we've looked at mechanisms over the years where we try and solve some of those inequity gaps that exist. Not so much to solve that inequity, that's part of the problem, but the other reason is to ensure that we are helping to address all angles of the market, if you like, so we're not leaving any of the market behind as we do it. A nice consequence is maybe you're helping people who couldn't otherwise afford it.
>
> — *Interview, Paul McCartney, Chief Clean Futures Officer, CEFC*

These programs may have unintended consequences. For example, preliminary statistical analysis of national household data suggests that "Australian renters with solar panels pay approximately A$19 more in weekly housing rents than non-solar renters [where] landlords have been able to benefit from investments in solar panels through higher rent, with a payback period of around 5 years" (Best et al. 2021a:1, 15). In this way, private investment in rooftop solar has the potential to exacerbate (rental) housing unaffordability and asset wealth inequality through regressive redistribution of public funds (Best et al. 2021b). These insights raise questions around effective use of public funds to address barriers to solar uptake and fair allocation of energy system costs.

Prospects for institutional management of (privately owned) distributed energy resources (DER) such as rooftop solar highlight unresolved tensions around value relative to the wider energy network and broader challenges associated with the speed of technology uptake relative to lagging regulatory change. "Uncontrolled" or "uncoordinated" DER can contribute to local network constraints and system insecurity where there is high penetration of solar, resulting in significant electricity export to the grid or critically low demand requiring system balancing (CutlerMerz 2020). The Australian Energy Market Commission's "smart solar reforms" (effective 1 July 2022 and enforceable in 2025) (AEMC 2021; AEMC n.d.) include requiring distribution businesses to remove blanket solar export bans, alongside the introduction of export tariff options to incentivise more or less generation and export depending on network conditions. These and similar network regulations (e.g. "last resort" remote switch-off of solar in Western Australia and South Australia [Vorrath 2022]) have nevertheless drawn criticism from solar advocates as an unfair "sun tax" and perceived form of profiteering by companies unwilling to bear the costs of necessary grid transformation (Morton 2021; Solar Citizens 2022). Conversely, based on AEMC modelling, solar company EnergyMatters (2021) states that in the "worst-case scenario, solar owners will lose 10% of their current revenue. Best-case scenario, it will force distributor networks into upgrading infrastructure to be more solar friendly and make solar batteries more viable for investment." In response to this issue, a report commissioned by Energy Consumers Australia (CutlerMerz 2020:i) suggests that "wherever DER control imparts private costs on the DER owner/lessee, regardless as to whether they are real or perceived [including non-financial costs], a social licence to control must be obtained by or on behalf of" governments and institutions.

The extent to which energy justice is reflected in emerging digital energy technology configurations, like software-enabled peer-to-peer (P2P) electricity markets, also remains unclear in practice. P2P trading systems are intended to allow "consumers and prosumers to buy and sell self-generated electricity and other services, such as flexibility or demand response, in an open electricity market" (Wilkinson et al. 2020:2) while bypassing traditional energy retailers. Evaluating the first real world trial of P2P electricity trading as part of the Renewable Energy and Water Nexus (RENeW Nexus) project in Fremantle, Western Australia, Wilkinson and colleagues (2020:12) found that end users involved in the trial had expectations around "social equity and sharing energy within the community [...] that the eventual market design failed to deliver." These concerns, which also contributed to participant drop-out rates, include perceptions that the P2P market rewards high electricity users and penalises low users; that the design was "too market driven with no ability to trade with individuals of one's choice" and akin to the "stock market" such that "the uneducated or disadvantaged will be less able to trade effectively and therefore be further disadvantaged" and that P2P trading introduced burdensome financial risk for participating households with solar assets (Wilkinson et al. 2020:11).

Similarly, recent research highlights unresolved tensions in algorithm design for neighbourhood-scale battery storage from the perspective of social responsibility. In the Australian context, Ranson-Cooper and colleagues (2021:816) examined the relationship between algorithm design and technology functionality relative to the "citizens' imaginaries of what storage at the neighbourhood scale 'could be,'" arguing that "some values are inescapably in tension with one another and require trade-offs." For example, while citizens

valued "decarbonisation, local independence and simplicity," algorithms with easy to explain objectives such as "buying low and selling high" can lead to "vastly different outcomes of battery profit, communal bill reductions or carbon emission reductions" (Ransan-Cooper et al. 2021:819). The authors suggest that social values may be especially at risk in private-sector-led deployment of grid-scale batteries given the default to financial metrics and without meaningful end-user participation through system co-design (Ranson-Cooper et al. 2021: 820). A submission from the **ARC Centre of Excellence for Automated Decision-Making and Society (ADM+S)** highlights similar issues regarding algorithm design for grid-scale "big batteries" which risk prioritising financial gains derived from energy market price movements over the ecological impacts associated with the scale of the facility.

Novel approaches to (clean) energy supply oriented towards household capabilities are emerging in the margins of political debate and, more substantially, in practice. The Greens election platform signals a more radical alternative to market-based energy services provision in its commitment to "create a non-profit publicly owned retailer to push down power bills and increase take-up of green energy" as well as "[ending] price gouging by the big energy companies" (The Greens, n. d.). In the private market, The Green Electricity Guide recently released by Greenpeace (2022) independently ranks electricity providers according to their green credentials (both supply of and support for renewable energy, and commitments to fossil fuel phase out across their corporate structure) as well as highlighting when electricity providers have "innovative new ways to empower customers and local communities to take more control over their electricity generation" (Greenpeace 2022). Enova Energy (operating in NSW and South East QLD) currently tops the list with bonus scores for community engagement as a social enterprise, distributing a portion of its profits through energy efficiency and other projects, and by sourcing energy from customers' solar panels. Similarly, the Real Deal coalition's research and action agenda – supported by academics, unions, social and environmental organisations, and other community groups and not-for-profits – highlights cooperatively-owned energy retailer CoPower as an example of "[reimagining] the principles underlying energy investment in Australia from commercial goals to social justice, democracy and cooperative ownership" (Tattersall et al. 2020:54). Cooperative Power recognises that "while some have invested in household solar or set up community wind farms, these actions are currently out of reach for most people, especially for those on low incomes and for renters" (Tattersall et al. 2020:54) and redistributes profits through social and environmental initiatives, including enabling "members to provide solidarity credits that reduce the power bills of members experiencing hardship" during COVID-19 (Tattersall et al. 2020:55).

Urban experimentation with diverse stakeholders can also support energy transition across sectors (Sharp and Raven 2021). Net Zero Precincts is an ARC Linkage project led by Monash University that is trialling an innovative approach to precinct-scale decarbonisation in collaboration with industry, government and community partners. This four year interdisciplinary demonstration project will test and learn from what works at precinct scale using the Monash Clayton campus and Monash Technology Precinct as a living lab for transition experimentation. The project team is undertaking transition experiments in energy systems, mobility, buildings, local governance and data science that are aligned with the precinct community's shared future visions. This approach will incorporate the real-life experiences of the precinct community and its businesses, government, knowledge actors and civil society. It is also expected to provide significant benefits to industry seeking to enhance community engagement for net zero transitions.

4.4.4 Sharing and commoning the benefits of renewable energy expansion

Beyond individualised access to clean and affordable electricity supply, concepts of procedural, distributional, and recognition justice raise different questions around who decides, who pays, and who benefits from scaling up renewable energy production. Despite being less destructive forms of resource extraction compared with coal-based power plants, the material and spatial characteristics of wind, solar, and battery facilities require consideration of localised social impacts and land use conflicts, as well as mineral supply chains and waste production. Importantly, large-scale renewable energy deployment must be understood within ongoing recognition of First Nations land rights – including formal representation – and the struggle for self-determination in Australia. These dimensions nevertheless highlight the potential for local and community benefit distribution, democratic decision-making, and (co)ownership of renewable energy facilities (Bell et al. 2020; Coy et al. 2021).

State governments are currently filling a national policy vacuum when it comes to renewable energy, reminiscent of state-level energy governance preceding the establishment of the NEM in 1998 (McConnell 2020). Renewable energy targets set by state and territory governments are estimated to amount to a 55% Australia-wide renewable energy target by 2030 (ClimateWorks Australia 2021:4). However, to limit global warming to 1.5 degrees Celsius, ClimateWorks Australia (2021:5) modelling suggests that 70-79% renewable energy generation is needed by 2030. The concept of Renewable Energy Zones (REZs) has been mapped

by AEMO (2020:48) across the NEM (Queensland, NSW, South Australia, Victoria, and Tasmania) and are mobilised in state-level planning for regional electricity transmission and storage infrastructure upgrades to support renewable energy expansion and consumption while leveraging private investment (e.g. in the Hunter Valley region [Bernasconi and Murphy 2022] experiencing coal phase-out [Whitson and Janda 2022]) (Climate Council 2020). More broadly, various industry actors are calling for Australia to become a renewable energy "superpower" by capitalising on solar and wind potential as a source of economic growth (Briggs et al. 2021; BZE 2015; Clean Energy Council n.d.; Garnaut 2019; Tattersall et al. 2020; Transgrid 2021; WWF 2021). Flagship renewable export projects such as the Western Green Energy Hub (50GW), Murchison Renewable Hydrogen Hub (5GW), Sun Cable (3.2GW) and the Asian Renewable Energy Hub (26GW) promote energy trading from Australia to the Asia-Pacific.

The availability of minerals critical to renewable energy systems in Australia, including cobalt, bauxite, lithium and nickel, are increasingly recognised as the source of Australia's next "resources boom" if we can achieve a "virtuous cycle" of domestic resource mining supported by renewable energy supply (Thornton 2021). The CSIRO recently released a Critical Energy Minerals Roadmap (2021) which positions Australia as playing a key role in the global transition to renewable energy thanks to its mineral resource endowments (which are expected to be in high demand) – while also suggesting mechanisms such as local content quotas for solar PV deployment to enable local manufacturing, and co-location of mineral mining and battery production and recycling, to become more internationally competitive. Nonetheless, these claims need to be considered against ecological limits and social impacts. In particular, there are risks that demand for minerals associated with battery and solar PV exceed current reserves, and potential social impacts, including the geographical concentration of mineral production globally and associated health risks from contamination, as well as hazardous working conditions in mineral recycling (Dominish et al. 2019).

In arguments for accelerating and scaling up renewable energy production, practitioners and policymakers often cast land in remote areas as "available" for the extraction of renewable resources (for profit). This rhetoric denies the ongoing presence of and cultural value of these and other areas for Indigenous communities, and an understanding of these lands as living ecosystems (Hunt et al. 2021:364). Interviews noted that while there is an assumption that renewable energy will not be as impactful or destructive as other heavy industries, renewable energy projects and associated infrastructure footprints can easily harm Aboriginal Sacred Sites and areas of cultural heritage. Existing research explores the intersection of renewable energy potential and Indigenous land rights and interests in Australia to consider how Indigenous communities can participate in and benefit from renewable energy developed on their lands in a way that reflects their aspirations and values across different geographies. While all lands and waters of Australia were unceded by First Nations people at colonial settlement, the prevailing mechanisms for realising First Nations rights and interests include Land Rights regimes in several states and territories and Native Title (Commonwealth) legislation, offering different forms and degrees of consent, possession, and revenue sharing (Chandrashekeran 2021; O'Neill et al. 2021a). The transition to renewable energy offers important opportunities for First Nations to negotiate strong agreements with renewable energy proponents which may provide much-needed on-Country employment, training and business development, equity investments, and other opportunities such as enhanced land management and access to cheap and reliable renewable energy. The Queensland Government's (2021a) community consultation paper on planned Queensland Renewable Energy Zones, for example, goes some way towards acknowledging the value of local benefits for Indigenous communities in terms of engagement of Traditional Owners and First Nations people to secure economic participation, and collaborative cultural heritage management.

Negotiating successful land use agreements in the renewable energy domain requires Aboriginal

organisations to have capacity to negotiate deals which will benefit current and future generations. Best practice agreement making guidelines for clean energy companies developed at Australian National University's Centre for Aboriginal Economic Policy Research (CAEPR) by O'Neill and colleagues (2021b) draw on lessons from extractive industries and the principles of Free, Prior and Informed Consent (FPIC) enshrined in the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP). The guidelines include meaningful outcomes for First Nations peoples in agreements between Traditional Owners and clean energy companies in terms of First Nations rights and autonomy in ensuring environmental and cultural heritage protection (e.g. ability to object to harmful activities, provision of funding for cultural heritage protection work, continued access to land for cultural practice) and establishing income streams (e.g. through ownership, equity, or royalty payments) "commensurate with the scale and likely revenue stream of the project" (O'Neill et al. 2021b:8). Strong agreements with Traditional Owners also require actionable plans and clauses for investment in employment and business development for First Nations peoples; implementation, monitoring, and review of the agreement for the life of the project; and rehabilitation or repowering of the site by the company at end of life.

It is generally unclear whether large-scale renewable energy development will provide adequate and spatially equitable benefits to First Nations peoples. The ability of Indigenous communities with Native Title rights to secure desirable conditions for (large-scale, export oriented) renewable energy developments through agreement making are often constrained by a relatively weak negotiating position.

Aboriginal landowners have varying political influence, and organisational capacity to "insist companies go above the minimum requirements of the Native Title Act and other laws" (Hunt et al. 2021: 371). As an interview reflected:

> The benefits will accrue to those with capacity – political, informational, legal, financial and organisational. [W]e were concerned from the outset that the benefits of these mega scale developments – and at least some of them are going to go ahead, there's no doubt about that – will only actually benefit a very small number of Aboriginal people if they want it on the land and can negotiate some real benefits. But for the rest, we're not sure what the benefit is, if any, and there may be costs [...] Where are Indigenous people in this renewable energy transition, and are they going to just get left behind again? There needs to be much greater levels of support in order to go some way to [...] a level playing field.
>
> — *Interview, Honorary Associate Professor, Janet Hunt, Centre for Aboriginal Economic Policy Research (CAEPR), ANU*

The extent to which developers adequately engage and involve representative bodies of Aboriginal interests is also contested. As interviews highlighted, inadequate resourcing of representative prescribed body corporate entities under the Native Title Act 1992 is also a key issue. Referring to news reports from a wind farm development in North Queensland, we were told:

> [T]hat prescribed body corporate has probably [...] very little funding. They don't always have the capacity to consult with all of their claim group, who [...] may not all live in that local area [...] So in that ABC radio program, you heard from a Native Title holder who said "Well I've not been consulted on this" [...] So the prescribed body corporate of that Native Title group [that has] negotiated with the wind farm developer, has perhaps not gone back to the whole claim group about this development. Or if they have, they've not done it adequately for at least that one person. That person may be a lone voice [...] and you'd need to do more research to really establish what's going on there. But it does raise that whole question about who's making these decisions and how inadequately these Native Title organisations are resourced [...] They have many stakeholders coming to them and they have to try to respond to the stakeholders' requirements through processes triggered by third parties for their own – usually commercial – benefit, while the costs in time, energy and money may be externalised to the affected Native Title holders. [...] A lot of them are just volunteers, and they are required to respond in very tight timeframes sometimes, so it's very difficult for them.
>
> — *Interview, Honorary Associate Professor, Janet Hunt, Centre for Aboriginal Economic Policy Research (CAEPR), ANU*

In addition to formal agreements and partnerships between First Nations peoples and private companies, prospects for Indigenous-led investment in renewable energy infrastructures are being explored in practice. Original Power is an Aboriginal organisation that aims to "build the power, skills, capacity and collective capability of our people [Aboriginal and Torres Strait Islander peoples] to genuinely self determine what happens in our communities and on our country" – including in the transition to clean energy. Original Power have been involved in novel solar PV installations for Indigenous communities such as Borroloola, Marlinja, and Tennant Creek, which address issues around energy unaffordability, energy insecurity, extreme heat, and employment (Original Power, n.d.). Original Power proposed an "electricity highway" linking disparate electricity grids, renewable energy generation, and local communities from Alice Springs to Katherine and Darwin, as part of the Northern Territory's Economic Reconstruction plan in response to COVID-19. Original Power (2020:4-5) argue that:

> *"Aboriginal community members own the land required for solar generation [...] The long-term financial return on [renewable energy] assets can flow directly to the communities and ensure they benefit from the clean energy transition while a properly staged deployment of renewables could provide a steady supply chain of work for both local manufacturing opportunities and meaningful traineeships and apprenticeships."*

The proposal was adopted in the Territory Economic Reconstruction Commission recommendations to the Northern Territory Government as a feasibility study (TERC 2020:102) alongside a recommendation to "transition remote power systems for the 72 remote communities services by the Indigenous Essential Services program, to renewables-based systems by 2030" by the private sector (101). Building on this work, the First Nations Clean Energy Network was launched in 2021 as a coalition of unions, energy and climate peak bodies, a university, among others, to support communities to develop clean energy projects, establish an "innovation hub"

to advance best practice agreement making and community capacity building, and advocate for policy change and investment. Underpinning these objectives are core values: genuine self-determination, community-driven solutions, consent, and collaboration (First Nations Clean Energy Network n.d.). https://www.firstnationscleanenergy.org.au/

These initiatives raise the prospects for a more fundamental reconfiguration of political and economic power in (clean) energy production through the self-determination of First Nations and communities more broadly. In regional and remote areas of Australia, localised renewable energy networks and decentralised off-grid systems have for some 20 years provided more reliable and affordable energy access as well as improved community and household capabilities (Hunt et al. 2021). A submission from Energy Consumers Australia underscores the value of Stand Alone Power Systems (SAPS) supported by solar PV, adding that:

> We are unaware of anywhere else globally where market actors [including the Australian Energy Market Commission (AEMC)] recognise that it would be cheaper to disconnect consumers from the network, given the declining costs of modular solar and batteries."
>
> — *Submission, Energy Consumers Australia, February 2022*

Predating current developments, the **Bushlight** program (2001-2013) demonstrates an innovative approach to co-designed, co-operated and community owned standalone energy services with the participation of remote Indigenous communities.

BUSHLIGHT COMMUNITY ENERGY PLANNING

In 2002 Bushlight was formed by the Centre for Appropriate Technology (CfAT), an Aboriginal and Torres Strait Islander controlled business based in Alice Springs, with funding from the Federal Government. Bushlight worked with over 130 communities to help remote communities manage their energy use through education and training programmes, to design and build renewable energy technologies within communities, and to engage and train people to be able to install and maintain renewable energy systems within communities.

The community energy planning model employed by Bushlight aims to deliver benefits of tailored services provision, including cost reduction, improved energy literacy, and broader development outcomes associated with access to reliable and affordable energy services through **shared decision-making** (CfAT 2011). The process involves:

- Two-way exchange between residents and Bushlight team in the planning process (meetings and ongoing communication), and resident education about energy services and energy use;
- Systems designed based on current and future needs of the community, established in community mapping and energy profiles, dwelling audits, and evaluation of options and limitations, cultivating a "sense of ownership" and confidence in operating the solar system;
- Ongoing support and training for residents and service providers, with an emphasis on "image-based and hands-on resources" and activities to build technical understanding and capacity in community (including user manuals and posters); and
- Regular maintenance of renewable energy systems.

The program is also characterised as an "**innovation in demand management**" and achieved continuous energy supply (avoiding disconnection) (Riley 2021). The solar and battery systems were sized according to need and configured to ensure a minimum 24-hour power supply for essential uses (usually fridges, lighting, and medical devices) separate from discretionary power uses – reflecting what was important for the community (CfAT 2014). To facilitate daily household energy budgeting, energy availability is displayed by the Energy Management Unit (EMU).

The Bushlight approach is distinguished from supplier-led approaches characterising previous deployment of solar PV systems in remote communities through the 1990s (Lloyd et al. 2000). This history presented a challenge for Bushlight to effectively engage with these communities, as well as an imperative to do things differently through co-design.

Since the discontinuation of the program in 2013, Bushlight systems are mostly maintained through the Outback Power program under the Remote Australia Strategies Programme (Australian Government) (which does not fund new systems) (Hunt et al. 2021:375). Now that certain components in many systems will be approaching end-of-life, a challenge for participating communities may be funding replacement parts (interview, February 2022).

The West Australian Government has since undertaken a 'Solar Incentives' scheme which involved co-funding rooftop solar on community owned buildings in partnership with Aboriginal corporations (Riley 2021:14).

Participatory renewable energy development and management is being debated at a national level. Independent Federal MP Helen Haines (representing Indi, Victoria) is spearheading the Local Power Plan (2020) with support and expert input from community groups, energy and environment think tanks and peak bodies, and local councils, including a national co-design process comprising workshops and submissions. This work draws on increasing activity in the sector since the first community-owned renewable energy project (Hepburn Wind) became operational in 2011 (Coy et al. 2020). Envisioning an energy transition "with and for local communities, not to us," the Australian Local Power Agency Bill 2021 – which has been unsuccessful in parliament – proposed establishing an independent statutory body to deliver technical support and development capital for community energy (broadly defined), guarantee revenues for local energy developments, and require new, private large-scale renewable energy developments to allow residents within 30 kilometres of the site to co-invest in the facility (The Local Power Plan, 2020). At a state level, the Victorian Government has reinforced its commitment to community-owned and operated renewable energy facilities by announcing further funding for region Community Power Hubs in 2021 following a two-year pilot program. Social enterprise Indigo Power (see **Case Study: Totally Renewable Yackandandah)** will host the first hub for the Hume region and has previously partnered with Taungurung Land and Waters Council Traditional Owners and the Victorian Government to establish a local renewable energy facility (Beck 2019).

TOTALLY RENEWABLE YACKANDANDAH (TRY)

Totally Renewable Yackandandah (TRY) provides an illustrative case of community-led and localised shifts to renewable energy systems. Following a council community energy forum, TRY was founded in 2014 with the aim of powering Yackandandah – a Victorian town of approx. 1,800 people – with clean, locally-sourced energy by 2022. At the edge of the National Electricity Market (NEM), Yackandandah is subject to frequent blackouts as well as fluctuating quality of electricity (which can damage household appliances), representing a further motivation for the initiative. TRY operates on the basis of local, commercial and public support. Volunteers from the community manage the day-to-day running and overall direction of the organisation. TRY is nearing the final stages of its transition, which consists of:

- increasing rooftop solar penetration across the town, (currently exceeding 60% of all buildings);
- installing energy management systems (Mondo Ubi) and household batteries;
- establishing 4 minigrids across the township;
- incorporating a local energy retailer (Indigo Power); and
- constructing mid-scale, community-owned energy generation and storage (including a 274kWh battery 'Yack01') to meet the remainder of the town's needs.

Through the localisation of energy infrastructure and services, TRY aims to create ongoing local jobs and retain energy profits in the area. As a social enterprise Indigo Power plans to return half of their profits to clean energy and other community projects. TRY also established a Perpetual Energy Fund, which uses public donations to offer loans to the Yackandandah community for energy efficiency and renewable energy upgrades; the resulting savings on energy bills are then used to repay loans and replenish the fund for use in further projects. The first Perpetual Energy Fund project involved a $5,000 loan to the Yackandandah Health Service to replace 276 lights with LEDs, as part of a wider installation of rooftop solar and energy efficiency upgrades.

Image: Yackandandah, Victoria, showing rooftop solar systems (Copyright: Rex Martin 2019)

Partnerships with the local energy distributor AusNet Services (of which Indigo Power is a subsidiary) and infrastructure and technology company Mondo Power have enabled TRY to scale up and navigate the complexities of the transition to local renewable energy by drawing on technical expertise. In turn, AusNet Services and Mondo Power can learn about the real-world challenges faced by communities in transition through these partnerships. TRY has received several state and federal funding grants, including from the Victorian government's Department of Environment, Land, Water and Planning, and under the New Energy Jobs Fund III. TRY also works with research institutions including an ARENA-funded project with the University of Technology Sydney and Mondo Power on one of the town's minigrids in Ben Valley (UTS 2019).

4.4.5 Possibilities for just energy futures in Australia

The possibilities for just transitions in the energy sector can be understood across varied configurations and scales of renewable energy infrastructure and services provision. Opportunities for realising energy justice can be identified in terms of recognition of structural inequalities and injustices, democratic participation and non-discrimination, and fair distribution of resources, costs, and benefits.

Individuals can increasingly exercise agency through their choice of energy provider within the energy market. In contrast to commercial models, cooperatively owned and other social enterprise type energy retailers are offering consumers both green electricity supply and the opportunity to have a say in how the provider's profits can be distributed in the community according to social priorities.

Renewable energy investment designed for distribution is more likely to achieve equitable access to renewable energy than individualised market interventions. Adequate regulation of energy markets should minimise unfair and burdensome cost transfers to consumers least able to afford them (including environmental levies and network upgrade costs). Prioritising public investment in renewable energy and energy efficiency upgrades in social housing and remote communities – alongside increased income support – can address structural energy vulnerabilities. Where solar panels cannot be integrated in built forms, networked renewable energy provision and storage is needed.

Participatory and democratic modes of renewable energy development can respond to the energy needs of households and communities in ways that empower people and centre First Nations justice. For large-scale developments, negotiation of land use agreements between corporations and Traditional Landowners according to principles of Free, Prior and Informed Consent (FPIC) provide opportunities for local economic development and enhanced land management. Local, community-owned renewable energy development can enable energy transitions that reflect shared local priorities and needs and generate local wealth, including those led by First Nations peoples as a form of self-determination. The First Nations Clean Energy Network is playing a leading role in this agenda.

These insights demonstrate the value of place-based experimentation and challenge-oriented innovation policy frameworks as part of a research and action agenda towards decarbonisation. In contrast to prevailing national policy attention on technological innovation by the private sector, prospects for universal renewable energy access to meet the needs of households and communities will likely require institutional, financial, and grassroots innovations that prioritise social and ecological outcomes beyond the growth metrics of markets (Coenen and Morgan 2020; Hadfield and Coenen 2022; Schot and Steinmueller 2018). Just transitions in energy systems require pluralism and local adaptation (Bell et al. 2020) and will likely benefit from improved multilevel governance between local, state, and federal governments and communities (GCoM 2021; Ironbark Sustainability and ICLEI 2021).

4.5 Technology and Data

SUMMARY

This section explores just transitions with, related to, and using new technologies and digital solutions. In Australia, although new and emerging technologies, data and systems are central to government initiatives, technological innovation is still not clearly aligned with urgent net-zero goals. The Australian Government's perspective on technological innovation is hopeful, though somewhat abstract. They view global innovation trends, smarter use of data, and general market forces will drive transitions to decarbonisation. There are many opportunities to innovate locally, but conflicting means by which innovation is approached in domestic policy and strategies.

We examine a set of key sites where everyday life puts pressure on existing systems, and where emerging technologies offer challenges and new opportunities for transition to decarbonisation.

New technologies also have negative environmental impacts stemming from their manufacture and maintenance. This includes reliance on energy-intensive data-centres, and the amount of digital devices that become e-waste. For a just transition new technology will by necessity, have to demonstrate green credentials.

New devices, and uses of information, can also make citizens into valuable data points, as vectors of cybersecurity risk, and in many instances, hostages to data that they may not have access to, but which is commercialised. Such concerns are pertinent, even if a given technology is introduced for the purpose of decarbonisation. Secure data governance, rights to privacy, and user-centric control need to underpin uses of technology for just transitions to decarbonised futures.

4.5.1 What might transition mean with, and for, technologies?

Technology questions both connect and fill the gaps between the other domains featured in this report. From a policy standpoint technology connects energy, economy, and workforce transitions. This section of the report focuses on the key issues relating to the role of technology itself in just transition through the use of digital devices or platforms for consumers (or with consumer facing elements), broadly employed for the purposes (or for assistance with) transitions to decarbonisation. The focus on consumers and uses means that examples are likely bound up in the wider transition context, and have variable meanings for 'just': it can relate to where the balance of power lies in an exchange that involves individuals and business, as well as what means are employed to limit, reduce, or offset the carbon-intensive creation and maintenance of digital solutions.

As Swilling notes, just transitions are essentially about relationality (2020: 35), and despite the tendency to associate technology with rapid change, most transitions - regardless of their speed and scale - are based on many years of cultural changes (Newell and Simms, 2021: 910-12). Too often, technological innovation, rather than people and relations, are placed at the centre of analyses and evaluations (Santos and Lane, 2017) - even though the interconnected and cascading impacts associated with a globalised technology sector are clear. Multi-level perspectives[3] - are vital, given the necessity of maintaining the socio-technical systems that the world relies on (Raven et al., 2021: 87). As Petti and colleagues (2018) point out, these kinds of investigations are valuable because they…

> *"…assess the social and socio-economic aspects of products and their positive and negative impacts along their life cycle encompassing extraction and processing of raw materials, manufacturing, distribution, use, re-use, maintenance, recycling, and final disposal."*

Bamana and colleagues (2021) provide a pertinent example of what such an analysis looks like, exploring the mining of cobalt (vital in the construction of lithium-ion batteries) in the Democratic Republic of Congo. This was motivated by the increasing uptake of electric vehicles (EVs) as a means to decarbonise transport, and the fact that the DRC supplies more than half of the world's supply of cobalt (Banma et al., 2021: 1706). Population movement, labour conditions, health and safety are facets discussed in the research, but as a shorthand for the harrowing nature of this mining work, media outlets simply use the term 'blood cobalt' (Davie, 2022). While not specific to Australia, such an example reminds us that Australia is inculcated in the wider global trade - and associated costs to people and planet - that comes with the carbon-intensive processes underpinning technology innovation.

According to a recent research plan for energy transition, proposed by the Australian Council of Learned Academies (ACOLA), the need for cross-cutting approaches to transition is 'urgent', with Australia facing 'difficult' transitions (ACOLA, 2021: 10). Shifting job markets, impacts on regional populations, the rights of First Nations peoples, and unpredictable challenges (including pandemics) are all significant areas for transitions in Australia (2021: 2-13). They suggest we ought to learn from recent examples where transitions have taken place with limited consideration of the wider impacts (see ACOLA, 2021: 11):

There have already been instances of community frustration, anger and distrust around the construction of major transmission infrastructure to accommodate large-scale renewable energy projects. This can be a stressful and costly exercise for all parties, especially when community engagement or mediation occur near the end of the process. Past experiences and learnings will assist, such as those arising from a consideration of community concerns associated with the health impacts of wind turbines during increased industry developments in the early 2000s. In these engagements, it is vital that the consultation processes are cognisant of the ways in which disadvantage will affect community participation in the transition.

3. Two popular means of accounting for such breadth – with relevance to the topic of this report – are the Multi-Level Perspective (MLP) (Geels, 2002) and Social Lifecycle Analysis (SLCA) (Wu et al., 2014). See Raven et al (2021: 87) and Markard et al., (2012) for other examples of frameworks, and their use.

In a technologically intensive and data-reliant 21st century, the role of technology will be vital for transitions. Making these 'just' will mean governments, manufacturers and retailers reconceptualising hardware and software production - toward wider considerations of computing ecologies and scarcity. Previously black-boxed infrastructures (such as data centres and 'cloud' computing) will need to be recontextualised as material. In turn, more open government systems - with greater transparency in data storage and data (re)use policy - will be necessary to ensure users and citizens have appropriate trust in transition technologies. In everyday life, interactions with technology will need to be viewed as less ephemeral, and more deeply tied to global systems of exchange. Significantly, and across all these areas, justice in the digital space must be viewed as it is elsewhere: as the promoting of equitable access, consideration of marginalised populations, and foregrounding diverse (including indigenous) knowledge.

4.5.2 Current technology infrastructures and digital innovation

Australia is considered by some, as a leader in renewable energy investment (Chestney, 2020) and the deployment of renewable energy technologies in areas of solar power, data centre infrastructure and its national grid. Yet, leading engineering, technology and science researchers have recently demanded the 'immediate deployment of existing mature, low-carbon technologies which can make deep cuts to high-emitting sectors before 2030' (ASTE, 2021: 3). Running in parallel to these debates, is a clear policy trajectory that suggests management of mature and emerging energy sources will require changed understandings of both policymakers and consumers, and will rely on data-driven approaches. It is no coincidence that Australia's 2030 net-zero emissions goals have similar timelines to visions of digitalised futures, including the Digital Economy Strategy, Data Strategy and Digital Government Strategy (Commonwealth of Australia, 2021d: 7).

In a global comparative and historical context, Australia is a nation where 'states take the lead' especially in terms of how lands, resources, and urban growth are managed (Beatley and Newman, 2009: 188). In transition phases, states and territories maintain significant say over areas such as energy and transport (Wood et al., 2021: 22): state and territory governments agree on national net-zero targets, with exceptions made for interim goals and outlier states with more ambitious timelines. Unfortunately for policy observers, a recent shift in how intergovernmental negotiations are organised has obscured the processes by which goals are negotiated. The Council of Australian Governments (COAG) that existed between 1992-2020 incorporated states and representation of the Australian Local Government Association (ALGA), and was structured around 'councils' on key issues. Notably, these included a Transport and Infrastructure Council and an Energy Council. This model was replaced by the National Federation Reform Council (NFRC), widely understood through 'National Cabinet' meetings that have driven policy throughout the COVID-19 pandemic. These engagements are composed only of state/territory leaders and are protected by cabinet confidentiality. This obscures decision making processes, allocation or resources, and limits the ability of the wider population to see how priorities filter down to state government and local council actions.

Structures aside, the transitions of wider economy and society toward net-zero futures remains largely the domain of the federal Commonwealth government, with investments in nationally significant infrastructure - including in the technology space - are decided by the Department of Industry, Science, Energy and Resources. Generally, Australia's policies - across the above four departmental areas - talk of transformation: the government is happy to borrow language popularised by start-up cultures (such as 'stretch goals' and 'disruption'). However, policymakers are averse to making hard decisions or expensive investments when it comes to steering the development and use of technology. Strategy documents of the Australian Government's Critical Technologies Policy Coordination Office speaks of the transformational potential of technology and

ways to harness data, weighed against possible threats to national security (Commonwealth of Australia, 2021b). However, they cut this potential with an emphasis on reducing spending. Quite literally: 'the Government has four different types of response available and will always prioritise the lowest-cost option' (Commonwealth of Australia, 2021a: 29). Here, 'Category A' responses lead the list, and these are 'no regrets [...] lowest costs' responses (2021: 29).

Transformational discourses and policies

Therefore it is clear that the policy, investment and development of technology in Australia tend to be couched in 'technocentric' discourses. This means that emphasis is placed on developing (either creating or importing) technologies as solutions to problems, without wider considerations of associated or flow on impacts, such as where a technology is going to be implemented, who might be impacted, and how. In a very literal sense too, terms like 'technologies' are used vaguely - as catch-all terms to solve complex problems. As such there is emphasis on research as a tool for scientific discovery alone.

In Australia, the flagship science industry body is the Commonwealth Scientific and Industrial Research Organisation (CSIRO), which claims to 'shape the future […] by using science to solve real issues to unlock a better future for our community, our economy, our planet' (CSIRO, 2021a). This narrative flows through to CSIRO's 'digital specialist arm' Data61, which claims to 'solve the greatest challenges through innovative science and technology' (CSIRO, 2021b). These organisations have a strong commitment to science and technology for social good, and collaborate widely. Yet, as highly influential organisations, driven by science and technology, they lack the interdisciplinary capacity to re-think the design of technologies for a just transition in such a way that fully accounts for the everyday.

The dominance of science and technology driven approaches in Australia is coherent with the colonising tendencies of science globally. This has been critiqued particularly by Indigenous Australian scholars who draw our attention to the relevance of memory, history, land, and non-human species, and insist that these need to be accounted for in science and technology design (Harle et al., 2018; Abdilla et al., 2018). Their points are not only relevant for technologies that are intended for engagement with First Nations people, but the principles they expound ought to be applied broadly, to attend to people and the sites where technologies are intended to be engaged.

Further, an economics based approach - based on Australia's global position as an exporter of resources (Wood et al., 2021) - drives much of the change agenda. This results in goals oriented toward short-term goals of exporting near-mature energy technology, and 'watching' and eventual importation of overseas innovations (Commonwealth of Australia, 2020). There is little discussion of home-grown innovation, or use of existing expertise, aside from the claimed benefits of continuing to rely on coal-based energy (2020: 16), and explorations in some emerging materials and substances within the scope of usual practices and existing infrastructures across industries like energy and agriculture (2021b: 53). The notion of 'watching' extends to how private enterprise and consumers are imagined: as rational economic actors who, left to themselves, drive change purely out of cost-benefit calculations. Such rhetoric continues in the first principle of the government's Low Emissions Technology Statement, 'technology not taxes' (Commonwealth of Australia, 2021b: 7). This results in a dearth of inclusive, locally-sourced, locally-focussed strategy - a theme returned to frequently throughout this report.

Smaller innovations - usually at the level of software platforms, created to harness existing government data - are also encouraged. Australian governments - at the federal level through departmental funding, and at the state level - support initiatives such as the annual Gov Hack 'hackathon'. This is Australia's largest hackathon, and has been running for over a decade. These events are part of a general ethos of digital and 'open' government initiatives that have become popular in the last decade (see also, the Digital Transformation Agency (DTA) case study ahead). In 2020, Gov Hack focused on sustainability and 'sustainable communities' (Weigel, 2020). Projects included initiatives to

systematically dim public lighting to conserve energy, smart labels to better track plastic waste, and the use of IoT sensors to temperatures and monitor water reserves during firefighting efforts (Weigel, 2020).

However, hackathon approaches to innovations place the burden of forward-thinking technology in the hands of passionate citizens, with no guarantee of support to scale-up, nor be taken up by relevant authorities. Moreover, these hackathon events are usually conducted in a space where at least some of the underlying infrastructure relies on the involvement of private enterprises, and thus positions corporations - not communities - to benefit first from any developments. For example, Telstra is a notable primary sponsor for the 2020 and 2021 event. The ethos of open government data may be generally beneficial, but such encouragement is not aligned with some of the technology investment decisions made, and ironically, many of these decisions remain black-boxed unless they are embroiled in controversies.

Beyond government-funded research organisations, there is great reliance on non-specific developments in the private sector, as evident in Australia's Low Emissions Technology Roadmap and Statement (Commonwealth of Australia, 2020b; 2021b). In areas of 'energy storage', 'low emission energy', 'brief technologies' coupled with a reliance on technologies as additive to existing areas of energy and manufacture (such as smarter uses of 'proven' sources such as coal and hydro, and the cleaning/greening of steel production). The only 'new' investment area named repeatedly in the roadmap is hydrogen. There are also significant hopes placed on digitalisation to play the role of making existing strategies of energy management more efficient. This includes more 'smart' systems, monitoring, and novel forms of economic exchange, such as 'peer-to-peer trading' (2020: 26).

As these government focuses suggest, there is much sociopolitical currency in claiming that manufacturing is part of Australia's identity. In an interview, human geographer, sociologist, and sustainable innovation expert Associate Professor Thomas Birtchnell (University of Wollongong) explained how the nostalgia for a manufacturing heyday is shaping the policy orientation of transitions.

> Manufacturing is a real focus, you could say, for politicians. They're obsessed with it. Manufacturing and bringing manufacturing home. With a sense of what the Australian identity is too [...] I don't think we can underemphasise how important Australian identity is to transitions. So with Australia, we have this idea that, you know, that the people are self-educated, that they aspire to be independent, self-sufficient, and that runs throughout the whole society, it's incredible how important it is in politics.
>
> *— Interview, Associate Professor Thomas Birtchnell, University of Wollongong*

Concurrent with the focus on a manufacturing revival and support for existing industries , government-funded bodies such as the Clean Energy Finance Corporation (CEFC), engage with emerging technological innovations. The CEFC is a government funded enterprise launched in 2013, and has made $9.5bn investments in emerging clean technologies, and community consultation (Reshaping Infrastructure For a Net Zero Emissions Future, 2020).

DIGITAL GOVERNMENT IN AUSTRALIA

The Digital Transformation Agency (DTA) is a cross-cutting government agency established in 2016, with responsibilities in digital government, cyber infrastructure and public service delivery. The DTA seeks to accelerate digital transformation 'for Australia to become one of the top three digital governments in the world by 2025' (DTA, 2021: 6), and seeks to address criticisms that Australia has fallen behind in areas of digitalisation (Dunleavy et al., 2008). Such systems are vital in a transition context, as they are the front-line of communications between citizen and state, impacting access to welfare, support, education, work, and domestic and international migration.

One of their core aims has been to standardise how the Australian Public Service (APS) interfaces with citizens, with for example, the 'Services Australia' portal now resembling 'Gov.uk' and systems used by other OECD nations. But deeper changes have been hampered by a lack of true data sharing between departments, and there is reticence to engage in deeper restructuring of the relationship between the state and the government, with the recent Delivering For Australians report, in which many 'digital'-related recommendations are, at best, only 'agreed to in part' (2019: 18, 19).

Generally, the broad agenda of digitising services has also been criticised for being distant and impersonal, especially alienating disadvantaged and vulnerable communities that not only need public service support, but assistance engaging with online platforms (O'Sullivan and Walker, 2018). In recent years, controversies have surrounded digital government initiatives. Notably, the implementation of algorithmic systems to detect welfare overpayments - known as 'Robodebt' - is seen as an unjust failure, and has been subject to multiple Senate Inquiries and a class action lawsuit (Braithwaite, 2020; Parker et al., 2021: 4). During the COVID-19 pandemic, the government's 'COVIDSafe' smartphone software was also poorly received and poorly taken up at launch, and found to be largely ineffective in subsequent evaluations (Taylor, 2021; Vogt, et al., 2022). The app was intended to allow contract-tracing positive cases of COVID-19, but was criticised widely for a number of basic elements, including: overseas investment (Amazon Web Services were the majority recipient of initial funding), rollout (poor iOS support), security concerns (citizen data; bluetooth protocols), and delayed release of source code (despite being based on an open-source Singapore-based project) .

Unfortunately, the *Digital Government Strategy* (Commonwealth of Australia, 2021c), makes no reference to Australia's wider decarbonisation agenda, and related strategy documents make passing reference to big data climate modelling (2021d: 20, 24). A line then, can be drawn between this lack of holistic thinking and the emphasis placed on 'quick-fix' approaches to finding technology-based solutions to societal problems, outlined in the *Blueprint for Critical Technologies* (Commonwealth of Australia, 2021b) and the controversies above. However, related projects - such as that of the Australian Data and Digital Council (ADDC) - show that state and territory-based digital initiatives may drive change, with important interrelated areas of 'energy switching', inequalities (welfare and subsidies), and disaster resilience (see Commonwealth of Australia 2020).

4. Post-launch, funding was also provided to app developers with familial connections to the (incumbent) Liberal Party (Kearsley and Cooper, 2020). This developer, Delv, was also the primary developer of the 'Coronavirus Australia' app, which provided high level alerts, news and advice and public health data related to the pandemic. COVIDSafe has been subject to multiple investigations, from media freedom-of-information requests, and an ongoing audit by the Australian National Audit Office (ANAO).

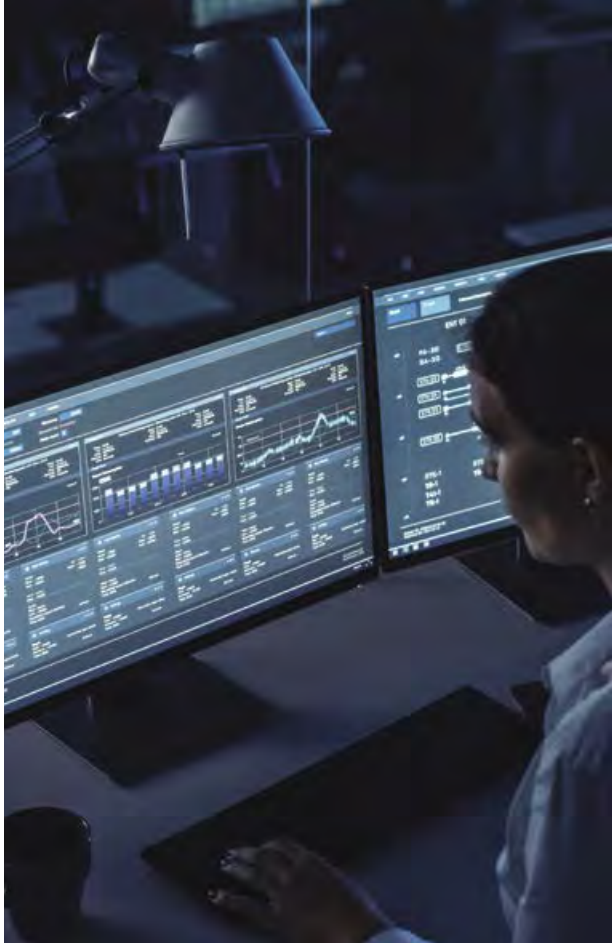
The approach outlined, which focuses on investments in training and skills development, aims to rapidly commercialise developments, to provide funds to assist startups, bolster the supply chains for technologies, improve security, update policy to cover digital developments, shift funding to national interest projects, and promote public awareness. Transformation then, is framed on an international stage - with little in terms of concrete examples of what change might look like from an internal domestic perspective.

The costs of storing and using data

There is significant energy expenditure in keeping systems functional, and maintaining cool operating temperature is essential in an already warm and warming climate, let alone the very real danger of fire (Parker et al., 2021: 2-3). The introduction of new forms of digital assets and security technologies also add to an increasing load on national digital infrastructure. While these come with some advantages (outlined ahead) they have been either not created nor implemented with the purpose of providing decarbonised alternatives to mainstream technologies. As such, public and private sectors are now grappling with the challenges of greening these technologies for the future.

Data centres

Data centres play an integral, and often hidden, part of global infrastructure. A data centre is a physical facility (such as a building, or dedicated space within a building) that houses the network and computing infrastructure necessary for wired or wireless information networks to operate and function. In particular, this infrastructure is hidden by terms like ‘cloud’ computing, which suggest a weightlessness and dislocation that belies the physicality of data centres. Consisting of various key components, such as servers, storage systems, routers and security features (i.e., firewalls), the purpose of data centres is to collect, store, process and distribute vast amounts of data within highly controlled, secure and resilient environments.
In today’s highly interconnected and digitally-mediated world, data centres are considered highly critical pieces of infrastructure. Governments, businesses and individuals increasingly turn to



'the cloud' and its services, whether for improved continuity, reduced storage costs or the improved flexibility and scalability of their day-to-day operations. Due to unprecedented global demands in data usage and storage, the last decade or so has seen a rapid growth in data centre infrastructure. One estimate suggests that there are approximately 8,000 data centres globally, with the vast majority geographically concentrated in North America, Europe and Asia (Cloudscene, 2021). Following the pandemic, this figure is expected to grow even further as states: organisations and global infrastructure are adapting to new forms of work and education (i.e., remote work, hybrid learning, and the ubiquity of video conferencing), digitising their existing services and operational processes, and rapidly developing data-reliant technologies (such as artificial intelligence (AI), machine learning (ML), the Internet of Things (IoT) and 5G telecommunication networks) (ALSO, 2021). In 2020, the global data centre market was valued at $48.90 billion, with that figure expected to reach $105.6 billion by 2026 (Mordor Intelligence, 2021).

As with any rapid technological advancement or transformation in today's digitally-mediated world, the rapid demand for data storage infrastructure comes with drawbacks. Indeed, it is widely documented that the data centre industry is incredibly energy-intensive, with large amounts of electricity and water (often overlooked) required to power its server racks and networking equipment, as well as to cool equipment (Mytton, 2020; 2021). A recent estimate suggests that data centres consume somewhere between 1-2% of global electricity demand (Mytton, 2020), whilst contributing 2% of global greenhouse gas emission (Pearce, 2018; Vaughan, 2015). This is equivalent to the emissions of the global airline industry, yet, as the geographer Jessica McLean notes 'there is debate about the impact of flying on climate change [but] we're less likely to evaluate our digital lives the same way' (2019 see also Nursey-Bray et al 2019). Nevertheless, in recent years we have seen a growing body of academic literature emerge that is beginning to assess and critique the multi-level social and environmental impacts of the network technologies around the world (see, Jones, 2018; Siddik et al., 2021).

CRITICAL ISSUES FOR DATA CENTRES AND HEAT MANAGEMENT

A central part of data centre management is heat management: ***servers produce heat, and as they are gathered in large numbers in close areas, temperatures rise raising the risk of fire.*** *To overcome this, data centre operators have various techniques to cool down these facilities and avoid any risks of data loss caused by fires. The technical answers given by operators to heat management and* ***their material implications on energy networks and resources are at the heart of most of the debates concerning data centres' environmental consequences.***

[It is important] to understand how companies, public agencies and civil society understand and address the environmental, economic and cultural conditions and limitations facing the establishment and management of data centres. ***What shapes the environmental impacts of data centres' cooling infrastructures? How are companies dealing with growing mistrust of their environmental impact? What do local authorities think they should do to improve planning and reduce data centres' environmental impacts?***

— Submission, Parker et al., ADM+S, January 2022

Yet, contrary to many of the alarming headlines and hyperbole surrounding data centres over the last decade or so - from warnings of a 'Tsunami of data [that] could consume one fifth of global electricity by 2025' (Vidal, 2017) to being posited as the dirty 'factories' of today's digital age (Pearce, 2018) - it must be noted that discourse surrounding the environmental impact of data centres is not entirely congruent. A number of environmental researchers and analysts have found that despite an exponential growth in demand for data centre services, overall energy use has remained 'flat' (Kamiya and Kvarnström, 2019; Koomey and Masanet, 2021). This is in large part down to technological advancements in data centres themselves - from smaller facilities to 'hyperscale data centres' - which have led to greater operational efficiencies (Kamiya and Kvarnström, 2019). Importantly, there has also been movement toward considerations of 'data centre sustainability', with organisations seeking to lower their carbon footprint through the use of renewables. The location of data centres has traditionally relied on factors relating to cost of land, favourable tax rates and proximity to the 'backbones' of existing internet infrastructure - such as undersea cables (Blum, 2012). But a number of big-tech companies have recognised the importance of constructing data centres in locations with cooler climates and access to renewables. For example, both Meta (incl. Facebook) and Alphabet (incl. Google) are exploring Sweden and Finland as data centre sites, chosen for their cold temperatures, hydroelectric power, wind farms, and sea water (for cooling) - all of which reduce energy consumption.

In the above trajectories, it remains unclear how corporate intent will impact local communities, and what kinds of consultations might occur to ensure understanding, equity, and justice. But in an interview, Chief Clean Futures Officer at Australia's Clean Energy Finance Corporation (CEFC), Paul McCartney, provided a perspective on consultative practises and the decision making around technology investments (emphasis added):

5. Between 2010 and 2018 'the data workloads hosted by the cloud data centres increased 2,600 percent and energy consumption increased 500 percent. But energy consumption for all data centres rose less than 10 percent' (Lohr, 2021).

> ***We always undertake investments with a view to driving a benefit to the Australian taxpayer, as well as the public good, decarbonisation, or the impact on the sector or community. You can see that particular regions and areas have a big stranded asset risk. They could get caught in a bit of a time warp, left with old technology.*** *Understanding the peculiarities of each individual community's really important.* ***I think local governments [...] will become far more important for us. We'll look at all the community feedback and issues that arise*** *[...] Social good is always a consideration in our decision-making. It's not the prime driver, but if we felt through an investment that we're going to do harm to communities, then it'd certainly give us cause for pause.*
>
> — *Interview, Paul McCartney, Chief Clean Futures Officer, CEFC*

Without the promise of cold, Arctic Circle temperatures, environmental critics would perhaps initially cast doubts over the green credentials of Australia's burgeoning data centre industry, yet technologists believe that Australia can lead the way in the development of the sustainable data centre (Alliaume, 2021). At the time of writing, there are approximately 270 data centres in Australia (Cloudscene, 2021), with that number expected to rise sharply over the next decade. Given the geography and climate of Australia, its telecommunications and data centre network faces a number of unique technological challenges. Unsurprisingly, therefore, nearly all of its data centres are sited in major Australian cities such as Sydney, Melbourne, Brisbane, Adelaide and Perth, with Sydney and Perth serving as major interconnection hubs for the country's telecommunications network and landing points for undersea cabling from Asia (via Singapore) and North America (via Hawaii).

Despite the disparate distribution of Australia's data centre infrastructure, its market continues to grow, whilst both government and industry are taking steps to ensure that such growth is achieved in a sustainable manner. With industry often shouldering much of the responsibility for the energy impact of its data centres through its design efficiencies, the federal government has raised concerns for the welfare of existing infrastructure: 'the average Australian data centre is now over 20 years old and many are inefficiently designed' (Commonwealth of Australia, 2022). Recognising this, the Department of Industry, Science, Energy and Resources has established the National Australian Built Environment Rating System (NABERS) for measuring the energy efficiency and environmental impact of a data centre[6]. In what many see as a step towards making the data centre industry more sustainable, the system promotes companies to be assessed/evaluated on their IT equipment, infrastructure and facility as a whole, where its certified NABERS rating can be 'used to identify areas for operational improvements and cost savings, as well as promote your environmental credentials to help you win business

6. An example of irregular intergovernmental relations in Australia, NABERS is managed by the New South Wales government Department of Industry, Planning and Environment, on behalf of the federal Department.

from blue chip clients' (NABERS, 2021). According to the NABERS website (2021), it is claimed that by raising a rating from 3 to 5 stars, a company can save on average $2,226,000 per annum, whilst driving a sustainable business culture across the market in the process.

Meanwhile, across the private sector, we are beginning to see conversations and action around transitions towards a decarbonised economy and what role data centres and the cloud can play in such a transition. At a corporate level, we have seen this in discourse promoted by the likes of Atos, a global digital transformation consultancy, which has called for the transition towards a 'green cloud' in Australia, working with its partners to 'ensure energy efficiency in data centres' by working with its clients to better manage digital and energy resources (Alliaume, 2021). The announcement of 'the world's first carbon-free data centre' in Western Australia (to be located close to the SKA Pathfinder Telescope) (DUG, 2021), and the development of renewable energy powered data centres in Queensland and New South Wales (Quinbrook, 2022), should be welcomed forerunners. Amidst the backdrop of a growing cryptocurrency market in Australia, we have also seen a boom in the number of dedicated crypto minings facilities being established across the country. However, it is notable that, despite the crypto mining industry being heavily criticised for its resource-intensive practices in data centres, there are a number of projects that seek to employ renewable/sustainable business models (see below).

Cryptocurrency in Australia

Cryptocurrency mining is often maligned as one of the most energy-intensive industries on the planet (Aratani, 2021). In short, there are two key factors that contribute to this: **maintenance** and **mining**.

1. The technology underpinning cryptocurrency - 'blockchain' - is distributed, using many nodes to validate and log transactions. Those using the blockchain (including people using cryptocurrencies) concurrently contribute to the upkeep of an open public ledger of transactions for all blockchain users. This distribution is a security and transparency feature, with decentralised nodes being resilient to attacks, errors, or adverse events (such as energy or telecommunications disruption).
2. 'Mining' cryptocurrency involves solving complex mathematical problems and requires powerful computers. In the case of Bitcoin, there are a finite number of coins that can be mined and as miners reach toward the ceiling, they face increasingly complex equations. Similar to mining the earth for minerals, the process is costly, and energy is expended for ever-diminishing returns.

Significantly in both cases, and despite the potential to distribute the load, constant (and increasing) amounts of energy, are required. Equally necessary are computing components that are capable of these increasingly demanding tasks. Such components also rely on further expenditure of energy, and the further extraction of rare minerals. Despite this, the connections to mining - both literal and analogous - are used to paint a picture of a logical way forward for Australia's economy (see case study below).

One study from the University of Cambridge notes that Bitcoin now has a 0.58% share of the

world's total yearly electricity consumption, with an equivalent annual consumption to that of Egypt, Ukraine or Norway (University of Cambridge, 2021). By 2024, it is predicted that Bitcoin mining globally will consume more electricity than the whole of Australia (Mazengarb, 2021). Such statistics are alarming, particularly against the backdrop of the climate emergency and efforts to decarbonise the global economy. Similarly, there are few attempts to understand the relationship between Bitcoin mining and their socio-ecological effects, for as 'Bitcoin miners plug into existing electrical infrastructures to power their mining equipment, they become part of complex circulatory systems of electricity, resources, and capital' (Lally et al., 2019: 9).

Evoking fossil fuel consumption, Professor Brian Lucey of Trinity College Dublin recently stated 'it's a dirty business. It's a dirty currency' (Martin and Nauman, 2021). Despite this, the mining of Bitcoin and other cryptocurrencies continues to rapidly expand, with its geographical distribution becoming more disparate and diverse, with geographic and geopolitical aspects overlooked (Howson, 2020). Following a recent government crackdown on cryptocurrency mining in China (where it had a clear monopoly on global production), Bitcoin mining infrastructure has been 'on the move' (BBC, 2021), with the U.S., Canada, Russia and Kazakhstan are now considered world leaders in Bitcoin production (Muir, 2021).

THE IMPACT OF BITCOIN MINING IN AUSTRALIA

In Australia, despite interest in cryptocurrency mining continuing to rise – a recent estimate (July 2021) suggests that Australia is mining 0.20% of global Bitcoin production (University of Cambridge, 2021) – progression appears to have been hampered by a number of economic, environmental and governance/regulatory issues. Despite the oscillating value of cryptocurrencies, it is clear that in Australia in 2020, Bitcoin was more expensive to mine than it was to buy (Carabott, 2021). However, a number of Australian cryptocurrency companies believe that greener and more cost effective use of blockchain is possible. They cite state inertia and an inherent 'bias' towards other industries from the Australian Securities Exchange (ASX) and the 'brain drain' of talent and expertise moving overseas (Powell, 2021a) as handbrakes in this regard. For example, the Australian-founded and sustainability-focussed cryptocurrency mining company Iris Energy debuted on the U.S. NASDAQ exchange, hinting that relocation was motivated by cheaper renewable energy infrastructure (Powell, 2021b).

With more than 800,000 Australians now owning some form of crypto asset (Gkritsi, 2021), and transactions surged across the country - up 63% during the Covid-19 pandemic (Jose and Kaye, 2021) - the government has recognised that regulation is required to manage uncertainty and protect consumers. In December 2021, the Australian Treasurer Josh Frydenberg announced what he believed to be the biggest reforms to the country's payment systems in over 25 years, creating a licencing framework for cryptocurrency exchanges (which will allow for buying/selling of crypto assets in a regulated environment) and announcing a feasibility assessment of establishing a bank for digital currency (Jose and Kaye, 2021). The announcement drew on a year-long inquiry by the Senate Select Committee on Australia as a Technology and Financial Centre (ATFC), and 12 recommendations for making Australia a 'leader in the digital assets space' (Parliament of Australia, 2021). This centres largely on the financial possibilities of blockchain technology (for currency, and for wider asset management and verification), but also leaves the door open to other blockchain use-cases, by virtue of it's decentralised and secure characteristics.

In what many may see as an approach to mitigate the huge environmental impact of cryptocurrency mining (and the maintaining of other blockchain technologies), one mooted policy recommendation involves a plan to offer companies a 10% tax cut if they use renewable energy for their mining operations (Parliament of Australia, 2021). With government regulation and 'green' incentivisation seemingly on the horizon, it is notable that the private sector may already be leading the way in transitioning towards a more sustainable crypto mining sector.

In 2018, DC Two announced Australia's first cryptocurrency mine powered primarily by renewable energy sources (solar), located in Collie near Perth, Western Australia (Smolaks, 2018). Similarly, BTC Mine Australia have positioned themselves as leaders in sustainable Bitcoin mining technology, securing 80,000 acres of land in Hunter Valley (NSW) to develop large-scale solar farms for their mining operations (BTC Mine Australia, 2021; Herd, 2021). Tourist hotspot Byron Bay (NSW) is soon to become home to Australia's largest Bitcoin mining site after Mawson Infrastructure Group announced a partnership with renewable energy provider Quinbrook Infrastructure Partners (Sier, 2021a). James Manning, founder of the aforementioned Mawson, asks: 'Australians are world leaders in traditional mining, so why not digital mining[?]' (Sier, 2021b). The ironies in this are obvious; with Byron's green credentials on the line, and coal-rich areas like the Hunter already dealing with workforce changes.

Given the resource-intensiveness of cryptocurrency mining, regardless of its energy source, critics may well question why renewable energy resources - especially when these are build from the ground-up to support crypto - are not first prioritised in other sectors to accelerate the decarbonisation of critical industries by or before 2050.

Cybersecurity

Given the increased reliance on data centres, and ongoing innovations in information processing, storage, and exchange, cybersecurity is vital to ensure that transitions are both safe (in a national security context) and just (in the context of how personal information is used). In a recent report published by RUSI, a UK-based defence and security think-tank, it was highlighted that cyber threats to energy infrastructure are becoming more prevalent around the world and that, as we shift towards renewables, 'there will be a greater reliance on smart electricity systems which must be resilient' to malicious cyberattacks (Dawda et al., 2021: 2). In Australia, too recent experience shows that cyber threats to infrastructure are both genuine and effective.

As we begin to transition towards a data-driven society - particularly within the energy sector - new vulnerabilities and risks are created, and the risk of cyberattacks increases exponentially (Savin, 2022). Interestingly, the authors note that much of the research in this area is technically-minded (thus less accessible for policymakers, industry and the wider public) and largely U.S.-centric, which may explain the dearth of academic research that examines transitions through a lens of data, digital technologies and cybersecurity. The Australian Government's Critical Technologies Policy Coordination Office speaks of the transformational potential of technology and ways to harness data, weighed against possible threats to national security (Commonwealth of Australia, 2021b).

The Australian Cyber Security Centre's (ACSC) Annual Cyber Threat Report (2021) reports that a quarter of cyber incidents reported between 1 July 2020 - 30 June 2021 were targeted at Australia's critical infrastructure or essential services such as 'health care, food distribution and energy sectors', with ransomware attacks in particular growing in prominence, rising by 15% (ACSC, 2021). In November 2021, the Australian government-owned energy company CS Energy was hit by a ransomware attack: attackers gained access to some of the company's IT infrastructure, and in effect, locked the company out of their own systems - holding them to ransom. This affected its corporate networks but fortunately, did not impact upon electricity generation at its Callide and Kogan Creek power stations in Queensland (Marzouk, 2021). With the Reserve Bank of Australia (RBA) recently warning that climate change risk and cyberattacks could have 'devastating' consequences for Australia's financial system (Karp, 2021), it is surprising that there is a lack of research and policy direction on the interrelated issue of decarbonisation and cybersecurity vulnerabilities, as well as the threats this can pose for Australian society more broadly.

An exception here is the Australian Energy Market Operator (AEMO) Integrated System Plan which identified that 'cyber security measures are needed to avoid unintended system security risks' as part of its wider comment on futures. Though, the plan does little to outline risks and mitigation measures[7] (AEMO, 2020). From both the perspective of the private sector, and policy offices, the rapid transformation of Australia's power and utilities sector - presented through the prism of 'three Ds'; decarbonisation, decentralisation and digitisation - has meant that the country's cyber 'attack surface' has broadened significantly (Bergman et al., 2021;

7. In another example of intergovernmental relations AEMO was established by COAG in 2009 to manage the energy market in eastern states of Australia. Ownership is shared between federal and state governments and industry representatives from across the country (AEMO, 2021).

Commonwealth of Australia, 2021b: 2). This means that governments, organisations and individuals need to explore ways to boost their resilience against any cyber threats.

Despite the lack of discourse around decarbonisation and cybersecurity in a national context, much of the discussion around energy transition, digital technologies and cybersecurity are being driven from the private sector, where organisations appear keen to express their green credentials and appetite towards transitioning to a net-zero economy to a wider public audience (Alliaume, 2021; King, 2020; LETA, 2022). The steps taken across important areas of hybridised public/privatise infrastructure are significant, and suggest a path forward where enterprise is able to influence both governments and individual technology consumers. In particular, private investments are recognising that the decarbonisation goals of nations across the Asia-Pacific region will push Australia to make good on promises, and likely force an acceleration of net-zero initiatives to remain competitive (Wood et al., 2021).

A key emerging concept - especially in areas where security interests may be tied to, or sit in tension with, technology multinationals - is 'data sovereignty'. This concept, by name, has obvious links to the nation state, and is used in this way by the Digital Transformation Agency (DTA) (Commonwealth of Australia, 2021c). But while it may be simplest to use the term in a clear-cut cybersecurity or national interest sense, definitions are diverse and in flux. In reviewing and mapping use of the term to date, Hummel and colleagues found values of security, transparency, control, representation/inclusion feature most frequently (2021: 11). This current plurality is important for 'just transitions' policymaking because it enables thinking that is sensitive to how such values manifest at national, enterprise, community and individual levels, and does so concurrent with the emergence of new possibilities for data.

Hummel et al. (2021: 12) also provide a conceptual grid, including examples, to demonstrate how the concept can be broken down for different applications. Many of these are reflected in the issues explored in the consumer technology section ahead.

	Example 1	Example 2	Example 3
Agents: Who is involved?	Indigenous populations	Consumers	Countries
Contexts: What is the broader domain and/or topic?	Legislation	IT architecture	Research
Values: Which values matter?	Control and power	Privacy	Deliberation and inclusion
Descriptions: What is the primary focus?	Rights	Abilities	Legal concept
Challenges: What are the main obstacles?	Nature of data	Technical impediments	Complexity
Management strategies: How should obstacles be addressed?	Realising rights and values	Technical designs	Focusing on consequences and effects

Data sovereignty: *a conceptual grid (adapted from Hummel et al. 2021: 12)*

Looking ahead, the notion of data sovereignty will be essential for technology transitions, and for implementing technologies in other domains. It can help to ensure that contextually-relevant rights and values are instilled in industry digitisation agendas, 'smart' data-use projects, and hardware design. Ideally too, this can provide some redress for instances where values were previously absent, or when certain voices were not heard.

Consumer technology

Australia's position as an importer - not a manufacturer - everyday of consumer technologies, and reliant on a continued position of the nation as an exporter of material and energy technologies (Wood et al., 2021), has resulted in a tendency to sidestep key issues of data use, privacy rights, and e-waste. In some ways, these issues are distinct. But as the examples of data management (above) show, there are many links between policy and investment, infrastructures, and end-users of technologies. Cohesive and holistic multi-level perspectives on transitions are based on these kinds of interconnections, and consider them as part of a shared agenda.

In their reading of transition, Affolderbach and Schulz (2018: 227) capture this digital relationality well, and it become clear how the broad infrastructural issues discussed prior have cascading effects:

> *"If the idea of smartness is narrowed down solely to - as is frequently the case - the use of digital infrastructures such as smart grids or communicating household devices (Internet of things), it tends to promise technology-based efficiency gains in green buildings without interrogating overall resource needs, production and consumption patterns or potential rebound effects (let alone aspects of data security)".*

Data use and reuse

Cryptocurrency technology has debuted in an era where decarbonisation agendas are already active, and is tied to both a product (i.e., Bitcoin) and an infrastructure (blockchain). However many technology services have not, and do not, prioritise matters of energy consumption, privacy, and

security. Moreover, there is concern that some technologies - regardless of any decarbonisation agenda - are premised on the tracking of consumer and behavioural data, informing the kinds of profiling already rife across the digital landscape (McLaren and Agyeman, 2017). Indeed, the recent emphasis on emerging technologies like blockchain being essential for the next 'iteration' internet (terms like, for instance 'Web 3.0') is distracting from wider issues of corporate monopolisation (Alphabet, Apple, Amazon, Meta, Microsoft) and a steady closing-off of internet services, into discrete product ecosystems and proprietary services.

That personal data has been characterised as the new 'oil' lacks nuance (Neff and Nafus, 2016: 113), but does give a shorthand for the extractive and highly profitable aspect of consumer technology, especially as corporations pivot to greener goals. As new markets form in these areas, competition can lead to an uptick in environmental impacts as these come online, jostling for market share. Failures or crashes in popularity can then also lead to waste (both in terms of misused data, and discarded devices). Businesses may contribute to these ills even when their focus is on emission reduction or transition. For example, gig-economy and sharing services (see also,

the Work domain of this report) can be unjust because they operationalise change as demand-side competition, rather than supply-side control: services may pit users against each other, while concurrently gathering user data to learn more about how to design and market products, or to on-sell to others (see Spinney and Lim, 2018 on bike sharing apps, and Dowling and Kent, 2015 on car sharing).

In recent years, there has been considerable focus on the political economies and inequities of mobility-as-a-service (MaaS), often centred on ridesharing services situated within the wider gig economy. However, peer-to-peer (P2P) car-sharing platforms have been less explored. In Australia, services like GoGet and CarNextDoor create decentralised rental markets: the former using a more typical fleet model (closer to traditional car rental), and the latter by leveraging the idle vehicles of private individuals. Vehicles can be selected to meet certain requirements, such as occupancy, load capacity, range, or ability to manage terrain. Payment can also be calculated hourly, daily, or per kilometre travelled. This allows a reimagining of vehicles (household/individual ownership is deeply embedded in Australian culture) and vehicle types (SUVs and utility vehicles are extremely popular) to something that is more purposive, efficient, and sustainable: from cars-as-freedom, and the culturally embedded notions of cars-as-property (discussed in the Mobilities sector), to cars-as-shared-commodity (Dowling and Kent, 2015: 60). Indeed, ethnographic research supports this, showing that a new 'ecology' of ad-hoc and planned user practices were emerging with CarNextDoor, which boasted 60,000 members in 2018 (Svangren et al., 2019: 754-45). Car sharing, unlike traditional rental fleets, have the potential to not merely be a disruptive player in the industry, but to be transformative: they resituate disparate vehicles into pieces of a wider transport network.

However, there are also tensions. Significant financial losses have been incurred by those invested, both financially and emotionally, in more traditional taxi mobility services which have been

threatened by the rapid rise of care-sharing platform gig work in many Australian cities, from companies such as Uber. In a study of taxi drivers experiencing significant financial losses in the city of Melbourne, David Bissell remarks more broadly on the neglected subject of loss that is often missed out by glossy assumptions of technological innovation:

> *"Productivist accounts of technological change fail to acknowledge the critical politics of who loses out in such mobility transitions and how these losses are reckoned with. Neglecting loss risks imagining mobility transitions as a simple toggling of one mode of operation to another without casualty, leaving insufficient space to consider the gaps, breaks and tears in experience" (Bissell 2022: 478).*

Furthermore, as these services have grown, corporate and government partnerships have emerged - with some undermining outcomes. In some council areas, Go Get have exclusive 'car share' parking spaces (see Dowling and Kent, 2015: 61-63), with companies learning the ideal locations through data tracking and sharing. User's data is used and reused cyclically, with significant benefits for the providers: precise usage data (including people and locations) can be leveraged to demonstrate impact, influence governance (i.e. councils), and result in providers gaining access to a greater share of parking spaces. This, in turn, generates more visibility, and more share of the market. In the case of CarNextDoor, the service's expansion has resulted in somewhat multiplicitous relations: while remaining reliant on the labour and data of their users for their primary offering, they are now also supported by fuel distributor Ampol, automotive manufacturer Hyundai, and Greenfleet carbon-offsetting program. These vexed connections are indicative of many 'towards…' approaches to decarbonisation, where the distributed support structures help to maintain existing systems of capital exchange during protracted transitions. This may economically incentivise customers, but leaves possible environmental benefits as more ambiguous. As the materials provided by the company repeatedly state, this is about individual steps - 'your carbon footprint' - rather than systems-level change (CarNextDoor, 2022).

Another example of exclusive car share parking spaces. *This example can be found near a key entertainment venue in Melbourne's Docklands precinct (January, 2022).*

However, technology development is not only responsive; technologies produce new practices (potentially unaccounted for) which then shift and shape the technology going forward - this is the upside of 'open data' initiatives (i.e., Gov Hack) discussed earlier. Promisingly, Australia's authorities such as the Australian Competition and Consumer Commission (ACCC) have shown willingness to critique the increasing dominance of technology multinationals in various ventures, and have made some moves toward regulating data collection and use practices in some ways consistent with local policy stances. For example, the position held on the protected status of health data (page 131, this document) carried forth in the ACCC's reviews of mergers in the health-tech space (ACCC, 2020). The ACCC was also responsible for 'News media bargaining code' (ACCC, 2021), the negotiations of which, infamously saw Facebook deplatform news from Australian outlets. These stances are also reflective of a turning tide across the globe, as regulators begin to attempt to curb the influence of technology giants. A chief driver of this is the Global Data Protection Regulation (GDPR), a rights-based regulatory system employed in the EU, which has had far-reaching global impacts in the transparency of how user data is collected and and how this is communicated to users (McDermott, 2017).

E-waste and ‘right to repair’

Waste is a growing global problem, not least because the movement of technologies is decoupled from manufacture and demand: industrialisation, urbanisation and growing wealth can all drive consumption, while the exportation of waste product can also shift the balance of where wast accrues (Forti et al., 2020: 13-14). In Oceania, it is estimated that in 2019, 16 kilograms of e-waste was generated per-capita, while only 8 percent of viable e-waste was actually recycled (2020: 78). With this geography in mind, Australia is a key contributor (both per-capita and total) to waste, but also leads the region with the only national e-waste policy and ‘product stewardship’ regulation (2020: 79). Australia has an opportunity to centralise waste management efforts going forward, and aid smaller nations in the region. There are many possibilities for Australia to contribute to smarter reuse of technology products. Entire new industries (such as 3D printing, which can draw on recycled materials) can be developed to address this issue, and also help Australia cope with workforce shifts that result from transitions in other sectors. These re-energise some of the planning around local commercialisation and manufacturing opportunities (Commonwealth of Australia, 2020; 2021b), and link emerging technologies to legacies of production:

> There’s a real push now to have manufacturing brought home [which] has this knock on effect for things like manufacturing where we have a sense that, you know, ‘you should be able to make your own things and repair your own things’ and ‘Australia was great when it was a manufacturing nation’ and so on. And this populism really feeds into the 3D printing innovation, the idea of 3D printing.
>
> — *Interview, Associate Professor Thomas Birtchnell, University of Wollongong*

Situated between concerns about consumer (and data) rights, and the feasibility of digital infrastructure, the issue of ‘right to repair’ is gaining global attention. Consumer technologies are not created in a vacuum: they come with environmental costs. These stem from the creation, the rare materials and carbon intensive processes required to build the complex sensors, circuits, and batteries that power digital consumer technology (Bamana et al., 2021); the upkeep, the energy cost of running data centres that power digital and IoT devices (Martin and Nauman, 2021); and the destruction of devices where e-waste enters landfill or is inefficiently recycled and creates further emissions (Forti et al., 2020). The ‘right to repair’ movement (Terryn, 2019; Stein and Crosby, 2021), rallies against the unnecessary iteration of products, and software and hardware design choices that shorten the life of technologies – amounting to what many term ‘planned obsolescence’.

The Australian Government’s Productivity Commission (PC) published a report into the issue in October 2021, drawing on existing research, policy, and a public submission from diverse parties including advocates and academics. They explore a dual meaning to the term: a broad ethos of individual rights to practice values of self-sufficiency, plus, a manufacturer obligation to provide the parts for the former pursuit, and a commitment to minimising environmental harms in their business practice (2021: 4). The report outlines the right to repair issue thusly (2021: iv): consumers or third parties are prevented from being able to repair the products due to a lack of access to necessary tools, parts or diagnostic software.

In noting that the above matters currently fall outside the bounds of anti-competitive consumer laws, the report recommends that the government (2021: 2):

1. Provide consumers with a product labelling scheme related to durability and repair.
2. Amend copyright laws to make repair information and instruction readily available to repairers and remove restrictions on software-based diagnostic tools.

3. Remove restrictions around ‘certified repairers’ and affirm consumer law status as above that of warranties.
4. Review and improve e-waste stewardship measures, including monitoring reuse and e-waste exports.
5. Conduct further reviews in specific markets (i.e., communications or medical devices) to find appropriate strategies to balance repair access with device safety.

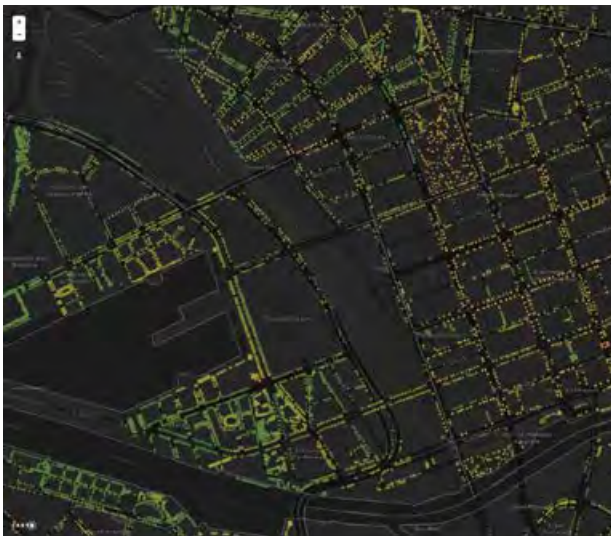
‘Right to repair’ has important connections to ‘just transitions’: protections (and/or incentives) need to be put in place for individuals to access technology - both affordable and functional - to conduct daily life. This is particularly pertinent at the intersections of hardware and software, where the viability of hardware for personal and business activities relies on the maintenance of software (i.e., backwards compatibility or regular updates). Guarantees here can ensure that the technologies created and employed for greening purposes are themselves sustainably produced and used. A particular vector for this concern, as identified in the PC report, is the agricultural sector where the impacts of restricted repair processes have cascading impacts on livelihoods (2021: 18, 31, 39). This is made more significant given the investment strategies discussed earlier (see Commonwealth of Australia, 2020a; 2021a), which indicate that new proprietary technologies will be explored to reduce emissions in the agricultural sector.

Those employed as repairers also stand to gain from revised repair contracting arrangements (PC, 2021). This latter point is particularly important, as Australia is a consumer technology market based largely on importation not manufacturing. Encouraging repair and recycling would also fuel a new manufacturing base utilising existing materials. With greater clarity around consumer rights, there would then be possibilities of introducing end-of-life obligations for consumers and manufacturers/vendors, encouraging correct disposal of e-waste when repair options are exhausted. Empowering small repair businesses within this system would also distribute the load of establishing and maintaining circular economies.

People and place: seeing diversity through everyday technology

Embedded in homes and workplaces, and carried in our pockets, our devices are increasingly communicating with a wider ‘Internet of Things’ (IoT) that allows us to harness the information we generate as we go about our lives. We can think here of health tracking technologies like Fitbit devices, the ubiquity of geolocation services (i.e., Google Maps), smart home devices, and domestic energy monitoring systems, which render complex issues as simple visualisations and allow us to participate at the touch of a button. Such tools are vital for reframing personal actions in times of transition, and can also help understand place and space in relation to technology, the built environment, and nature.

With local councils taking active stances on climate change (see ALGA, 2022), many cities are seeking to reconfigure built environments in relation to natural tree canopies (as both means to absorb carbon and provide shade), and capital cities of Australia are sharing data about their ‘urban forests’ (see http://opentrees.org). In Melbourne, Urban Forest Visual (Gulsrud et al., 2018; Phillips & Atchison, 2020; de Kleyn et al., 2020) maps over 70,000 trees (Urban Forest and Ecology Team, 2012), and allows citizens to email any of the city’s trees to share feelings and experiences (see Tan, 2015; Burin, 2018 & O’Shea, 2021 for email examples). Cynics of ‘green urbanism’ (Swilling, 2020: 175-81) may see this as lip service, but the map and the messages should also be read as a successful activation of citizen interest and an affective form of participation in urban governance. Similarly, the platform Our Songlines hopes to remap Australia to bring First Nations communities to the fore. The platform provides an overlay on a standard map, plotting sites of significance, sharing stories of Indigenous Australians, and promoting business and cultural centres of different Australian Aboriginal nations. Rather than contesting or replacing government map sources (see AIATSIS, 2022) the goal of the platform - as founder Kayla Cartledge explained - is to ensure that people are ‘learning about indigenous culture from indigenous people’ (Fennell, 2021).



Screenshots of the interactive maps for the Our Songlines (left) and Urban Forest Visual (right). Both are novel applications of mapping to diversify social and ecological understandings of space and place (January, 2022).

While these are not as purposive as policy instruments, the hybrid and plural perspectives of grassroots mapping initiatives encourage holistic understandings from citizens and communities, without the pressure of action. Moreover, they are in stark contrast to the usual 'top-down' approach employed in digital monitoring or interventions (Gulsrud et al., 2018: 165). The downside to these approaches is that they can be hard to evaluate (as is also the case of energy consumption practices or household activities – see Morganti et al., 2017; Johnson et al., 2017; Raven et al., 2021: 87), and may ultimately shirk moral questions associated with just transitions, in favour of purely instrumental relationships between domains and actions. For example, reducing issues of climate to personal time management, or consumption practices, or tourism. Awareness-raising at the individual level is important, but it is vital that the pressure of making transitions just, is applied to landowners, corporate leaders, and technologists.

GREENING CONSUMER BEHAVIOUR AND MAKING VIRTUAL FORESTS REAL

Building on examples of urban forest visualisations, there are initiatives aimed at changing consumer behaviour while aiding afforestation. Ant Forest is an initiative of Alipay, one of the world's most popular digital payment systems. Their app harnesses various 'gamification' affordances to 'nudge' users toward making greener consumption choices. This means game-like features (icons, progress indicators, leaderboards, real-time notifications), are used to encourage users to engage: earning material rewards for taking 'green' actions.

The app interface uses a tree illustration to visualise the steps taken by individuals to reduce their carbon footprint. Transactions through the wider Alipay system are monitored, with 'green energy points' awarded for supping with carbon-neutral business types (such as purchasing recycled products or shopping from home), utilising public transport, or cycling with share-bike services. These actions 'grow' the virtual tree, and allow for competition with others; to grow the largest tree. As users grow virtual trees, Alipay plants real trees as part of a reforestation programme. Users can also access satellite imagery of the real trees as they are planted.

The app has claims to significant user engagement; over 112,000 hectares of tree planting (and associated jobs – though these are not a foregrounded value proposition of the app), funded by the transactions of more than half a billion users (UNFCCC, 2020), and has received plaudits from the United Nations through its Global Climate Action Awards. While Ant Forest is China-based, and the reforestation only applies onshore, the app now has a global user base courtesy of Alipay's growing international acceptance. In addition, copycat programs such as the 'GCash' (Philippines) tree-planting initiative are also emerging, using systems relevant in local contexts.

Ant Forest has been explored in communications, economics, and behaviour change research. Focus group research suggests that the app successfully encourages behavioural shifts but that this may be tied to the passive accruing of points with only limited ways to actively participate, and thus may not remain as engaging in the long term (Chen and Cai, 2019). Behavioural research has noted that app use could be more strongly connected to knowledge, and ought to strengthen users' understanding of environment actions and outcomes to encourage longer term use of the platform (Ashfaq et al., 2021: 9-10). As the app relies on surveillance of personal financial transaction data, data privacy was a concern that moderated user attitudes to the platform (Ashfaq et al., 2021: 9). While Ant Forest is an isolated case, research using the app has also revealed only weak associations between the gratification associated with collective action (reciprocal behaviour and communal behaviour) and that of actions toward environmental protection (Mi et al., 2021: 9).

4.5.3 Possibilities

Just transitions in the technology space show the importance of thinking globally and locally. With mining of rare earth minerals, poor working conditions, global systems of trade, short product life cycles, and massive exchanges in user data underpinning most consumer technologies, it is vital that holistic perspectives be used, and that any developments consider end-to-end consequences.

There is an opportunity to enshrine green, equitable, consultative practices in all new technological infrastructure. Australian governments seek to use existing systems in smarter ways, but new technology can be created specifically with net-zero goals in mind. New data storage and cybersecurity technologies are prime examples of this, and already have substantial investment.

The role of the individual – as consumer, as citizen, and as technology user – must be considered in all future design. Profit motivations drive most technology multinationals, and Australia is just as reliant on these services as any western nation. Local governments and grassroots initiatives are leading the way in equitable design and data use, while Australia's strong consumer laws are primed for extensions that protect data sovereignty.

Policy in this space must be coherent with investment and make prospective - rather than nostalgic - decisions. The private sector drives much innovation in Australia, while government investments remain vexed: delaying some innovations for political reasons, while also making significant investments. Greater harmony is needed to achieve net-zero goals in a transparent, consultative, and just manner.

There is not a particularly 'Australian' manifestation of data use, technology enterprise, or consumer behaviour for decarbonisation. Australia's position on technology investment – which prioritises cheap short-term action, a resuscitated manufacturing identity, and a longer-term stance of 'watching' overseas developments – sits in tension with a recognition of the need for local innovation. There are many opportunities, and an emerging community groundswell, for the bridging of these tensions, and to accelerate just technology transitions.

Bibliography

ABC News. 2022. As household solar stresses the grid, WA and South Australia will have the power to turn it off. 14th February. Available at: www.abc.net.au/news/2022-02-14/household-solar-power-to-be-switched-off-to-prevent-overload/100820354

ABC News. 2021a. Electricity companies get green light to charge rooftop solar owners for exporting power to grid. 12th August. Available at: www.abc.net.au/news/2021-08-12/power-companies-to-charge-solar-owners-for-exporting-to-grid/100368588

ABC News (2021b) 'High-powered electric scooter trial to start in Melbourne and Ballarat "for something different"', 3 September. Available at: https://www.abc.net.au/news/2021-09-03/e-scooter-hire-trial-victoria/100429144 (Accessed: 17 December 2021).

ABC News. 2018. Modern homes trapping heat 'like a plastic bag'. Malcolm Sutton. 4th January. Available at: www.abc.net.au/news/2018-01-04/australian-houses-losing-in-heat-management-design/9287188 (Accessed: 10 February, 2022).

Abdilla, A. (2018). Beyond Imperial Tools: Future-Proofing Technology through Indigenous Governance and Traditional Knowledge Systems. In Decolonising the Digital: Technology As Cultural Practice, 67-81. Sydney: Tactical Space Lab. http://ojs.decolonising.digital/index.php/decolonising_digital/article/view/BeyondImperialTools.

Aboumahboub, T. et al. (2020) 'Decarbonization of Australia's Energy System: Integrated Modeling of the Transformation of Electricity, Transportation, and Industrial Sectors', Energies, 13(15), p.3805. doi:10.3390/en13153805.

ABS 2020, Australian System of National Accounts, 2019-20, Cat. no. 5204.0, Canberra.

ABS 2020, Education and Work, Australia, Cat. no. 6227.0, Canberra.

ABS. 2018. Census of Population and Housing: Estimating Homelessness, 2016. Australian Bureau of Statistics. Available at: www.abs.gov.au/statistics/people/housing/census-population-and-housing-estimating-homelessness/latest-release (Accessed: 2 February, 2022).

ABS. 2019. Housing occupancy and costs, 2017-18 financial year. Australian Bureau of Statistics. Available at: www.abs.gov.au/statistics/people/housing/housing-occupancy-and-costs/latest-release (Accessed: February 2, 2022).

ACOLA. 2021. Clarke, D., Baldwin, K., Baum, F., Godfrey, B., Richardson, S., and Robin, L. Australian Energy Transition Plan, Report for the Australian Council of Learned Academies (ACOLA), Available at: https://acola.org/energy-transition-research-plan/

ACT Government. (2019). ACT Climate Change Strategy 2019-25. p. 108. Available at: https://www.environment.act.gov.au/cc/act-climate-change-strategy

ACT Government. n.d. 'Next Generation Renewables Next Generation Energy Storage (Next Gen) Program'. Available at: www.environment.act.gov.au/energy/cleaner-energy/next-generation-renewables (Accessed: 2 February, 2022).

ACT Government. n.d. 'Sustainable Household Scheme'. Available at: www.climatechoices.act.gov.au/policy-programs/sustainable-household-scheme (Accessed: 2 February, 2022).

ACT Greens (n.d.) 'Just Transitions to a Zero Emissions Future'. Available at: https://greens.org.au/act/just-transition (Accessed: 2 February, 2022).

Actuaries Institute (2020) The Rise of the Gig Economy and its Impact on the Australian Workforce. Available At: https://actuaries.asn.au/Library/Opinion/2020/GPGIGECONOMYWEBtest.pdf (Accessed: 1 January, 2022).

Affolderbach, J., & Schulz, C. (2018). Green Building Transitions. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-77709-2

AIFS. 2021. Home ownership and Housing Tenure. Australian Institute of Family Studies. Available at: www.aihw.gov.au/reports/australias-welfare/home-ownership-and-housing-tenure (Accessed: February 2, 2022).

AIFS. n.d., Population and households. Australian Institute of Family Studies. Available at: www.aifs.gov.au/facts-and-figures/population-and-households (Accessed: February 2, 2022).

AIHW. 2021. Homelessness and homelessness services. Australian Institute of Health and Welfare. Available at: www.aihw.gov.au/reports/australias-welfare/homelessness-and-homelessness-services (Accessed: February 2, 2022).

Akhtar, A. (2019) 'More Uber and Lyft drivers are using the app to fit their schedules, but those who make it a full-time job are barely earning a livable wage', Business Insider, May 6th, https://www.businessinsider.in/More-Uber-and-Lyft-drivers-are-using-the-app-to-fit-their-schedules-but-those-who-make-it-a-full-time-job-are-barely-earning-a-livable-wage/articleshow/69206831.cms

Albanese, A. (2021). Rewiring the Nation. Available at: https://anthonyalbanese.com.au/our-policies/rewiring-the-nation

Alliaume, S. (2021). Decarbonisation in Australia: transitioning towards green Cloud. Atos https://atos.net/en/blog/decarbonisation-in-australia-transitioning-toward-green-cloud (Accessed: 17 January, 2021)

ALSO (2021). The future of data centres - trends and industry overview. ALSO - The Technology Provider. https://www.also.com/ec/cms5/en_6000/6000/blog/vlog/channel-insights/the-future-of-data-centres-trends-and-an-industry-overview.jsp (Accessed: 19 January, 2022)

Altman, J., Ansell, J,I & D. Yibarbuk (2020) 'No ordinary company: Arnhem Land Fire Abatement (Northern Territory) Limited', Postcolonial Studies, DOI: 10.1080/13688790.2020.1832428

American Council for an Energy Efficient Economy. 2018. Authors: Castro-Alvarez, F. Vaidyanathan, S. Bastian, H. & King, J. The 2018 International Energy Efficiency Scorecard. Available at: www.aceee.org/sites/default/files/publications/researchreports/i1801.pdf

AMSJ (2020) 'Mining fatality rate falls in 2020' Available At: https://www.amsj.com.au/mining-fatality-rate-falls-in-2020/ (Accessed: 12 December, 2021).

Anderson, M.J., Williamson, A.B., Fernando, P., Wright, D. and Redman, S. 2018. Housing conditions of urban households with Aboriginal children in NSW Australia: tenure type matters, BMC Public Health, 18(70), doi: 10.1186/s12889-017-4607-y

Ansell, J., & Evans, J., Adjumarllarl Rangers, Arafura Swamp Rangers, Djelk Rangers, Jawoyn Rangers, Mimal Rangers, Numbulwar Numburindi Rangers, Warddeken Rangers, Yirralka Rangers, and Yugul Mangi Rangers (2019). Contemporary Aboriginal savanna burning projects in Arnhem Land: a regional description and analysis of the fire management aspirations of Traditional Owners. International Journal of Wildland Fire, 29(5), 371-385. https://doi.org/10.1071/WF18152

Aratani, L. (2021, February 27). Electricity needed to mine Bitcoin is more than used by 'entire countries'. The Guardian. https://www.theguardian.com/technology/2021/feb/27/Bitcoin-mining-electricity-use-environmental-impact (Accessed: 11 December, 2021)

ARENA. 2017a. 'Demand Response Round - Funding details'. Available at: https://arena.gov.au/funding/demand-response-round/ (Accessed: 1 February, 2022).

ARENA. 2017b. 'Pooled Energy Demonstration Project'. Available at: https://arena.gov.au/projects/pooled-energy-demonstration-project/ (Accessed: 1 February, 2022).

ARENA. 2017c. 'Powershop Australia Demand Response Program'. Available at: https://arena.gov.au/projects/powershop-australia-demand-response-program/ (Accessed: 2 February, 2022).

ARENA. 2017d. 'Zen Ecosystems Demand Response'. Available at: https://arena.gov.au/projects/zen-ecosystems-demand-response/ (Accessed: 2 February, 2022).

ARENA. 2017e. 'My Energy Marketplace'. Available at: https://arena.gov.au/projects/wattwatchers-my-energy-marketplace/ (Accessed: 2 February, 2022).

ARENA. 2017f. 'Western Australia Distributed Energy Resources Orchestration Pilot'. Available at: https://arena.gov.au/projects/western-australia-distributed-energy-resources-orchestration-pilot/ (Accessed: 2 February, 2022).

ASBEC. 2008. The Second Plank – Building a Low Carbon Economy with Energy Efficient Buildings. Available at: https://www.asbec.asn.au/research-items/the-second-plank-building-a-low-carbon-economy-with-energy-efficient-buildings/

Ashfaq, M., Zhang, Q., Ali, F., Waheed, A., & Nawaz, S. (2021). You plant a virtual tree, we'll plant a real tree: Understanding users' adoption of the Ant Forest mobile gaming application from a behavioral reasoning theory perspective. Journal of Cleaner Production, 310, 127394. https://doi.org/10.1016/j.jclepro.2021.127394

Australia's 2030 emissions: States lead the way (2021). Climate Analytics. Available at: https://climateanalytics.org/publications/2021/australias-2030-emissions/ (Accessed: 2 December 2021).

Australia's Critical Minerals Strategy (2019). Commonwealth of Australia. Australia's National Hydrogen Strategy (2019). Commonwealth of Australia.

Australia's Road to Zero Transport Emissions (2020). PricewaterhouseCoopers. Available at: https://www.pwc.com.au/government/Australias-road-to-zero-transport-emissions_1.pdf.

Australia's Vehicle Fleet: Dirty and falling further behind (2019). Climate Analytics, p. 7. Available at: http://climateanalytics.org.

Australian Academy of Technology and Engineering (ATSE) (2021, November) Position statement: Australia's technology-led transition to net zero emissions. [Text]. https://www.atse.org.au/research-and-policy/publications/publication/australias-technology-led-transition-to-net-zero-emissions/ (Accessed: 12 January, 2022)

Australian Associated Press (2018) 'Foodora condemned for closing Australian operation during back pay dispute' Available At: https://www.theguardian.com/business/2018/aug/02/foodora-condemned-for-closing-australian-operation-during-back-pay-dispute (Accessed: 9 December, 2021).

Australian Bureau of Statistics (ABS) (2020c) Tourism Satellite Account: quarterly tourism labour statistics, Australia, experimental estimates (cat. no. 5249.0.55.005).)

Australian Bureau of Statistics (ABS), (2021), https://www.abs.gov.au/statistics/economy/national-accounts/australian-national-accounts-tourism-satellite-account/latest-release

Australian Centre of Excellence for Local Government (2012) Scoping Study: Impact of fly-in-fly-out/drive-in-drive-out work practices on local government. Available at: https://www.uts.edu.au/sites/default/files/1336624408_ACELG_Scoping_Study_FIFO_May_2012.pdf

Australian Competition and Consumer Commission (ACCC) (2020, June 18). Statement of Issues: Google LLC – proposed acquisition of Fitbit Inc. https://www.accc.gov.au/public-registers/mergers-registers/public-informal-merger-reviews/google-llc-proposed-acquisition-of-fitbit-inc (Accessed: 30 January, 2022)

Australian Competition and Consumer Commission (ACCC) (2021). News media bargaining code. https://www.accc.gov.au/focus-areas/digital-platforms/news-media-bargaining-code (Accessed: 30 January, 2022)

Australian Council of Learned Academics (2021) Australian Energy Transition Research Plan Available At: https://acola.org/australian-energy-transition_research-plan-2021/ (Accessed: 2 February 2021).

Australian Cyber Security Centre (ACSC) [Australian Government] (2021) ACSC Annual Cyber Threat Report 2020-21. https://www.cyber.gov.au/acsc/view-all-content/reports-and-statistics/acsc-annual-cyber-threat-report-2020-21 (Accessed: 17 January, 2022)

Australian Electric Vehicle Market Study (2018). Australian Renewable Energy Agency. Available at: https://arena.gov.au/knowledge-bank/australian-electric-vehicle-market-study/ (Accessed: 2 December 2021).

Australian Embassy in Tokyo (no date). Department of Foreign Affairs and Trade. Available at: https://japan.embassy.gov.au/tkyo/resources.html (Accessed: 17 December 2021).

Australian Energy Market Commission (AEMC). (2021). "Smart solar reforms will inject more clean energy into the grid." Available at: https://www.aemc.gov.au/news-centre/media-releases/smart-solar-reforms-will-inject-more-clean-energy-grid

Australian Energy Market Commission (AEMC). (n.d.). The new energy guide: Making solar, batteries and new energy technology work for everyone. https://new-energy-guide.aemc.gov.au/

Australian Energy Market Operator (AEMO) (2020). 2020 Integrated System Plan. https://aemo.com.au/-/media/files/major-publications/isp/2020/final-2020-integrated-system-plan.pdf?la=en&hash=6BCC72F9535B8E5715216F8ECDB4451C (Accessed: 18 January, 2021)

Australian Energy Market Operator (AEMO) (2021). AEMO Australian Energy Market Operator. https://aemo.com.au/ (Accessed: 18 January, 2021)

Australian Energy Regulator (AER). (2021). Annual retail markets report 2020–21. Available at: https://www.aer.gov.au/news-release/with-energy-debt-up-the-aer-calls-for-better-customer-hardship-support-from-retailers

Australian Government (2021) 'Funding for businesses to integrate their products and services into domestic and global value chains' Available At: https://business.gov.au/grants-and-programs/modern-manufacturing-initiative-manufacturing-integration (Accessed: 1 February, 2022).

Australian Human Rights Commission (2004) 'Age Discrimination', Available At: https://humanrights.gov.au/sites/default/files/GPGB_age_discrimination.pdf (Accessed: 1 January, 2022).

Australian Infrastructure Audit 2019 (2019). Infrastructure Australia. Available at: https://www.infrastructureaustralia.gov.au/publications/australian-infrastructure-audit-2019 (Accessed: 2 December 2021).

Australian Institute (2020) The Costs of Market Experiments: Electricity Consumers Pay the Price for Competition, Privatisation, Corporatisation and Marketization. Available at: https://australiainstitute.org.au/wp-content/uploads/2020/12/P470-Electricty-Consumers-Pay-the-Price-WEB.pdf

Australian Institute of Aboriginal and Torres Strait Islander Studies, The (AIATSIS) (2022). Map of Indigenous Australia. https://aiatsis.gov.au/explore/map-indigenous-australia (Accessed: 2 February, 2022)

Australian Local Government Association (ALGA) (2022). Address the Risks of Climate Change [Text]. https://alga.asn.au/policy-centre/climate-change/ (Accessed: 11 December, 2021)

Back of the pack: An assessment of Australia's energy transition (2021). The Australia Institute. Available at: https://australiainstitute.org.au/report/back-of-the-pack/.

Bamana, G., Miller, J. D., Young, S. L., & Dunn, J. B. (2021). Addressing the social life cycle inventory analysis data gap: Insights from a case study of cobalt mining in the Democratic Republic of the Congo. One Earth, 4(12), 1704–1714. https://doi.org/10.1016/j.oneear.2021.11.007

Banks, G. (2008) Industry Policy for A Productive Australia, Productivity Commission Chairman's Speech, Canberra. Available at: https://www.pc.gov.au/news-media/speeches/cs20080806

Barnes Hofmeister, T. and Stibe, A. (2017) 'Living mobility transitions towards bicycling. Designing practices through co-creation and socially influencing systems', The Design Journal, 20(sup1), pp. S3305–S3316. doi:10.1080/14606925.2017.1352834.

BBC (2021, July 15). Cambridge data shows Bitcoin mining on the move. BBC News. https://www.bbc.co.uk/news/technology-57811959 (Accessed: 11 December, 2021)

Beatley, T., & Newman, P. (2009). Green urbanism down under: Learning from sustainable communities in Australia. Washington, DC: Island Press.

Beck, E. (2019, July 9). On Country renewable energy partnership gets green light. ABC News. https://www.abc.net.au/news/2019-07-09/on-country-renewable-energy-gets-green-light/11292928

Beck, M. Hensher, D. 2020. Insights into the impact of COVID-19 on household travel and activities in Australia – The early days under restrictions, Transport Policy, Volume 96, pp. 76-93.

Becken, S., 2019. Decarbonising tourism: Mission impossible? Tourism Recreation Research, 44(4)

Beer, A. (2018) 'The closure of the Australian car manufacturing industry: Redundancy, policy and community impacts', Australian geographer, 49(3), pp. 419-438.

Begg, A., Copper, J., Bruce, A., MacGillivray, P. and Sproul, A. 2019. 'Investigating the thermal comfort of Aboriginal Housing in Walgett and opportunities for improvement' Asia-Pacific Solar Research Conference. Australian National University: Canberra, 3-5 December.

Bell, P. 2002. A History of the Queensland House, Historical Research.

Bell, S. E., Daggett, C., & Labuski, C. (2020). Toward feminist energy systems: Why adding women and solar panels is not enough. Energy Research & Social Science, 68, 101557. https://doi.org/10.1016/j.erss.2020.101557

Benoît, C., Norris, G. A., Valdivia, S., Ciroth, A., Moberg, A., Bos, U., … Beck, T. (2010). The guidelines for social life cycle assessment of products: Just in time! The International Journal of Life Cycle Assessment, 15(2), 156–163. https://doi.org/10.1007/s11367-009-0147-8

Bergman, R., Saunders, R. and Kieltyka, C. (2021). How Australian utilities can strengthen utilities ahead of regulatory changes", Ernst and Young. https://www.ey.com/en_au/power-utilities/how-australian-utilities-can-strengthen-cybersecurity-ahead-of-regulatory-changes (Accessed: 19 January, 2021)

Bertolini, L. (2020) 'From "streets for traffic" to "streets for people": can street experiments transform urban mobility?', Transport Reviews, 40(6), pp. 734–753. doi:10.1080/01441647.2020.1761907.

Best, R., Chareunsy, A., & Li, H. (2021b). Equity and effectiveness of Australian small-scale solar schemes. Ecological Economics, 180, 106890. https://doi.org/10.1016/j.ecolecon.2020.106890

Best, R., Esplin, R., Hammerle, M., Nepal, R., & Reynolds, Z. (2021a). Do solar panels increase housing rents in Australia? Housing Studies, 1–18. https://doi.org/10.1080/02673037.2021.2004094

Beyond Zero Emissions (BZE). (2015). Renewable Energy Superpower. Available at: https://bze.org.au/research_release/renewable-energy-superpower/

Biofuels and Transport: An Australian opportunity (2019). Australian Renewable Energy Agency. Available at: https://arena.gov.au/knowledge-bank/biofuels-and-transport-an-australian-opportunity/(Accessed: 2 December 2021).

Birtchnell, T., Harada, T. and Waitt, G. (2018) 'On the verge of change: Maverick innovation with mobility scooters', Environmental Innovation and Societal Transitions, 27, pp. 118–128. doi:10.1016/j.eist.2017.11.002.

Bissell, D., & Gorman- Murray, A. (2019). Disoriented geographies: Undoing relations, encountering limits. Transactions of the Institute of British Geographers, 44(4), 707-720. https://doi.org/10.1111/tran.12307

Bissell, D. (2021). Encountering automation: Redefining bodies through stories of technological change. Environment and Planning D: Society and Space, 39(2), 366-384. https://doi.org/10.1177/0263775820963128

Bissell, D. (2021). Affective life of financial loss: Detaching from lost investments in the wake of the gig economy. Environment and Planning A: Economy and Space, https://doi.org/10.1177/0308518X211052054

Bloomberg.Com (2019) 'Life-Saving Lessons From the Other Dutch Bike Mecca', 5 July. Available at: https://www.bloomberg.com/news/articles/2019-07-05/how-the-dutch-made-utrecht-a-bicycle-first-city (Accessed: 16 December 2021).

Blum, A. (2012). Tubes: A journey to the center of the Internet. New York: Ecco.

Bouzarovski, S., & Simcock, N. (2017). Spatializing energy justice. Energy Policy, 107, 640–648. https://doi.org/10.1016/j.enpol.2017.03.064

Braithwaite, V. (2020). Beyond the bubble that is Robodebt: How governments that lose integrity threaten democracy. Australian Journal of Social Issues, 55(3), 242–259. https://doi.org/10.1002/ajs4.122

Briggs, C., M. Hemer, P. Howard, R. Langdon, P. Marsh, S. Teske and D. Carrascosa (2021). Offshore Wind Energy in Australia: Blue Economy Cooperative Research Centre, Launceston, TAS. Available at: https://blueeconomycrc.com.au/projects/offshore-wind-potential-australia/

Broadbent, G.H., Metternicht, G. and Drozdzewski, D. (2019) 'An Analysis of Consumer Incentives in Support of Electric Vehicle Uptake: An Australian Case Study', World Electric Vehicle Journal, 10(1), p. 11. doi:10.3390/wevj10010011.

Brook, B. (2019) 'Glaring omission in new $20b rail line', news.com.au — Australia's leading news site, 22 October. Available at: https://www.news.com.au/finance/economy/australian-economy/lack-of-stations-on-20b-sydney-metro-west-rail-line-questioned/news-story/8c88efe8c1b955e7687c7aaf54250f8c (Accessed: 17 December 2021).

Brouder, P., Teoh, S., Salazar, N.B., Mostafanezhad, M., Pung, J.M., Lapointe, D., Higgins Desbiolles, F., Haywood, M., Hall, C.M. and Clausen, H.B., 2020. Reflections and discussions: tourism matters in the new normal post COVID-19. Tourism Geographies, 22(3), pp.735-746. https://doi.org/10.1080/14616688.2020.1770325

Brown, V. et al. (2019) 'Better transport accessibility, better health: a health economic impact assessment study for Melbourne, Australia', International Journal of Behavioral Nutrition and Physical Activity, 16(1), pp. 1–10. doi:10.1186/s12966-019-0853-y.

BTC Mine Australia (2021). Mining Cryptocurrency - Australia's Bitcoin Mining. BTC Mine. https://www.btcmine.com.au/ (Accessed: 10 December, 2021)

Building 4.0CRC (n.d.) 'Home' Available At: https://building4pointzero.org (Accessed: 1 February, 2022).

Bulkeley, H., Edwards, G. A. S., & Fuller, S. (2014). Contesting climate justice in the city: Examining politics and practice in urban climate change experiments. Global Environmental Change, 25, 31–40. https://doi.org/10.1016/j.gloenvcha.2014.01.009

Burin, M. (2018, December 12). People from all over the world are sending emails to Melbourne's trees [Text]. https://www.abc.net.au/news/2018-12-12/people-are-emailing-trees/10468964 (Accessed: 15 January, 2022)

California: Plug-Ins Capture Almost 11% Of The Market In Q1 2021 (no date) InsideEVs. Available at: https://insideevs.com/news/516906/california-plugin-car-sales-2021q1/ (Accessed: 16 December 2021).

Cant, C. (2019) Riding for Deliveroo: Resistance in the New Economy. Cambridge: Polity.

Carabott, M. (2021). Bitcoin Mining in Australia – Solving the Energy Problem. Leading Energy. [Blog]. https://www.leadingedgeenergy.com.au/blog/Bitcoin-mining-in-australia-solving-energy-problem-with-demand-response/ (Accessed: 10 December, 2021)

Carbon dioxide emissions intensity for new Australian light vehicles (2020). National Transport Commission (NTC). Available at: https://www.ntc.gov.au/sites/default/files/assets/files/Carbon%20dioxide%20emissions%20intensity%20for%20new%20Australian%20light%20vehicles%202020.pdf.

Centre for Appropriate Technology (CfAT). (2014). Reliable power a spring board to enterprise success – a Kimberley case study. https://cfat.org.au/renewable-energy-supporting-enterprise

Centre for Appropriate Technology (CfAT). (2011). Bushlight's Community Energy Planning Model. Available at https://static1.squarespace.com/static/5450868fe4b09b217330bb42/t/547530a6e4b08b6cd903ce41/1416966310958/Community-Energy-Planning-Model-Booklet-2011-web.pdf

Chandrashekeran, S. (2021). Rent and reparation: How the law shapes Indigenous opportunities from large renewable energy projects. Local Environment, 26(3), 379–396. https://doi.org/10.1080/13549839.2020.1861590

Chandrashekeran, S. (2020). From responsibilization to responsiveness through metrics: Smart meter deployment in Australia. Geoforum, 116, 110–118. https://doi.org/10.1016/j.geoforum.2020.07.014

Charmes J. 2019. The Unpaid Care Work and the Labour Market. An analysis of time use data based on the latest world compilation of time-use surveys. Geneva: International Labour Office. https://www.ilo.org/gender/Informationresources/Publications/WCMS_732791/lang--en/index.htm

Chen, Y., & Cai, D. (2019). Ant Forest through the haze: A case study of gamified participatory pro-environmental communication in china. J, 2(4), 467–479. https://doi.org/10.3390/j2040030

Chestney, N. (2020). Australia moves into top three countries for renewable energy investment: research. Reuters. https://www.reuters.com/article/us-renewables-ranking-idUSKBN2840HV (Accessed: 17 January, 2022)

Clean Energy Council. n.d. A Clean Recovery. Available at: https://assets.cleanenergycouncil.org.au/documents/advocacy-initiatives/A-Clean-Recovery_infographic.pdf

Clean Energy Council. n.d. Energy storage. Available at: www.cleanenergycouncil.org.au/resources/technologies/energy-storage (Accessed: 2 February, 2022).

Clean Energy Regulator (CER). (2018). About the Renewable Energy Target. http://www.cleanenergyregulator.gov.au/RET/About-the-Renewable-Energy-Target

Climate Council (2021) Three ways battery storage is already decarbonising Australia: cars, homes, and grids. Available at: https://www.climatecouncil.org.au/resources/battery-storage-batteries-decarbonising-australia-cars-homes-grid/ (Accessed: 15 December 2021).

Climate Council. (2020). What are renewable energy zones? Available at: https://www.climatecouncil.org.au/resources/what-is-renewable-energy-zone/

ClimateWorks Australia. (2021a). State and territory climate action: Leading policies and programs in Australia. Available at: https://www.climateworksaustralia.org/resource/state-and-territory-climate-action-leading-policies-and-programs-in-australia/

ClimateWorks Australia. 2021b. Cities in Australia are a major cause of emissions – but they can be a part of the climate solution, too. Margot Delafoulhouze. Available at: www.climateworksaustralia.org/news/cities-in-australia-are-a-major-cause-of-emissions-but-they-can-be-a-part-of-the-climate-solution-too/ (Accessed: 10 February, 2022).

Cloudscene (2021). Colocation & Interconnection Industry Global Search. Cloudscene. https://discover.cloudscene.com/search/markets (Accessed: 19 January, 2022)

Coenen, L., & Morgan, K. (2020). Evolving geographies of innovation: Existing paradigms, critiques and possible alternatives. Norsk Geografisk Tidsskrift - Norwegian Journal of Geography, 74(1), 13–24. https://doi.org/10.1080/00291951.2019.1692065

Colvin, R.M. (2020) 'Social identity in the energy transition: an analysis of the "Stop Adani Convoy" to explore social-political conflict in Australia', Energy Research & Social Science, 66, p. 101492. doi:10.1016/j.erss.2020.101492.

Commonwealth of Australia (2017) Carbon Credits (Carbon Farming Initiative—Emissions Abatement through Savanna Fire Management) Methodology Determination 2015. https://www.legislation.gov.au/Series/F2015L00344

Commonwealth of Australia (2018) Select Committee on the Future of Work and Workers: Hope is not a strategy – our shared responsibility for the future of work and workers. Available At: https://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Future_of_Work_and_Workers/FutureofWork/Report (Accessed: January 1 2022).

Commonwealth of Australia [Australian Government] (2022). Data centres. Department of Industry, Science, Energy and Resources. https://www.energy.gov.au/business/equipment-and-technology-guides/data-centres (Accessed: 20 January, 2022)

Commonwealth of Australia [Australian Government] (2019). Delivering for Australians - A world-class Australian Public Service: The Government's APS reform agenda. Department of the Prime Minister and Cabinet: Canberra. from https://www.pmc.gov.au/sites/default/files/publications/delivering-for-australians.pdf (Accessed: January 26, 2022)

Commonwealth of Australia [Australian Government] (2020b) Technology Investment Roadmap - First Low Emissions Technology Statement. https://www.industry.gov.au/data-and-publications/technology-investment-roadmap-first-low-emissions-technology-statement-2020 (Accessed: 30 January, 2022)

Commonwealth of Australia [Australian Government] (2021a). Blueprint for critical technologies: The Australian Government's framework for capitalising on critical technologies to drive a technologically-advanced, future-ready nation. Critical Technologies Policy Coordination Office, Department of the Prime Minister and Cabinet: Canberra. https://apo.org.au/sites/default/files/resource-files/2021-11/apo-nid315199.pdf (Accessed: 26 January, 2022)

Commonwealth of Australia [Australian Government] (2021b). Low Emissions Technology Statement. https://www.industry.gov.au/sites/default/files/November%202021/document/low-emissions-technology-statement-2021.pdf (Accessed: 30 January, 2022)

Commonwealth of Australia [Australian Government] (2021d). Australian Data Strategy: The Australian Government's whole-of-economy vision for data. Department of the Prime Minister and Cabinet: Canberra. https://apo.org.au/sites/default/files/resource-files/2021-12/apo-nid316241.pdf (Accessed: 3 February, 2022)

Commonwealth of Australia [Australian Government] Australian Data and Digital Council (ADDC) (2020a) State of the Data and Digital Nation. Department of the Prime Minister and Cabinet: Canberra. https://pmc.gov.au/sites/default/files/publications/state-data-digital-nation.pdf (Accessed: 26 January, 2022)

Commonwealth of Australia [Australian Government] Digital Transformation Agency (DTA) (2021c). Digital Government Strategy. https://www.dta.gov.au/sites/default/files/2021-11/Digital%20Government%20Strategy_acc.pdf (Accessed: 30 January, 2022)

Consumer Action Law Centre (CALC). (2019). Energy Assistance Report: Tracking how Victoria's changing energy policies are impacting households in the state. Available at: https://consumeraction.org.au/energy-assistance-report/

Cox, L. (2021) 'Victoria's electric vehicle tax faces high court challenge', The Guardian, 16 September. Available at: https://www.theguardian.com/environment/2021/sep/16/victorias-electric-vehicle-tax-faces-high-court-challenge (Accessed: 2 December 2021).

Coy, D., Malekpour, S., Saeri, A. K., & Dargaville, R. (2021). Rethinking community empowerment in the energy transformation: A critical review of the definitions, drivers and outcomes. Energy Research & Social Science, 72, 101871. https://doi.org/10.1016/j.erss.2020.101871

Coy, D., Dargaville, R., & Malekpour, S. (2020, October 13). People power: everyday Australians are building their own renewables projects, and you can too. The Conversation. https://theconversation.com/people-power-everyday-australians-are-building-their-own-renewables-projects-and-you-can-too-146885

Crocker, E., Condon, B., Almsaeed, A., Jarret, B., Nelson, C. D., Abbott, A. G., Main, D., & Staton, M. (2020). TreeSnap: A citizen science app connecting tree enthusiasts and forest scientists. Plants, People, Planet, 2(1), 47–52. https://doi.org/10.1002/ppp3.41

CSIRO (2021a). About - CSIRO. CSIRO. [Text] https://www.csiro.au/en/About (Accessed: 27 January, 2022)

CSIRO (2021b). Home - Data61. Data61. [Text] Retrieved January 27, 2022, from Data61 website https://data61.csiro.au/

CSIRO. (2021, May 13). Australia installs record-breaking number of rooftop solar panels [Press Release]. https://www.csiro.au/en/news/news-releases/2021/australia-installs-record-breaking-number-of-rooftop-solar-panels

Cummins, R., Mead, R., Hutchinson, D., Capic, T., Khor, S., Olsson, C., Fuller-Tyszkiewicz, M., Stamatescu, M., Little, J., & Falkingham, W. 2021. The Australian Unity Wellbeing Index 20th Anniversary Commemorative Edition. Australian Unity and Deakin University, Melbourne. Available at: www.acqol.com.au/uploads/surveys/20yr-anniversary-report.pdf (Accessed: 10 February, 2022).

Currie, G. (2010). Quantifying spatial gaps in public transport supply based on social needs. Journal of Transport Geography, 18(1), 31-41."

Currie, G. (2004). Gap analysis of public transport needs: measuring spatial distribution of public transport needs and identifying gaps in the quality of public transport provision. Transportation Research Record, 1895(1), 137-146.

CutlerMerz. (2020). Social Licence for Control of Distributed Energy Resources: Final Report. Energy Consumers Australia. Available at: https://energyconsumersaustralia.com.au/publications/social-licence-for-control-of-distributed-energy-resources

D'Ambrosio, L. (2021, July 7). Traditional Owners Empowered to a Clean Energy Future [Press Release]. https://www.premier.vic.gov.au/traditional-owners-empowered-clean-energy-future

Dahlgren, K., Pink, S., Strengers, Y., Nicholls, L. and Sadowski, J. 2021. Personalization and the Smart Home: questioning techno-hedonist imaginaries. Convergence, 27(5), pp.1155-1169.

Dahlgren, K., Strengers, Y., Pink, S., Nicholls, L. & Sadowski, J. 2020. Digital energy futures: review of industry trends, visions and scenarios for the home. Available at: www.monash.edu/__data/assets/pdf_file/0008/2242754/Digital-Energy-Futures-Report.pdf

Dahlgren, Kari (2019) Digging deeper: precarious futures in two Australian coal mining towns. PhD thesis, London School of Economics and Political Science.

Daigle, B. (2021) Data Centers Around the World: A Quick Look. [Text]. https://www.usitc.gov/publications/332/executive_briefings/ebot_data_centers_around_the_world.pdf (Accessed: 19 January 2022)

Daniel, L. Moore, T. Baker, E. Beer, A. Willand, N. Horne, R. & Hamilton, C. 2020. Warm, cool and energy-affordable housing policy solutions for low-income renters, AHURI Final Report No. 338, Australian Housing and Urban Research Institute Limited, Melbourne, Available at: www.ahuri.edu.au/research/final-reports/338 doi:10.18408/ahuri-3122801

Darebin City Council. (2017) Darebin Climate Emergency Plan 2017-2022. Available at: https://www.darebin.vic.gov.au/Waste-and-environment/Sustainable-Darebin/Energy-and-climate/How-Council-is-addressing-the-climate-emergency

Davie, M. (2022) Blood cobalt. ABC News, February 24. Available at: https://www.abc.net.au/news/2022-02-24/cobalt-mining-in-the-congo-green-energy/100802588

Dawda, S., Herath, C. and MacColl, J. (2022). Security a Net-Zero Future: Cyber Risks to the Energy Transition. RUSI Emerging Insights Paper, 1-27. https://rusi.org/explore-our-research/publications/emerging-insights/securing-net-zero-future-cyber-risks-energy-transition.

de Kleyn, L., Mumaw, L., & Corney, H. (2020). From green spaces to vital places: Connection and expression in urban greening. Australian Geographer, 51(2), 205–219. https://doi.org/10.1080/00049182.2019.1686195

Decarbonisation Futures: Solutions, actions and benchmarks for a net zero emissionsAustralia (2020). ClimateWorks Australia. Available at: https://www.climateworksaustralia.org/resource/decarbonisation-futures-solutions-actions-and-benchmarks-for-a-net-zero-emissions-australia/ (Accessed: 2 December 2021).

Delbosc, A. and Naznin, F. (2019) 'Future life course and mobility: A latent class analysis of young adults in Victoria, Australia', Transport Policy, 77, pp. 104–116. doi:10.1016/j.tranpol.2019.03.005.

Deloitte Access Economics. (2020). A new choice: Australia's climate for growth. p. 24. Available at: https://www2.deloitte.com/content/dam/Deloitte/au/Documents/Economics/deloitte-au-dae-new-choice-climate-growth-051120.pdf?nc=1 (Accessed: 1 February, 2022).

Department of Environment, Land, Water and Planning (2021) Victoria's zero emissions vehicle roadmap. Available at: https://nla.gov.au/nla.obj-2965150778 (Accessed: 2 December 2021).

Department of Foreign Affairs and Trade (2020) Trade and investment at a glance 2020. Available At: https://www.dfat.gov.au/publications/trade-and-investment/trade-and-investment-glance-2020#australias-trade-balance (Accessed: 1 February, 2022).

Department of Industry, Science, Energy and Resources (2015) Mechanical Boon: will automation advance Australia?. Available At: https://www.industry.gov.au/data-and-publications/staff-research-papers/mechanical-boon-will-automation-advance-australia (Accessed: 2 February, 2022).

Department of Industry, Science, Energy and Resources (2019) Coal in India 2019. Available At: https://www.industry.gov.au/data-and-publications/coal-in-india-2019-report (Accessed: 1 February, 2022).

Department of Industry, Science, Energy and Resources (2020) Australia's National Resources Statement Available At: https://www.industry.gov.au/data-and-publications/australias-national-resources-statement/australias-national-resources-statement (Accessed: 1 February 2022).

Department of Industry, Science, Energy and Resources (2020) National Greenhouse Gas Inventory Quarterly Update: September 2020 Available At: https://www.industry.gov.au/data-and-publications/national-greenhouse-gas-inventory-quarterly-update-september-2020 (Accessed: 2 February, 2022).

Department of Industry, Science, Energy and Resources (2021a) Australia's Long-Term Emissions Reduction Plan. Text. Department of Industry, Science, Energy and Resources. Available at: https://www.industry.gov.au/data-and-publications/australias-long-term-emissions-reduction-plan (Accessed: 2 December 2021).

Department of Industry, Science, Energy and Resources (2021b) Future Fuels and Vehicles Strategy. Text. Department of Industry, Science, Energy and Resources. Available at: https://www.industry.gov.au/data-and-publications/future-fuels-and-vehicles-strategy (Accessed: 2 December 2021).

Department of Industry, Science, Energy and Resources (DISER). (2022a). Australian energy production - fuel type. https://www.energy.gov.au/data/australian-energy-production-fuel-type

Department of Industry, Science, Energy and Resources (DISER). (2022b). Renewables. https://www.energy.gov.au/data/renewables

Department of Industry, Science, Energy and Resources (DISER). (2022c). Australian energy mix, state and territory 2019-20. https://www.energy.gov.au/data/australian-energy-mix-state-and-territory-2019-20

Department of Industry, Science, Energy and Resources (DISER). (2021a). National Greenhouse Gas Inventory Quarterly Update: June 2021. https://www.industry.gov.au/data-and-publications/national-greenhouse-gas-inventory-quarterly-update-june-2021

Department of Industry, Science, Energy and Resources (DISER). (2021b). Australia's Long-Term Emissions Reduction Plan. Available at: https://www.industry.gov.au/data-and-publications/australias-long-term-emissions-reduction-plan

Department of Industry, Science, Energy and Resources (DISER). (2019). A fair deal on energy. Available at: https://www.energy.gov.au/publications/fair-deal-energy

Department of Industry, Science, Energy and Resources (DISER). (n.d.). Price safety net. https://www.energy.gov.au/government-priorities/energy-programs/price-safety-net

Department of Parliamentary Services (2021) Employment by industry statistics: a quick guide Available At: https://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/pubs/rp/rp2021/Quick_Guides/EmployIndustry (Accessed: 2 February, 2022).

Derndorfer, J., Disslbacher, F., Lechinger, V., Mader, K. & Six, E. 2021. 'Home, sweet home? The impact of working from home on the division of unpaid work during the COVID-19 lockdown', PLOS ONE, doi: 10.1371/journal.pone.0259580

Dodson, J. et al. (2021) 'Innovative responses to urban transportation: current practice in Australian cities', AHURI Final Report [Preprint], (360). doi:10.18408/ahuri53231.

Dominish, E., Florin, N. and Teske, S. (2019). Responsible Minerals Sourcing for Renewable Energy. Report prepared for Earthworks by the Institute for Sustainable Futures, University of Technology Sydney. Available at: https://www.uts.edu.au/isf/explore-research/projects/responsible-minerals-sourcing-renewable-energy

Dowling, R., & Kent, J. (2015). Practice and public–private partnerships in sustainable transport governance: The case of car sharing in Sydney, Australia. Transport Policy, 40, 58–64. https://doi.org/10.1016/j.tranpol.2015.02.007

Doyon, A., Boron, J., & Williams, S. (2021). Unsettling transitions: Representing Indigenous peoples and knowledge in transitions research. Energy Research & Social Science, 81, 102255. https://doi.org/10.1016/j.erss.2021.102255

Druce, A. (2021) 'E-scooter chaos forces city to act', news.com.au — Australia's leading news site, 24 November. Available at: https://www.news.com.au/technology/motoring/on-the-road/spike-in-serious-escooter-crashes-forces-brisbane-to-clamp-down/news-story/a1a7106fb4392e1d896eec5ea5586774(Accessed: 1 7 December 2021).

Dubois, A. and Carson, D., 2020. Sustainable agriculture and multifunctionality in South Australia's Mid North region. Australian Geographer, 51(4), pp.509-534. https://doi.org/10.1080/00049182.2020.1813960

DUG. 2021. "World's first carbon-free data centre planned for takeoff in regional Western Australia", (https://dug.com/worlds-first-carbon-free-data-centre-planned-for-takeoff-in-regional-western-australia/), (accessed: 10 February 2022).

Duffy, M., & Whyte, S. (2017) 'The Latrobe Valley: The politics of loss and hope in a region of transition', The Australasian Journal of Regional Studies, 23(3), pp. 421-446.

Duncan, A., Kiely, D., Mavisakalyan, A., Peters, A., Seymour, R., Twomey, C. & Vu, L. 2021. Stronger Together: Loneliness and social connectedness in Australia, Bankwest Curtin Economics Centre Focus on the States Series, #8, November 2021. Available at: https://bcec.edu.au/assets/2021/11/139532_BCEC-Stronger-Together-report_WEB.pdf (Accessed: 10 February, 2022).

Dunleavy, P., Margetts, H., Bastow, S., & Tinkler, J. (2008). Australian e-Government in comparative perspective. Australian Journal of Political Science, 43(1), 13–26. https://doi.org/10.1080/10361140701842540

Electric Vehicle Council. 2021. State of Electric Vehicles. Available at: www.electricvehiclecouncil.com.au/wp-content/uploads/2021/08/EVC-State-of-EVs-2021-sm.pdf (Accessed: 10 February, 2022).

Energy Consumers Australia (ECA) and KPMG. (2021). Australia's Energy Transition: A Snapshot of the Changing Policy Landscape. Available at: https://energyconsumersaustralia.com.au/publications/australias-energy-transition-a-snapshot-of-the-changing-policy-landscape

Energy Consumers Australia (ECA). (2020). Power Shift: Final Report. Available at: https://energyconsumersaustralia.com.au/publications/power-shift-final-report

Energy Matters. (2021, August 16). Why Solar Owners Shouldn't Panic About the "Sun Tax." https://www.energymatters.com.au/renewable-news/why-solar-owners-shouldnt-panic-about-the-sun-tax/

Ernst and Young, 2021 How can Australia's agriculture sector realise opportunity in a low emissions future? Farmers for Climate Action. Available at: https://farmersforclimateaction.org.au/wp-content/uploads/2021/09/FCA-EY-FINAL-Report-Low-emissions-future-for-Agriculture.pdf

Fairwork Commission (2021) 'Franco v Deliveroo Australia Judgement'. Available At: https://www.fwc.gov.au/documents/decisionssigned/html/2021fwc2818.htm (accessed: 1 January, 2022).

Fairwork Ombudsman (2018) '$216,700 in penalties after Pizza Hut franchisee engages in sham contracting', [Press Release] Available At: https://www.fairwork.gov.au/newsroom/media-releases/2018-media-releases/june-2018/20180615-skyter-penalty (Accessed: 5 January, 2022).

Farbotko, C. & Waitt, G. 2011. Residential air-conditioning and climate change: voices of the vulnerable. Health Promotion International, 22(4):13-16. PMID: 22518913.

Federal Labor Party. (2021). Powering Australia Plan. Available at: https://anthonyalbanese.com.au/our-policies/powering-australia

Fell, L., 2020. Trust and COVID-19: Implications for interpersonal, workplace, institutional, and information-based trust. Digital Government: Research and Practice, 2(1), pp.1-5. https://doi.org/10.1145/3428472

Fennell, M. (2021). Indigenous start-ups talk country, culture and health. Download This Show. [Radio Interview]. Sydney, Australia: ABC Radio National. https://www.abc.net.au/radionational/programs/downloadthisshow/indigenous-start-ups-talk-country,-culture-and-health/13435032 (Accessed: 1 February, 2022)

Field, C. and Jon, I. (2021) 'E-Scooters: A New Smart Mobility Option? The Case of Brisbane, Australia', Planning Theory & Practice, 22(3), pp. 368–396. doi:10.1080/14649357.2021.1919746.

Foong, D. Mitchell, P. Wagstaff, N. Duncan, E. & McManus, P. 2017. Transitioning to a more sustainable residential built environment in Sydney? Geo. 4(1) pp. 1-11. https://doi.org/10.1002/geo2.33

Forti V., Baldé C.P., Kuehr R., Bel G. (2020) The Global E-waste Monitor 2020: Quantities, flows and the circular economy potential. United Nations University (UNU)/United Nations Institute for Training and Research (UNITAR) – co-hosted SCYCLE Programme, International Telecommunication Union (ITU) & International Solid Waste Association (ISWA), Bonn/Geneva/Rotterdam.

Friedman, A., & Byron, J. (2012) High-tech, high-touch, and manufacturing's triple bottom line. Innovations: Technology, Governance, Globalization, 7(3), 83-95. https://doi.org/10.1162/INOV_a_00141

Future Cities (2018). Infrastructure Australia. Available at: https://www.infrastructureaustralia.gov.au/sites/default/files/2019-06/future-cities-paper-web.pdf.

Gabrys, J. (2016). Practicing, materialising and contesting environmental data. Big Data & Society, 3(2), 205395171667339. https://doi.org/10.1177/2053951716673391

Gabrys, J. (2020). Smart forests and data practices: From the Internet of Trees to planetary governance. Big Data & Society, 7(1), 205395172090487. https://doi.org/10.1177/2053951720904871

Gardner, N., Cui, J. and Coiacetto, E. (2017) 'Harassment on public transport and its impacts on women's travel behaviour', Australian Planner, 54(1), pp. 8–15. doi:10.1080/07293682.2017.1299189.

Garnaut, R. (2019). Superpower: Australia's Low-Carbon Opportunity. La Trobe University Press.

Geddes, A., Schmidt, T. S., & Steffen, B. (2018). The multiple roles of state investment banks in low-carbon energy finance: An analysis of Australia, the UK and Germany. Energy Policy, 115, 158–170. https://doi.org/10.1016/j.enpol.2018.01.009

Geels, F. W. (2002). Technological transitions as evolutionary reconfiguration processes: A multi-level perspective and a case-study. Research Policy, 31(8–9), 1257–1274. https://doi.org/10.1016/j.joule.2017.09.018

Geels, F.W., Sovacool, B.K., Schwanen, T. and Sorrell, S., 2017. The socio-technical dynamics of low-carbon transitions. Joule, 1(3), pp.463-479. https://doi.org/10.1016/j.joule.2017.09.018

Gill, N., Osman, P., Head, L., Voyer, M., Harada, T., Waitt, G., & Gibson, C. (2015). Looking beyond installation: Why households struggle to make the most of solar hot water systems. Energy Policy, 87, 83-94. https://doi.org/10.1016/j.enpol.2015.08.038

Gkritsi, E. (2021) Australia Set for Massive Shakeup to Crypto Regulations: Treasurer. Coindesk. https://www.coindesk.com/policy/2021/12/08/australia-set-for-massive-shakeup-to-crypto-regulations-treasurer/ (Accessed: 11 December, 2021)

Global Covenant of Mayors for Climate and Energy (GCoM). (2021). The Multilevel Climate Action Playbook for Local and Regional Governments. Available at: https://www.globalcovenantofmayors.org/press/the-multilevel-climate-action-playbook-for-local-and-regional-governments/

Godden, L. (2020). Energy Justice and Energy Transition in Australia: From Remote Access to Consumer Protection. In L. Godden, Energy Justice and Energy Law (pp. 178–200). Oxford University Press. https://doi.org/10.1093/oso/9780198860754.003.0011

Gong, S., Ardeshiri, A. and Hossein Rashidi, T. (2020) 'Impact of government incentives on the market penetration of electric vehicles in Australia', Transportation Research Part D: Transport and Environment, 83, p. 102353. doi:10.1016/j.trd.2020.102353.

Gosnell, H., Charnley, S. and Stanley, P., 2020. Climate change mitigation as a co-benefit of regenerative ranching: insights from Australia and the United States. Interface focus, 10(5), https://doi.org/10.1098/rsfs.2020.0027

Gosnell, H., Gill, N. and Voyer, M., 2019. Transformational adaptation on the farm: processes of change and persistence in transitions to 'climate-smart' regenerative agriculture. Global Environmental Change, 59, p.101965. https://doi.org/10.1016/j.gloenvcha.2019.101965

Gössling, S. and Scott, D. (2018) The decarbonisation impasse: Global tourism leaders' views on climate change mitigation. Journal of Sustainable Tourism, 26(12), pp.2071-2086. https://doi.org/10.1016/j.gloenvcha.2019.101965

Gössling, S., Peeters, P., Ceron, J.P., Dubois, G., Patterson, T. and Richardson, R.B. (2005) The eco-efficiency of tourism. Ecological economics, 54(4), pp.417-434. https://doi.org/10.1016/j.ecolecon.2004.10.006

Government of Western Australia. (2021). Household electricity pricing. Available at: https://www.wa.gov.au/organisation/energy-policy-wa/household-electricity-pricing

Government takes historic step towards net-zero with end of sale of new petrol and diesel cars by 2030 (no date) GOV.UK. Available at: https://www.gov.uk/government/news/government-takes-historic-step-towards-net-zero-with-end-of-sale-of-new-petrol-and-diesel-cars-by-2030 (Accessed: 15 December 2021).

Gram-Hanssen, K. 2007. Teenage consumption of cleanliness: how to make it sustainable? Sustainability: Science, Practice & Policy, 3(2):1-9. https://doi.org/10.1080/15487733.2007.11907998

Green Buildings Council of Australia (2021) Embodied Carbon & Embodied Energy in Australia's Buildings Available At: https://new.gbca.org.au/news/gbca-news/gbca-and-thinkstep-release-embodied-carbon-report/ (Accessed: 1 February 2022).

Greenpeace. (2022). The Green Electricity Guide. Available at: https://www.greenelectricityguide.org.au/report

Guia, J., 2021. Conceptualizing justice tourism and the promise of posthumanism. Journal of Sustainable Tourism, 29(2-3), pp.503-520. https://doi.org/10.1080/09669582.2020.1771347

Gulsrud, N. M., Hertzog, K., & Shears, I. (2018). Innovative urban forestry governance in Melbourne?: Investigating "green placemaking" as a nature-based solution. Environmental Research, 161, 158–167. https://doi.org/10.1016/j.envres.2017.11.005

Ha, J. and Reeve, A. (2021). Coal plants are closing faster than expected. Governments can keep the exit orderly", The Conversation. https://theconversation.com/coal-plants-are-closing-faster-than-expected-governments-can-keep-the-exit-orderly-172150 (Accessed: 11 December, 2021)

Hadfield, P., & Coenen, L. (2022). Contemporary financial capitalism and sustainability transitions in urban built environments. Environmental Innovation and Societal Transitions, 42, 285–300. https://doi.org/10.1016/j.eist.2022.01.004

Hadfield, P. (2021). Bending the rules: Socio-spatial possibilities and constraints in financing urban renewable energy transitions (PhD thesis). The University of Melbourne, Melbourne. http://hdl.handle.net/11343/279398

Haines, H. (2020). The Local Power Plan. Available at: https://www.localpowerplan.com/

Hajer, M. A., & Pelzer, P. (2018). 2050—An Energetic Odyssey: Understanding 'Techniques of Futuring' in the transition towards renewable energy. Energy Research & Social Science, 44, 222–231. https://doi.org/10.1016/j.erss.2018.01.013

Hale, J., Schipanski, M. and Carolan, M., 2021. Just wheat transitions?: working toward constructive structural changes in wheat production. Local Environment, 26(1), pp.43-59. https://doi.org/10.1080/13549839.2020.1861591

Hansen, T., & Winther, L. (2014). Competitive low-tech manufacturing and challenges for regional policy in the European context—lessons from the Danish experience. Cambridge Journal of regions, economy and Society, 7(3), 449-470. https://doi.org/10.1093/cjres/rsu015

Hansen, T., & Winther, L. (2015). Manufacturing in the knowledge economy: innovation in low-tech industries. In Handbook of manufacturing industries in the world economy. Edward Elgar Publishing.

Harada, T., Birtchnell, T. and Du, B. (2021) 'The rush of the rush hour: mobility justice for seniors on public transport in Sydney, Australia', Social & Cultural Geography, 0(0), pp. 1–20. doi:10.1080/14649365.2021.1922735.

Harle, J., Abdilla, A., & Newman, A. (2018). Digital capture: photogrammetry as rhetoric, fiction, and relic. Decolonising the Digital, Tactical Space Lab, Sydney.

Hazas, M. & Strengers, Y. 2019. Promoting smart homes. Energy fables: Challenging ideas in the energy sector: 78.

Heating Upgrades Victoria (2021) 'About us' Available at: www.heatingupgrades.vic.gov.au/about-us (Accessed: 2 February, 2022).

Herd, T. (2021) Andrew Parry's BTC Mine Australia Leads The Way In Renewable Energy In Australia. Forbes. https://forbes.mc/article/andrew-parrys-btc-mine-australia-leads-the-way-in-renewable-energy-in-australia (Accessed: 11 December, 2021)

Hobson, K. 2006. Bins, bulbs, and shower timers: on the "techno-ethics' of sustainable living. Ethics, Place and Environment, 9(3):317-336. https://doi.org/10.1080/13668790600902375

Hopkins, D. and Schwanen, T. (2018) 'Automated Mobility Transitions: Governing Processesin the UK', Sustainability, 10(4), p. 956. doi:10.3390/su10040956.

Howson, P. (2020). Climate crises and crypto-colonialism: Conjuring value on the blockchain frontiers of the Global South. Frontiers in Blockchain, 3, 22. https://doi.org/10.3389/fbloc.2020.00022

Hummel, P., Braun, M., Tretter, M., & Dabrock, P. (2021). Data sovereignty: A review. Big Data & Society, 8(1), 205395172098201. https://doi.org/10.1177/2053951720982012

Hunt, J., Riley, B., O'Neill, L., & Maynard, G. (2021). Transition to Renewable Energy and Indigenous People in Northern Australia: Enhancing or Inhibiting Capabilities? Journal of Human Development and Capabilities, 22(2), 360–378. https://doi.org/10.1080/19452829.2021.1901670

Iles, A., 2021. Can Australia transition to an agroecological future?. Agroecology and Sustainable Food Systems, 45(1) pp.3-41. https://doi.org/10.1080/21683565.2020.1780537

ImagineSydney (2018). Deloitte Australia. Available at: https://www2.deloitte.com/au/en/pages/future-of-cities/articles/imagine-sydney-live.html (Accessed: 2 December 2021).

Inquiry into Electric Vehicles (2018). Parliament of Victoria | Economy and Infrastructure Committee. Available at: https://www.parliament.vic.gov.au/909-eic-lc/inquiry-into-electric-vehicles (Accessed: 2 December 2021).

Institute for Sustainable Futures (ISF). (2019). Networks Renewed: Project Results and Lessons Learnt. Available at: https://www.uts.edu.au/sites/default/files/2019-10/Networks%20Renewed%20-%20public%20dissemination%20report%20October%202019.pdf

International Energy Agency (2020) Key world Energy Statistics 2020. Available At: https://www.iea.org/reports/key-world-energy-statistics-2020 (Accessed: 2 February, 2022).

Irani, L. (2013) 'The cultural work of microwork', New Media & Society, 17(5), pp. 720 –739. https://doi.org/10.1177/1461444813511926

Ironbark Sustainability and ICLEI (Local Governments for Sustainability). (2021). Australian Local Government Climate Review 2021. Available at: https://www.ironbarksustainability.com.au/resources/articles/launch-of-the-australian-local-government-climate-review

Jackson, R.B., Saunois, M., Bousquet, P., Canadell, J.G., Poulter, B., Stavert, A.R., Bergamaschi, P., Niwa, Y., Segers, A. and Tsuruta, A., 2020. Increasing anthropogenic methane emissions arise equally from agricultural and fossil fuel sources. Environmental Research Letters, 15(7), p.071002. https://doi.org/10.1088/1748-9326/ab9ed2

Jamal, T. and Higham, J., 2021. Justice and ethics: Towards a new platform for tourism and sustainability. Journal of Sustainable Tourism, 29(2-3), pp.143-157. https://doi.org/10.1080/09669582.2020.1835933

Jenkins, K., McCauley, D., Heffron, R., Stephan, H., & Rehner, R. (2016). Energy justice: A conceptual review. Energy Research & Social Science, 11, 174–182. https://doi.org/10.1016/j.erss.2015.10.004

Jensen, R.H., Strengers, Y., Kjeldskov, J., Nicholls, L. & Skov, M. 2018. Designing the desirable smart home: A study of household experiences and energy consumption impacts. Montreal, Canada, 21-26 April. https://doi.org/10.1145/3173574.3173578

Johnson, C. 2020. Is demand side response a woman's work? Domestic labour and electricity shifting in low income homes in the United Kingdom. Energy Research & Social Science, 68. https://doi.org/10.1016/j.erss.2020.101558

Johnson, D., Horton, E., Mulcahy, R., & Foth, M. (2017). Gamification and serious games within the domain of domestic energy consumption: A systematic review. Renewable and Sustainable Energy Reviews, 73, 249–264. https://doi.org/10.1016/j.rser.2017.01.134

Jose, R. and Kaye, B. (2021). Australia proposes new laws to regulate crypto, BNPL", Reuters. https://www.reuters.com/markets/currencies/australia-plans-update-regulatory-framework-payment-systems-2021-12-07/ (Accessed: 11 December, 2021)

Kamiya, G. (2021). Data Centres and Data Transition Networks. [Report]. The International Energy Agency (IEA). https://www.iea.org/reports/data-centres-and-data-transmission-networks (Accessed: 19 January, 2022)

Kamiya, G. and Kvarnström, O. (2019). Data centres and energy - from global headlines to local headaches. [Commentary]. The International Energy Agency (IEA). https://www.iea.org/commentaries/data-centres-and-energy-from-global-headlines-to-local-headaches (Accessed: 19 January, 2022)

Karp, P. (2021). RBA warns cyber attacks and climate change could threaten financial system. The Guardian. https://www.theguardian.com/australia-news/2021/dec/16/rba-warns-cyber-attacks-and-climate-change-could-be-devastating-for-financial-system (Accessed: 17 January, 2022)

Rickards, L., Neale, T., & Kearnes, M. (2017). Australia's national climate: learning to adapt?. Geographical Research, 55(4), 469-476. https://doi.org/10.1111/1745-5871.12240

Kearsley, J., & Cooper, L. (2020, July 20). COVIDSafe app could have cost "tens of millions" for zero tracing results. [Text]. https://www.9news.com.au/national/coronavirus-COVIDsafe-app-could-have-cost-contact-tracing-millions-in-advertising-government-health-news/bd69cbbe-ad14-4547-baf9-eb81aead1198 (Accessed: 21 January, 2022)

King, A. (2020, November). Towards Net Zero: International and Australian climate risk reporting. KPMG. [Report] https://home.kpmg/au/en/home/insights/2020/11/climate-risk-reporting-towards-net-zero.html (Accessed: 18 January, 2022)

Kinley R CSIRO 2018, Asparagopsis feedlot feeding trial, Meat and Livestock Australia Limited. Available at: https://www.mla.com.au/research-and-development/reports/2020/asparagopsis-feedlot-feeding-trial/#

Koens, K., Melissen, F., Mayer, I. and Aall, C., 2021. The Smart City Hospitality Framework: Creating a foundation for collaborative reflections on overtourism that support destination design. Journal of Destination Marketing & Management, 19, p.100376. https://doi.org/10.1016/j.jdmm.2019.100376

Koomey, J. and Masanet, E. (2021). Does not compute: Avoiding pitfalls assessing the Internet's energy and carbon impacts, Joule, 5(7), 1625-1628. DOI: 10.1016/j.joule.2021.05.007

Kurmelovs, R. (2021) '"The worst electric vehicle policy in the world": automotive coalition pans Victoria's EV tax', The Guardian, 21 April. Available at: https://www.theguardian.com/environment/2021/apr/22/the-worst-electric-vehicle-policy-in-the-world-automotive-coalition-pans-victorias-ev-tax (Accessed: 15 December 2021).

Lally, N., Kay, K., & Thatcher, J. (2019). Computational parasites and hydropower: A political ecology of Bitcoin mining on the Columbia River. Environment and Planning E: Nature and Space, 251484861986760. https://doi.org/10.1177/2514848619867608

Lan, H., Gou, Z., & Liu, T. (2021). Residential solar panel adoption in Australia: Spatial distribution and socioeconomic factors. Australian Geographer, 52(3), 315–332. https://doi.org/10.1080/00049182.2021.1964161

Lancaster, D. (2021). The Financial Cost of Job Loss in Australia. The Reserve Bank of Australia (RBA) https://www.rba.gov.au/publications/bulletin/2021/sep/the-financial-cost-of-job-loss-in-australia.html (Accessed: 22 December, 2021)

Lang, M., Lane, R., Zhao, K., & Raven, R. (2022). Energy efficiency in the private rental sector in Victoria, Australia: When and why do small-scale private landlords retrofit? Energy Research & Social Science, 88, 102533. https://doi.org/10.1016/j.erss.2022.102533

Layman, L. (2014) 'Mining'. The Encyclopedia of Women and Leadership in Twentieth- Century Australia. Australian Women's Archives Project. Available At: http://www.womenaustralia.info/leaders/biogs/WLE0382b.htm. (Accessed: 2 February, 2022).

Lefort, C. (2020) 'Gig economy creates ripples in Australia's A$2.1 trillion pension pool' Reuters Online. Available At: https://www.reuters.com/article/us-australia-gig-pensions-idINKBN17707F (Accessed: January 1 2022).

Lenzen, M., Sun, Y.Y., Faturay, F., Ting, Y.P., Geschke, A. and Malik, A., 2018. The carbon footprint of global tourism. Nature Climate Change, 8(6), pp.522-528. https://doi.org/10.1038/s41558-018-0141-x

Local community benefits of Zero Emission Vehicles in Australia (2021). Australian Conservative Foundation. Available at: https://www2.deloitte.com/au/en/pages/public-sector/articles/local-community-benefits-zero-emission-vehicles-australia.html

Lohr, S. (2021, June 24). The Internet Eats Up Less Energy Than You Might Think. The New York Times. https://www.nytimes.com/2021/06/24/technology/computer-energy-use-study.html (Accessed: 12 January, 2022)

Longden, T., Quilty, S., Riley, B., White, L. V., Klerck, M., Davis, V. N., & Frank Jupurrurla, N. (2021). 'Energy insecurity during temperature extremes in remote Australia'. Nature Energy, 1-12. https://doi.org/10.1038/s41560-021-00942-2

Lovell, H., Hann, V. & Watson, P. 2017. Rural laboratories and experiment at the fringes: A case study of a smart grid on Bruny Island, Australia. Energy Research & Social Science, 36, pp.146-155. https://doi.org/10.1016/j.erss.2017.09.031

Low Emissions Technology Australia (LETA) (2022). Why Are LET's So Important? LETA. [Text]. https://www.letaustralia.com.au/low-emission-technology-let/why-lets/ (Accessed: 30 December, 2021)

Lloyd, B., Lowe, D., and Wilson, L. (2000). Renewable Energy in Remote Australian Communities (A Market Survey). Australian CRC for Renewable Energy Ltd. Available at: https://static1.squarespace.com/static/5450868fe4b09b217330bb42/t/5475301de4b0e9b1b372c1a0/1416966173707/ACRE-CAT-RE-System-Audit-Report-2000.pdf

Luscombe, G., 2021. A rough run for ski regions. Australasian Leisure Management, (145), pp.48-49. https://issuu.com/ausleisure97/docs/australasian_leisure_management_issue_145_2021/s/13271622

Lynch, J., Cain, M., Frame, D. and Pierrehumbert, R., 2021. Agriculture's contribution to climate change and role in mitigation is distinct from predominantly fossil CO2-emitting sectors. Frontiers in sustainable food systems, 4, p.300. https://doi.org/10.3389/fsufs.2020.518039

Maalsen, S. 2018. Generation Share: why more older Australians are living in share houses. The Conversation. Available at: https://theconversation.com/generation-share-why-more-older-australians-are-living-in-share-houses-107183 (Accessed: 1 February, 2022).

Mabin, S. and Roberts, L. 2022, February 17. NT Aboriginal groups call for moratorium on electricity disconnections in COVID-hit communities. ABC News. https://www.abc.net.au/news/2022-02-17/nt-remote-communities-aboriginal-organisations-power-disconnec/100837280

Maller, C. & Strengers, Y. 2013. The global migration of everyday life: Investigating the practice memories of Australian migrants. Geoforum, 44:243-252. https://doi.org/10.1016/j.geoforum.2012.09.002

Maller, C. 2011. Practices involving energy and water consumption in migrant households. In: Newton, P. (ed.). Urban Consumption. Collingwood: CSIRO Publishing.

Maller, C., Horne, R. & Dalton, T. 2011. Green Renovations: Intersections of Daily Routines, Housing Aspirations and Narratives of Environmental Sustainability. Housing, Theory and Society, 29(3): 255-275. https://doi.org/10.1080/14036096.2011.606332. https://doi.org/10.1080/14036096.2011.606332

Maller, C.J. & Strengers, Y. 2011. Housing, heat stress and health in a changing climate: promoting the adaptive capacity of vulnerable households, a suggested way forward. Health Promotion International, 26(1):100-108. https://doi.org/10.1093/heapro/dar003

Manufacturing Australia (2021) 'Manufacturing Australia welcomes Net Zero 2050 commitment' Available At: http://manufacturingaustralia.com.au/news/news-releases/manufacturing-australia-welcomes-net-zero-2050-commitmentnew-blogentry/ (Accessed: 1 February, 2022).

Markard, J., Geels, F. W., & Raven, R. (2020). Challenges in the acceleration of sustainability transitions. Environmental Research Letters, 15(8), 081001. https://doi.org/10.1088/1748-9326/ab9468

Markard, J., Raven, R., & Truffer, B. (2012). Sustainability transitions: An emerging field of research and its prospects. Research Policy, 41(6), 955–967. https://doi.org/10.1016/j.respol.2012.02.013

Marsden, G., Docherty, I. and Dowling, R. (2020) 'Parking futures: Curbside management in the era of "new mobility" services in British and Australian cities', Land Use Policy, 91, p. 104012. doi:10.1016/j.landusepol.2019.05.031.

Martin, K. and Nauman, B. (2021, May 20). Bitcoin's growing energy problem: 'It's a dirty currency'. The Financial Times. https://www.ft.com/content/1aecb2db-8f61-427c-a413-3b929291c8ac (Accessed: 10 December, 2021)

Marzouk, Z. (2021, November 30). Australian government-owned energy company hit by ransomware attack. [Tex]. ITPro. https://www.itpro.co.uk/security/ransomware/361687/cs-energy-ransomware-attack (Accessed: 17 January, 2022)

Master Builders Australia (2020) 'Facts & Stats on how building supports the economy' Available At: https://masterbuilders.com.au/Blog/Facts-Stats-on-how-building-supports-the-economy(Accessed: 1 February, 2022).

Mazengarb, M. (2021, April 7). Bitcoin mining to consumer more electricity than whole of Australia by 2024. [Text]. Renew Economy: clean energy news and analysis. https://reneweconomy.com.au/Bitcoin-mining-to-consume-more-electricity-than-whole-of-australia-by-2024/ (Accessed: 10 December, 2021)

Mazzucato, M. (2018). The Value of Everything: Making and Taking in the Global Economy. Penguin Random House, UK.

McConnell, D. (2020, December 1). Australia's states have been forced to go it alone on renewable energy, but it's a risky strategy. The Conversation. https://theconversation.com/australias-states-have-been-forced-to-go-it-alone-on-renewable-energy-but-its-a-risky-strategy-151086

McLaren, D., & Agyeman, J. (2017). Sharing cities: A case for truly smart and sustainable cities. The MIT Press., Cambridge, MA.

McLean, J. (2019, December 17). For a greener future, we must accept there's nothing inherently sustainable about going digital. The Conversation. https://theconversation.com/for-a-greener-future-we-must-accept-theres-nothing-inherently-sustainable-about-going-digital-128125 (Accessed: 19 January, 2022)

Mi, L., Xu, T., Sun, Y., Zhao, J., Lv, T., Gan, X., Shang, K., & Qiao, L. (2021). Playing Ant Forest to promote online green behavior: A new perspective on uses and gratifications. Journal of Environmental Management, 278, 111544. https://doi.org/10.1016/j.jenvman.2020.111544

Middha, B., Robertson, S., Willand, N., & Horne, R. 2022. Man caves, granny flats and alternative living spaces: Low carbon home retrofit and implications for policy making. Energy Research & Social Science 87: 102470.

Mihalic, T., 2020. Concpetualising overtourism: A sustainability approach. Annals of Tourism Research, 84, p.103025. https://doi.org/10.1016/j.annals.2020.103025

Ministry of Petroleum and Energy (2016) Renewable energy production in Norway, Government.no. regjeringen.no. Available at: https://www.regjeringen.no/en/topics/energy/renewable-energy/renewable-energy-production-in-norway/id2343462/ (Accessed: 16 December 2021).

Moore, T. Nicholls, L. Strengers, Y. Maller, C. & Horne, R. 2017. Benefits and challenges of energy efficient social housing. Energy Procedia, 121:300-307. https://doi.org/10.1016/J.EGYPRO.2017.08.031

Moore, T., Ridley, I., Strengers, Y., Maller, C. & Horne, R. 2016. Dwelling performance and adaptive summer comfort in low-income Australian households. Building Research & Information, 45(4): 443-456. https://doi.org/10.1080/09613218.2016.1139906

Mordor Intelligence (2021). Australia Data Center Market - Growth, Trends, COVID-19 Impact, and Forecasts (2022 - 2027). https://www.mordorintelligence.com/industry-reports/australia-data-center-market (Accessed: 31 January, 2022)

Morganti, L., Pallavicini, F., Cadel, E., Candelieri, A., Archetti, F., & Mantovani, F. (2017). Gaming for Earth: Serious games and gamification to engage consumers in pro-environmental behaviours for energy efficiency. Energy Research & Social Science, 29, 95–102. https://doi.org/10.1016/j.erss.2017.05.001

Morton, A. (2021, July 17). Australia's 'sun tax': solar energy supporters split over how to make electricity grid fairer. The Guardian. https://www.theguardian.com/environment/2021/jul/16/australias-sun-tax-solar-energy-supporters-split-over-how-to-make-electricity-grid-fairer

Morton, A. (2021, November 5). Australian government refuses to join 40 nations phasing out coal, saying it won't 'wipe out industries'. The Guardian. https://www.theguardian.com/environment/2021/nov/05/australia-refuses-to-join-40-nations-phasing-out-coal-as-angus-taylor-says-coalition-wont-wipe-out-industries (Accessed: 12 December, 2021)

Muiderman, K., Zurek, M., Vervoort, J., Gupta, A., Hasnain, S., & Driessen, P. (2022). The anticipatory governance of sustainability transformations: Hybrid approaches and dominant perspectives. Global Environmental Change, 73, 102452. https://doi.org/10.1016/j.gloenvcha.2021.102452

Muir, M. (2021, November 21). China's exiled crypto machines fuel global mining boom. The Financial Times https://www.ft.com/content/0dbe4f9f-a433-4288-858e-c4b852f4c340 (Accessed: 12 December, 2021)

Mytton, D. (2020). How much water do data centers use? [Text]. Retrieved January 19, 2022 from https://davidmytton.blog/how-much-water-do-data-centers-use/

Mytton, D. (2021). Data centre water consumption. Clean Water, 4(11), 1-6. DOI: https://doi.org/10.1038/s41545-021-00101-w

North Australian Indigenous Land and Sea Management Alliance Ltd (2015) Indigenous Fire Management and Carbon Farming, October 2015 edition, http://www.nailsma.org.au

National Australian Built Environment Rating System (NABERS) (2021). Data Centres | NABERS. New South Wales Department of Industry, Planning and Environment. https://www.nabers.gov.au/ratings/spaces-we-rate/data-centres (Accessed: 30 January, 2022)

Neff, G., & Nafus, D. (2016) Self-Tracking. The MIT Press: Cambridge.

Naughtin C, Horton J, Marinoni O, Mailloux M, Bratanova, A, Trinh K. 2018. Time travel: Megatrends and scenarios for Queensland transport out to 2048. Brisbane, Australia: CSIRO Data61.

Nelson, T., Simshauser, P., & Kelley, S. (2011). Australian Residential Solar Feed-in Tariffs: Industry Stimulus or Regressive form of Taxation? Economic Analysis and Policy, 41(2), 113–129. https://doi.org/10.1016/S0313-5926(11)50015-3

Newell, P., & Simms, A. (2021). How did we do that? Histories and political economies of rapid and just transitions. New Political Economy, 26(6), 907–922. https://doi.org/10.1080/13563467.2020.1810216

Newgate Research. 2019. Pets in Australia: A national survey of pets and people. Available at: https://animalmedicinesaustralia.org.au/wp-content/uploads/2019/10/ANIM001-Pet-Survey-Report19_v1.7_WEB_low-res.pdf (Accessed: 10 February, 2022).

Nicholls, L. & Strengers, Y. 2015 Peak demand and the 'family peak' period in Australia: Understanding practice (in)flexibility in households with children. Energy Research & Social Science 9: 116-124. https://doi.org/10.1016/j.erss.2015.08.018

Nicholls, L. & Strengers, Y. 2018. Heatwaves, cooling and young children at home: Integrating energy and health objectives. Energy Research & Social Science, 39, pp.1-9. https://doi.org/10.1016/j.erss.2017.10.002

Nicholls, L., Strengers, Y. & Tirado, S. 2017. Smart home control: exploring the potential for enabling technologies in households. Melbourne, Australia: Available at: https://cur.org.au/project/smart-home-control-exploring-potential-enabling-technologies-households/

Nicks, L., Gesiarz, F., Hardy, T. & Burd, H. 2021. How many days should we work from home? What works to improve gender equality. London: Government Equalities Office. Available at: www.bi.team/wp-content/uploads/2021/05/DES-report.pdf

Nikolaeva, A. et al. (2019) 'Commoning mobility: Towards a new politics of mobility transitions', Transactions of the Institute of British Geographers, 44(2), pp. 346–360. doi:10.1111/tran.12287.

Nilles, J.M. 1988. Traffic reduction by telecommuting: A status review and selected bibliography. Transportation Research Part A: General, pp. 301-317. Available at: www.sciencedirect.com/science/article/abs/pii/0191260788900088

Northern Territory Government (2018), Northern Territory Aboriginal Carbon Industry Strategy, https://depws.nt.gov.au/__data/assets/pdf_file/0006/584439/Aboriginal-Carbon-Industry-Strategy_A4_Digital.pdf

Northern Territory Govertnment, (2020) Northern Territory Electric Vehicle Strategy and Implementation Plan 2021 - 2026 Department of Infrastructure, Planning and Logistics, p. 22. Available at: https://dipl.nt.gov.au/strategies/electric-vehicle

NSW Government, (2021) NSW Electric Vehicle Strategy). NSW Environment, Energy and Science. Available at: http://www.environment.nsw.gov.au/topics/climate-change/net-zero-plan/electric-vehicle-strategy (Accessed: 2 December 2021).

NSW Government (2018) Future Transport Strategy 2056. Interactive Resource. Future Transport. Available at: https://future.transport.nsw.gov.au/node/79 (Accessed: 2 December 2021).

Nursey-Bray, M., Palmer, R., Meyer-Mclean, B., Wanner, T., & Birzer, C. (2019). The fear of not flying: Achieving sustainable academic plane travel in higher education based on insights from South Australia. Sustainability, 11(9), 2694: 1-22.

O'Brien, A (2021, October 20). This regional NSW coal town faces an uncertain future as COP26 approaches. SBS News. https://www.sbs.com.au/news/this-regional-nsw-coal-town-faces-an-uncertain-future-as-cop26-approaches/ed31aebc-b380-412d-bbc3-77e079c1f39c (Accessed: 19 January, 2022)

O'Neill, L., Thorburn, K., Riley, B., Maynard, G., Shirlow, E., & Hunt, J. (2021a). Renewable energy development on the Indigenous Estate: Free, prior and informed consent and best practice in agreement-making in Australia. Energy Research & Social Science, 81, 102252. https://doi.org/10.1016/j.erss.2021.102252

O'Neill, L., Riley, B., Junt, J., and Maynard, G. (2021b). Clean Energy Agreement Making on First Nations Land: What do Strong Agreements Contain? Centre for Aboriginal Economic Policy Research, Australian National University. https://doi.org/10.25911/VHH3-F498

O'Shea, J. (2021) The 72,000 trees you can email (and how they respond) [YouTube]. https://www.youtube.com/watch?v=r4BtdFgVGjc

O'Sullivan, S., & Walker, C. (2018). From the interpersonal to the internet: Social service digitisation and the implications for vulnerable individuals and communities. Australian Journal of Political Science, 53(4), 490–507. https://doi.org/10.1080/1036114 6.2018.1519064

Original Power. (2020). A clean-energy economic recovery plan for the Northern Territory. Available at: https://www.originalpower.org.au/electric_superhighway

Original Power. (n.d.). Clean Energy. https://www.originalpower.org.au/clean_energy2

ourPower. (2022). ourPower: a vision for clean, affordable, dependable energy for all. Available at: https://ourpower.org.au/wp-content/uploads/2022/02/ourPower-Booklet.pdf

Parliament of Australia (2017) Corporate Avoidance of the Fair Work Act. Available At: https://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Education_and_Employment/AvoidanceofFairWork/Report (Accessed: 1 January, 2022).

Parliament of Australia (APH) (2021). Select Committee on Australia as a Technology and Financial Centre: Final report. APH, Canberra. https://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Financial_Technology_and_Regulatory_Technology/AusTechFinCentre/Final_report (Accessed: 11 December, 2021)

Partridge, J. 2021. Switch to more home working after COVID 'will make gender inequality worse', The Guardian, 19 June. Available at: www.theguardian.com/business/2021/jun/19/switch-to-more-home-working-after-COVID-will-make-gender-inequality-worse (Accessed: 9 February 2022).

Passey, R., Watt, M., Bruce, A., & MacGill, I. (2018). Who pays, who benefits? The financial impacts of solar photovoltaic systems and air-conditioners on Australian households. Energy Research & Social Science, 39, 198–215. https://doi.org/10.1016/j.erss.2017.11.018

Pathways to a clean growth economy: Queensland Climate Transition Strategy (2020). Queensland Government, p. 38 Available at: https://www.qld.gov.au/environment/climate/climate-change/transition/queensland-climate-transition-strategy

Payscale (2021a) 'Average Coal Mine Worker Salary in Australia' Available At: https://www.payscale.com/research/AU/Job=Coal_Mine_Worker/Salary (Accessed: 10 December, 2021).

Payscale (2021b) 'Average Power Plant Operator Salary in Australia' Available At: https://www.payscale.com/research/AU/Job=Power_Plant_Operator/Hourly_Rate (Accessed: 10 December, 2021).

Pearce, F. (2018). Energy Hogs: Can World's Huge Data Centers Be Made More Efficient?. Yale School of the Environment. https://e360.yale.edu/features/energy-hogs-can-huge-data-centers-be-made-more-efficient (Accessed: 19 January, 2022)

Petti, L., Serreli, M., & Di Cesare, S. (2018). Systematic literature review in social life cycle assessment. The International Journal of Life Cycle Assessment, 23(3), 422–431. https://doi.org/10.1007/s11367-016-1135-4

Pham, T.D., Dwyer, L., Su, J.J. and Ngo, T., 2021. COVID-19 impacts of inbound tourism on Australian economy. Annals of Tourism Research, 88, p.103179. https://doi.org/10.1016/j.annals.2021.103179

Phillips, C., & Atchison, J. (2020). Seeing the trees for the (Urban) forest: More-than-human geographies and urban greening. Australian Geographer, 51(2), 155–168. https://doi.org/10.1080/00049182.2018.1505285

Pickering, C.M. and Buckley, R.C., 2010. Climate response by the ski industry: The shortcomings of snowmaking for Australian resorts. Ambio, 39(5), pp.430-438.

Pink, S. 2022. Digital Energy Futures Documentary. Emerging Technologies Research Lab. Monash University, Australia.

Pink, S., Lingard, H. & Harley, J. Digital pedagogy for safety: the construction site as a collaborative learning environment. Video J. of Educ. and Pedagogy 1, 5 (2016). https://doi.org/10.1186/s40990-016-0007-y

Pleace, N. O'Sullivan, E. & Johnson, G. 2021. Making home or making do: a critical look at homemaking without a home. Housing Studies: 1-17. https://doi.org/10.1080/02673037.2021.1929859

Poruschi, L., & Ambrey, C. L. (2019). Energy justice, the built environment, and solar photovoltaic (PV) energy transitions in urban Australia: A dynamic panel data analysis. Energy Research & Social Science, 48, 22–32. https://doi.org/10.1016/j.erss.2018.09.008

Powell, D. (2021a, November 11) ASX 'bias' forces crypto startup Bamboo to consider US listing. The Sydney Morning Herald. https://www.smh.com.au/business/entrepreneurship/asx-bias-forces-crypto-startup-bamboo-to-consider-us-listing-20211101-p594y4.html (Accessed: 10 December, 2021)

Powell, D. (2021b, November 17) Aussie brothers his Nasdaq with plan to turn Bitcoin green. The Sydney Morning Herald. https://www.smh.com.au/business/companies/aussie-brothers-hit-nasdaq-with-plan-to-turn-Bitcoin-green-20211117-p599pj.html (Accessed: 10 December, 2021)

Power, E.R. 2012. Domestication and the dog: embodying home. Area, 44(3):371-378.

PowerHousing Australia, 2021. Australian Affordable Housing Report: Standard House Environmental Scan. Available at: www.powerhousingaustralia.com.au/wp-content/uploads/2021/11/PHA-eScan-2021-FINAL.pdf (Accessed: 10 February, 2022).

Preece, J., McKee, K., Robinson, D. & Flint, J. 2021. Urban rhythms in a small home: COVID-19 as a mechanism of exception, Urban Studies, doi: 10.1177/00420980211018136

Productivity Commission (2021a) 'Submission to the Senate Economics References Committee Inquiry into the Australian Manufacturing Industry' Available At: https://www.pc.gov.au/research/supporting/manufacturing-industry/manufacturing-industry.pdf (Accessed: 1 February, 2022). Available at: https://www.pc.gov.au/research/ongoing/trade-assistance/2019-20

Productivity Commission (2021b) '2021b, Trade and Assistance Review 2019-20, Annual Report Series, Canberra'.

Productivity Commission (PC) [Australian Government]. (2021). Right to repair. https://nla.gov.au/nla.obj-3007760440 (Accessed: 28 December, 2021)

Project overview: About Sydney Metro West | Sydney Metro (no date). Available at: https://www.sydneymetro.info/west/project-overview (Accessed: 17 December 2021).

PwC (2019) Transforming Australian Manufacturing: Preparing businesses and workplaces for Industry 4.0. Available At: https://www.pwc.com.au/education/industry-proposal-13may2019.pdf (Accessed: 1 February, 2022).

Queensland Government. 2021a. Local benefits in Queensland Renewable Energy Zones: Principles for delivering local benefits in Queensland Renewable Energy Zones (QREZ). Available at: https://www.epw.qld.gov.au/__data/assets/pdf_file/0020/18362/qrez-consultation-paper.pdf

Queensland Government. 2021b. 'Solar for rentals trial'. Available At: www.epw.qld.gov.au/about/initiatives/solar-rentals-trial (Accessed: 10 February 2022).

Queensland Government. 2022. 'Solar for remote communities'. Available At: www.epw.qld.gov.au/about/initiatives/solar-remote-communities (Accessed: 10 February, 2022).

QUT (Queensland University of Technology) (2019) Digital Platform Work in Australia Preliminary findings from a national survey. Available At: https://research.qut.edu.au/centre-for-decent-work-and-industry/wp-content/uploads/sites/35/2019/06/Report-of-Survey-Findings_18-June-2019_PUBLISHED.pdf (Accessed: 15 December, 2021).

Quinbrook. 2022. "APAC Green Data", (https://www.quinbrook.com/portfolio-companies/apac-green-data/), (accessed: 10 February 2022)

Race, D., Mathew, S., Campbell, M. and Hampton, K. 2016. Are Australian Aboriginal communities adapting to a warmer climate? A study of communities living in semi-arid Australia', Journal of Sustainable Development, 9(3), pp. 208- 223. https://doi.org/10.5539/jsd.v9n3p208

Rangel, C.B. (2008) H.R.6049 - 110th Congress (2007-2008): Energy Improvement and Extension Act of 2008. Available at: https://www.congress.gov/bill/110th-congress/house-bill/6049 (Accessed: 16 December 2021).

Ransan-Cooper, H. Lovell, H. Watson, P. Harwood, A. & Hann, V. 2020. Frustration, confusion and excitement: Mixed emotional responses to new household solar-battery systems in Australia. Energy Research & Social Science. https://doi.org/10.1016/j.erss.2020.101656

Ransan-Cooper, H., Sturmberg, B. C. P., Shaw, M. E., & Blackhall, L. (2021). Applying responsible algorithm design to neighbourhood-scale batteries in Australia. Nature Energy, 6(8), 815–823. https://doi.org/10.1038/s41560-021-00868-9

Raven, R., Reynolds, D., Lane, R., Lindsay, J., Kronsell, A., & Arunachalam, D. (2021). Households in sustainability transitions: A systematic review and new research avenues. Environmental Innovation and Societal Transitions, 40, 87–107. https://doi.org/10.1016/j.eist.2021.06.005

Renewable energy easily shared in the Netherlands thanks to smart solar-powered car network-Projects (no date). Available at: https://ec.europa.eu/regional_policy/en/projects/Netherlands/renewable-energy-easily-shared-in-the-netherlands-thanks-to-smart-solar-powered-car-network (Accessed: 16 December 2021).

Reshaping Infrastructure For a Net Zero Emissions Future (2020). Clean Energy Finance Corporation. Available at: https://www.cefc.com.au/media/media-release/infrastructure-can-lay-the-foundations-for-australia-s-net-zero-emissions-future (Accessed: 2 December 2021).

Richardson, D. and Denniss, R. 2020. Gender experiences during the COVID-19 lockdown – women lose from COVID-19, men to gain from stimulus. Available at: https://australiainstitute.org.au/wp-content/uploads/2020/12/Gender-experience-during-the-COVID-19-lockdown.pdf (Accessed: 9 February, 2022).

Riley, B. (2021). Scaling up: Renewable energy in Aboriginal Lands in North West Australia. Nulungu Publication Series, Nulungu Research Paper No. 3. Available at https://researchonline.nd.edu.au/nulungu_research/3/

Rosenfeld, S. A. (2018) Manufacturing by design. Economic Development Quarterly, 32(4), 313-325. https://doi.org/10.1177/0891242418798052

Rural, S., 2021. The future of Australia's aviation sector, in the context of COVID-19 and conditions post pandemic: interim report. Parliament of Australia. Available at: https://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Rural_and_Regional_Affairs_and_Transport/CovidAviation

Ryghaug, M., & Toftaker, M. (2016). Creating transitions to electric road transport in Norway: The role of user imaginaries. Energy Research & Social Science, 17, 119-126. http://dx.doi.org/10.1016/j.erss.2016.04.017

Santos, D., & Lane, R. (2017). A material lens on socio-technical transitions: The case of steel in Australian buildings. Geoforum, 82, 40–50. https://doi.org/10.1016/j.geoforum.2017.03.020

Savin, V. D. (2022). Cybersecurity Threats and Vulnerabilities in Energy Transition to Smart Electricity Grids. in; Fotea, S.L., Fotea, I.S., Vâduva, S (eds). Navigating Through the Crisis: Business, Technological and Ethical Considerations. GSMAC 2020. Springer Proceedings in Business and Economics. Springer, Cham.

Scaling up climate action: Key opportunities for transitioning to a zero emissions society (2020). Climate Action Tracker. Available at: https://climateactiontracker.org/documents/806/CAT_2020-11-10_ScalingUp_AUSTRALIA_FullReport.pdf.

Schmallegger, D. and Carson, D., 2010. Is tourism just another staple? A new perspective on tourism in remote regions. Current Issues in Tourism, 13(3), pp.201-221. http://dx.doi.org/10.1080/13683500903359152

Schor, J. (2021) After the Gig: How the Sharing Economy Got Hijacked and How to Win It Back, Oakland: California University Press.

Schot, J., & Steinmueller, W. E. (2018). Three frames for innovation policy: R&D, systems of innovation and transformative change. Research Policy, 47(9), 1554–1567. https://doi.org/10.1016/j.respol.2018.08.011

Schwanen, T. (2021) 'Achieving just transitions to low-carbon urban mobility', Nature Energy, 6(7), pp. 685–687. doi:10.1038/s41560-021-00856-z.

Sharp, D., & Raven, R. (2021). Urban planning by experiment at precinct scale: Embracing complexity, ambiguity, and multiplicity. Urban Planning, 6(1), 195-207. http://dx.doi.org/10.17645/up.v6i1.3525

Sheldrick, A. and Obayashi, Y. (2021) 'Japan, once a leader on climate, under fire for coal use at COP26', Reuters, 9 November. Available at: https://www.reuters.com/business/cop/japan-once-leader-climate-under-fire-coal-use-cop26-2021-11-09/ (Accessed: 17 December 2021).

Shiel, J.J. Moghtaderi, B. Aynsley, R.M. Page, A. Clarke, J.M. 2017. 'Decarbonising the Australian housing stock for climate change', AIRAH and IBPSA's Australasian Building Simulation 2017 Conference, Melbourne, 15-16 November. Available at: www.airah.org.au/Content_Files/Conferences/2017/Building-simulation/ABSC2017_TP_JohnShiel.pdf (Accessed: 9 February, 2022).

Sier, J. (2021a, October 25) Byron Bay becomes the new home of Aussie Bitcoin mining. The Australian Financial Review. https://www.afr.com/technology/byron-bay-becomes-the-new-home-of-aussie-Bitcoin-mining-20211024-p592oe (Accessed: 10 December, 2021)

Sier, J. (2021b, February 12) Bitcoin miners go bush in hunt for cheap green power. The Australian Financial Review. https://www.afr.com/markets/currencies/Bitcoin-miners-go-bush-in-hunt-for-cheap-green-power-20210212-p571ww (Accessed: 10 December, 2021)

Simpson, G., & Clifton, J. (2016). Subsidies for residential solar photovoltaic energy systems in Western Australia: Distributional, procedural and outcome justice. Renewable and Sustainable Energy Reviews, 65, 262–273. https://doi.org/10.1016/j.rser.2016.06.060

Skjølsvold, T. M., & Coenen, L. (2021). Are rapid and inclusive energy and climate transitions oxymorons? Towards principles of responsible acceleration. Energy Research & Social Science, 79, https://doi.org/10.1016/j.erss.2021.102164

Smit, R. (2019) Vehicle CO2 emissions legislation in Australia – A brief history in an international context. Transport Energy/Emission Research.

Smolaks, M. (2018, August 9). Australia's DC TWO is building a crypto mine powered by the sun. Data Centre Dynamics. https://www.datacenterdynamics.com/en/news/australias-dc-two-is-building-a-crypto-mine-powered-by-the-sun/ (Accessed: 10 December, 2021)

Sofoulis, Z. 2005. Big water, everyday water: a sociotechnical perspective. Continuum: Journal of Media & Cultural Studies, 19(4):445-463. https://doi.org/10.1080/10304310500322685

Solar Citizens. (2022, February 14). Australia hits huge 25GW solar milestone, but Government action needed to keep solar growing [Press Release]. https://www.solarcitizens.org.au/australia_25gw_solar_milestone

Solar Victoria. 2021. 'Solar Homes Program'. Available At: www.solar.vic.gov.au/solar-homes-program' (Accessed: 2 February, 2022).

Sonnberger, M. and Graf, A. (2021) 'Sociocultural dimensions of mobility transitions to come: introduction to the special issue', Sustainability: Science, Practice and Policy, 17(1), pp. 174–185. doi:10.1080/15487733.2021.1927359.

South Australia's Electric Vehicle Action Plan (2020). Government of South Australia, p. 32. Available at: https://www.energymining.sa.gov.au/__data/assets/pdf_file/0020/376130/201216_Electric_Vehicle_Action_Plan.pdf

South Australian Government Climate Change Action Plan 2021–2025 (2020). Government of South Australia, p. 64. Available at: https://www.environment.sa.gov.au/topics/climate-change/climate-change-action-plan-2021-2025

Sovacool, B. K., Burke, M., Baker, L., Kotikalapudi, C. K., & Wlokas, H. (2017). New frontiers and conceptual frameworks for energy justice. Energy Policy, 105, 677–691. https://doi.org/10.1016/j.enpol.2017.03.005

Sovacool, B.K. and Griffiths, S. (2020) 'The cultural barriers to a low-carbon future: A review of six mobility and energy transitions across 28 countries', Renewable and Sustainable Energy Reviews, 119, p. 109569. doi:10.1016/j.rser.2019.109569.

Sovacool, B.K. et al. (2020) 'Imagining sustainable energy and mobility transitions: Valence, temporality, and radicalism in 38 visions of a low-carbon future', Social Studies of Science, 50(4), pp. 642–679. doi:10.1177/0306312720915283.

Spinney, J., & Lin, W.-I. (2018). Are you being shared? Mobility, data and social relations in Shanghai's Public Bike Sharing 2.0 sector. Applied Mobilities, 3(1), 66–83. https://doi.org/10.1080/23800127.2018.1437656

Srnicek, N. (2017) Platform Capitalism. Cambridge: Polity.

St Vincent de Paul Society (SVDP) & Alviss Consulting. (2021). The NEM – Lower prices, more offers: Are consumers reaping the rewards? Available at: https://www.vinnies.org.au/icms_docs/329296_National_Energy_Market_-_Lower_prices_more_offers_Are_consumers_reaping_the_rewards.pdf

St Vincent de Paul Society (SVDP). (2019). Options for an Equitable Distributed Energy Resource Future: A Discussion Paper. Available at: https://www.vinnies.org.au/icms_docs/309778_Options_for_an_equitable_Distributed_Energy_Resource_future.pdf

State Electric Vehicle Strategy for Western Australia (2020). Department of Water and Environmental Regulation, p. 26. Available at: https://www.wa.gov.au/service/environment/environment-information-services/electric-vehicle-strategy

State of Victoria Government (2021) The Victorian Government Response to the Report of the Inquiry into the Victorian On-Demand Workforce. Available At: engage.vic.gov.au/inquiry-on-demand workforce (Accessed: 15 December, 2021).

Steiger, R., Scott, D., Abegg, B., Pons, M. and Aall, C., 2019. A critical review of climate change risk for ski tourism. Current Issues in Tourism, 22(11), pp.1343-1379. https://doi.org/10.1080/13683500.2017.1410110

Stein, J. A. & Crosby, A. (2021, January 2021) Right to Repair [Report]. Submission to Productivity Commission. University of Technology Sydney (UTS). Available at: https://www.pc.gov.au/__data/assets/pdf_file/0017/272330/sub051-repair.pdf

Strengers, Y. 2010. Air-conditioning Australian households: a trial of Dynamic Peak Pricing. Energy Policy, 38(11): 7312-7322. https://doi.org/10.1016/j.enpol.2010.08.006

Strengers, Y. & Maller, C. 2011. Integrating health, housing and energy policies: the social practices of cooling. Building Research & Information, 39(2):154-168. https://doi.org/10.1080/09613218.2011.562720

Strengers, Y. & Maller, C. 2012. Materialising energy and water resources in everyday practices: Insights for securing supply systems. Global Environmental Change, 22(3): 754-763. https://doi.org/10.1016/j.gloenvcha.2012.04.004

Strengers, Y. 2013. Smart energy technologies in everyday life: Smart Utopia?. Palgrave, London.

Strengers, Y. 2013. Smart Energy Technologies in Everyday Life: Smart Utopia? Basingstoke, Hampshire, UK. Palgrave Macmillan.

Strengers, Y. (2014). Smart energy in everyday life: are you designing for resource man?. interactions, 21(4), 24-31.

Strengers, Y. & Maller, C. 2014. Social practices, intervention and sustainability: Beyond behaviour change, Oxon, UK. Routledge.

Strengers, Y., Nicholls, L. & Maller, C. 2016. Curious energy consumers: Humans and nonhumans in assemblages of household practice. Journal of Consumer Culture, 16(3): 761-780. https://doi.org/10.1177/1469540514536194

Strengers, Y. & Nicholls, L. 2017. Convenience and energy consumption in the smart home of the future: Industry visions from Australia and beyond. Energy Research & Social Science, 32: 86-93. https://doi.org/10.1016/j.erss.2017.02.008

Strengers, Y. & Nicholls, L. 2018. Aesthetic pleasures and gendered tech-work in the 21st-century smart home. Media International Australia, 166(1): 70-80. https://doi.org/10.1177/1329878X17737661

Strengers, Y., Kennedy, J., Arcari, P., Nicholls, L. & Gregg, M. 2019a. Protection, Productivity and Pleasure in the Smart Home: Emerging Expectations and Gendered Insights from Australian Early Adopters. Paper presented at Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems, Glasgow, Scotland Uk:Paper 645. Available at: https://doi-org.ezproxy.lib.monash.edu.au/10.1145/3290605.3300875.

Strengers, Y., Pink, S. & Nicholls, L. 2019b. Smart energy futures and social practice imaginaries: Forecasting scenarios for pet care in Australian homes. Energy Research & Social Science, 48:108-115. https://doi.org/10.1016/j.erss.2018.09.015

Strengers, Y., Nicholls, L., Glover, A., Arcari, P. & Martin, R. 2019c. Engaging households towards the Future Grid: an engagement strategy for the energy sector. Melbourne, Australia: Available at: www.monash.edu/__data/assets/pdf_file/0004/1862833/Engaging-households-towards-the-Future-Grid-FINAL-181219.pdf.

Strengers, Y. & Kennedy, J. 2020. The Smart Wife: Why Siri, Alexa and other Smart Home Devices Need a Feminist Reboot. Cambridge, Massachusetts The MIT Press.

Strengers, Y. Duque, M. Mortimer, M. Pink, S. Eugene, A. Martin, R. Nicholls, L. Horan, B. Thomson, S. 2021a. Smart Homes for Seniors: Intelligent Home Solutions for Independent Living, Final research evaluation report, McLean Care, Monash University and Deakin University, Melbourne, Australia. Available at: https://intelligenthomesolutions.com.au/wp-content/uploads/2021/02/Final-Report.pdf.

Strengers, Y., Dahlgren, K., Nicholls, L., Pink, S. & Martin, R. 2021b. Digital Energy Futures: Future Home Life. Melbourne, Australia. Available at: www.monash.edu/__data/assets/pdf_file/0011/2617157/DEF-Future-Home-Life-Full-Report.pdf. https://doi.org/10.1016/j.erss.2021.102366

Strengers, Y., Dahlgren, K., Pink, S., Sadowski, J. & Nicholls, L. 2022. Digital technology and energy imaginaries of future home life: Comic-strip scenarios as a method to disrupt energy industry futures. Energy Research & Social Science, 84. Available at: https://www.dpac.tas.gov.au/divisions/climatechange/Climate_Change_Priorities/reducing_emissions/transport/supporting_electric_vehicle_update_-_fact_sheet

Tasmanian Climate Change Office (2021). Supporting Electric Vehicle Uptake. Tasmanian Government Office, p. 2.

Svangren, M. K., Brereton, M., Skov, M. B., & Kjeldskov, J. (2019). Investigating the use of an online peer-to-peer car sharing service. In D. Lamas, F. Loizides, L. Nacke, H. Petrie, M. Winckler, & P. Zaphiris (Eds.), Human-Computer Interaction – INTERACT 2019 (Vol. 11748, pp. 740–759). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-030-29387-1_43

Swilling, M. (2019). The age of sustainability: Just transitions in a complex world. Routledge. https://doi.org/10.4324/9780429057823

Tan, M. (2015, July 15). Leaf letters: Fan email for Melbourne's trees pours in from around the world. The Guardian. https://www.theguardian.com/australia-news/2015/jul/15/leaf-letters-fan-mail-melbourne-trees-pours-in-around-the-world (Accessed: 5 January, 2022)

Tattersall, A., Bryant, G., Hancock, R., Napier, I. and Stears, M. (2020). A Real Deal: A research action agenda for transforming Australia in and beyond the pandemic. Sydney Policy Lab, University of Sydney. Available at: https://www.sydney.edu.au/sydney-policy-lab/our-research/real-deal.html

Taylor, J. (2021, December 2). 'A lemon': Coalition fights to keep Covidsafe app data under wraps. The Guardian. https://www.theguardian.com/australia-news/2021/dec/02/a-lemon-coalition-fights-to-keep-COVIDsafe-app-data-under-wraps (Accessed: 28 January, 2022)

Temby, H. & Ransan-Cooper, H. 2021. 'We want it to work': Understanding household experiences with new energy technologies in Australia. Canberra, ACT. Available at: https://apo.org.au/sites/default/files/resource-files/2021-03/apo-nid313616.pdf

Territory Economic Reconstruction Commission (TERC). (2020). Territory Economic Reconstruction Commission: Final Report. Available at: https://ntrebound.nt.gov.au/publications/final-report

The ACT's Transition to Zero Emissions Vehicles (2018). ACT Government, p. 12. Available at: https://www.environment.act.gov.au/__data/assets/pdf_file/0012/1188498/2018-21-ACTs-transition-to-zero-emissions-vehicles-Action-Plan-ACCESS.pdf

The Deloitte City Mobility Index: Gauging global readiness for the future of mobility (2018). Deloitte Australia. Available at: https://www2.deloitte.com/au/en/pages/about-deloitte/articles/how-ready-australian-cities-future-mobility.html (Accessed: 2 December 2021).

The Draft Tasmanian Renewable Energy Action Plan 2020 (2020). Department of State Growth, p. 29. Available at: https://www.stategrowth.tas.gov.au/__data/assets/pdf_file/0011/241112/TREAP.PDF.

The Government of Victoria, 2022 'Greenhouse gas cycles in agriculture, Agriculture Victoria. https://agriculture.vic.gov.au/climate-and-weather/understanding-carbon-and-emissions/greenhouse-gas-cycles-in-agriculture

The Greens, n. d. Tackling the Climate Crisis. Available at: https://greens.org.au/platform/climate#end-coa

The Productivity Commission. 2021. Working from home: Research paper. The Australian Government. Available at: https://www.pc.gov.au/research/completed/working-from-home

Thomas, J. Barraket, J. Parkinson, S. Wilson, C. Holcombe-James, I. Kennedy, J. Mannell, K. Brydon, A. 2021. Australian Digital Inclusion Index: 2021. Melbourne: RMIT, Swinburne University of Technology, and Telstra. Available at: www.apo.org.au/sites/default/files/resource-files/2021-10/apo-nid314284.pdf

Thomsen, S. (2021, October 25) Bitcoin mining is coming to Byron Bay. Startup Daily. https://www.startupdaily.net/2021/10/Bitcoin-mining-is-coming-to-byron-bay/ (Accessed: 11 December, 2021)

Thornton, K. (2021, June 16). Australia's renewable energy sector to drive the next resources boom. Clean Energy Council. https://www.cleanenergycouncil.org.au/news/australias-renewable-energy-sector-to-drive-the-next-resources-boom

Time Travel: Megatrends and Scenarios for Queensland Transport out to 2048 (2018). Queensland Department of Transport, p. 124.

Tirado Herrero, S., Nicholls, L. & Strengers, Y. 2018. Smart home technologies in everyday life: do they address key energy challenges in households? Current Opinion in Environmental Sustainability, 31:65-70. https://doi.org/10.1016/j.cosust.2017.12.001

Transgrid. (2021). Energy Vision: A clean energy future for Australia. Available at: https://www.transgrid.com.au/media-publications/blogs/could-australia-become-a-clean-energy-superpower

TWU (2019a) 'TWU Slams Fairwork Ombudsman's Uber Decision; Calls for urgent law changes'. Available At: https://www.twu.com.au/press/twu-slams-fair-work-ombudsmans-uber-decision-calls-for-urgent-law-changes/ (Accessed: 12 December, 2021).

TWU (2019b) 'Fighting for rights in the on-demand economy', Available At: https://www.twu.com.au/on-demand/fighting-for-rights-in-the-on-demand-economy/ (Accessed: 12 December, 2021).

TWU (2019c) 'Gig economy survey reveals exploitation of transport workers' Available At: https://twunsw.org.au/press/gig-economy-survey-reveals-exploitation-of-transport-workers/ (Accessed: 12 December, 2021).

Uncovering the hidden costs and benefits from electric vehicles - Electric Vehicle Council (2020). Ernst & Young Australia. Available at: https://electricvehiclecouncil.com.au/reports/ev-true-value/ (Accessed: 2 December 2021).

UNFCCC (2020). Alipay Ant Forest Using Digital Technologies to Scale up Climate Action China. United Nations Framework Convention on Climate Change. Retrieved January 7, 2022, from https://unfccc.int/climate-action/momentum-for-change/planetary-health/alipay-ant-forest

Unions ACT. 2016. A Comprehensive Residential Energy and Water Efficiency Retrofit Program for the ACT: A UnionsACT Discussion Paper. Available at: https://unionsact.org.au/wp-content/uploads/2016/01/retrofit-report-DIN-A4.pdf (Accessed: 10 February, 2022).

United Nations Environment Programme (UNEP). (2021, October 26). Updated climate commitments ahead of COP26 summit fall far short, but net-zero pledges provide hope [Press Release]. https://www.unep.org/news-and-stories/press-release/updated-climate-commitments-ahead-cop26-summit-fall-far-short-net

UNODC. 2018. Global study on homicide: Gender-related killing of women and girls. Vienna, Austria: United National Office on Drugs and Crime. Available at: https://www.unodc.org/documents/data-and-analysis/GSH2018/GSH18_Gender-related_killing_of_women_and_girls.pdf

Urban Forest and Ecology Team (2012) Urban Forest Strategy: Making a great city greener 2012-2032. https://www.melbourne.vic.gov.au/SiteCollectionDocuments/urban-forest-strategy.pdf (Accessed: 15 January, 2022)

Utilities Commission Northern Territory. (2021). 2019-20 Northern Territory Electricity Retail Review. Available at: https://utilicom.nt.gov.au/publications/reports-and-reviews/2019-20-northern-territory-electricity-retail-review

Vaughan, A. (2015). How viral cat videos are warming the planet. The Guardian. https://www.theguardian.com/environment/2015/sep/25/server-data-centre-emissions-air-travel-web-google-facebook-greenhouse-gas (Accessed: 19 January, 2022)

VicRoads (2021) e scooter trials in Victoria, VicRoads. Available at: https://www.vicroads.vic.gov.au:443/safety-and-road-rules/road-safety-programs/e-scooter-trials-in-victoria (Accessed: 17 December 2021).

Victoria State Government. 2021. 'Victorian Energy Upgrades Program'. Available at: www.energy.vic.gov.au/energy-efficiency/victorian-energy-upgrades (Accessed: 2 February, 2022).

Vidal, J. (2017, December 11) 'Tsunami of data' could consume one fifth of global electricity by 2025. The Guardian [Climate Home News]. [Text]. https://www.theguardian.com/environment/2017/dec/11/tsunami-of-data-could-consume-fifth-global-electricity-by-2025 (Accessed: 19 January, 2022)

Vogt, F., Haire, B., Selvey, L., Katelaris, A. L., & Kaldor, J. (2022). Effectiveness evaluation of digital contact tracing for COVID-19 in New South Wales, Australia. The Lancet Public Health, S246826672200010X. https://doi.org/10.1016/S2468-2667(22)00010-X

Vorrath, S. (2022, February 15). WA switches on rooftop solar switch-off rules, sparks call for faster grid reform. RenewEconomy. https://reneweconomy.com.au/wa-switches-on-rooftop-solar-switch-off-rules-sparks-call-for-faster-grid-reform/

Waitt, G., & Harada, T. (2019). Space of energy well being: Social housing tenants' everyday experiences of fuel poverty. Transactions of the Institute of British Geographers, 44(4), 794-807. Available at: http://dx.doi.org/10.1111/tran.12320

Waitt, G., Caputi, P., Gibson, C., Farbotko, C., Head, L., Gill, N. & Stanes, E. 2012. Sustainable Household Capability: which households are doing the work of environmental sustainability? Australian Geographer, 43(1):51-74. https://doi.org/10.1080/00049182.2012.649519

Webb, J., Wilson, C. and Kularatne, T. (2019) 'Will people accept shared autonomous electric vehicles? A survey before and after receipt of the costs and benefits', Economic Analysis and Policy, 61, pp. 118–135. doi:10.1016/j.eap.2018.12.004.

Weigel, J. (2020, October 22). Data driven IoT insights for sustainable communities: Govhack 2020 part 2. [Blog]. https://govhack.org/2020/10/data-driven-iot-insights-for-sustainable-communities-govhack-2020-part-2/ (Accessed: 21 January, 2022)

Western Australian Climate Policy (2020). Department of Water and Environmental Regulation, p. 38. Available at: https://www.wa.gov.au/service/environment/environment-information-services/western-australian-climate-change-policy

Western Australia Government (2021) Western Australian Carbon Farming and Land Restoration Program, https://www.agric.wa.gov.au/carbon-farming/western-australian-carbon-farming-and-land-restoration-program

Wheelan, S. (2020) 'Wage-cutting Strategies in the Mining Industry The cost to workers and communities', Available At: https://www.cfmeuqld.asn.au/wp/wp-content/uploads/McKell_Wage-Cutting_Mining.pdf (Accessed: 4 January, 2022).

Whitehead, J., Whitehead, J., and Kim, K. (2021) 'As the world surges ahead on electric vehicle policy, the Morrison government's new strategy leaves Australia idling in the garage', The Conversation https://theconversation.com/as-the-world-surges-ahead-on-electric-vehicle-policy-the-morrison-governments-new-strategy-leaves-australia-idling-in-the-garage-169824

Whitson, R. and Janda, M. (2022, February 17). Origin Energy to shut Australia's largest coal-fired power plant, Eraring Power Station, by 2025. ABC News. https://www.abc.net.au/news/2022-02-17/origin-to-shut-eraring-power-station-early/100838474

Wilkinson, S., Hojckova, K., Eon, C., Morrison, G. M., & Sandén, B. (2020). Is peer-to-peer electricity trading empowering users? Evidence on motivations and roles in a prosumer business model trial in Australia. Energy Research & Social Science, 66, 101500. https://doi.org/10.1016/j.erss.2020.101500

Willand, N. & Horne, R. 2018. "They are grinding us into the ground"– The lived experience of energy (in)justice amongst low-income older households. Applied Energy 226: 61-70.

Willand, N., Middha, B., & Walker, G. (2021). Using the capability approach to evaluate energy vulnerability policies and initiatives in Victoria, Australia. Local Environment, 26(9), 1109–1127. https://doi.org/10.1080/13549839.2021.1962830

Willing, R. and Pojani, D. (2017) 'Is the suburban dream still alive in Australia? Evidence from Brisbane', Australian Planner, 54(2), pp. 67–79, doi:10.1080/07293682.2017.1296875.

Wood, T., Reeve, A., and Ha, J. (2021). Towards net zero: A practical plan for Australia's governments. Grattan Institute. Available at: https://grattan.edu.au/report/towards-net-zero-a-practical-plan-for-australias-governments/

Woodcock, J. (2021) The Fight Against Platform Capitalism An Inquiry into the Global Struggles of the Gig Economy. London: University of Westminster Press.

Woodcock, J. & Graham, M. (2019) The Gig-economy: A critical Introduction. Cambridge Polity.

Workplace Gender Equality Agency (2018) WGEA, Coal Mining Data. Workplace Gender Equality Agency. Australian Government. Available At: http://data.wgea.gov.au/industries/239#gender_comp_content (Accessed 1 February, 2022)

Workplace Gender Equality Agency (2020) WGEA Data Explorer ' comparing all industries and construction' Available At: https://data.wgea.gov.au/comparison/?id1=1&id2=110%23summary_content#gender_comp_content (Accessed 1 February, 2022)

Wu, D. (2021, November 6). Protesters to march in Sydney CBD over government's climate change stance that is a 'bigger threat' to health than COVID-19. Sky News. https://www.skynews.com.au/australia-news/protesters-to-march-in-sydney-cbd-over-governments-climate-change-stance-that-is-a-bigger-threat-to-health-than-COVID19/news-story/5af425c3619a1dba613873f15fa64034. (Accessed: 12 December, 2021)

WWF (2020) The time is now: Tackling embodied carbon in the building and construction sector Available At: https://www.wwf.org.au/ArticleDocuments/353/WWF-Decarbonising%20Building%20and%20Construction%20Materials%20report.pdf.aspx?Embed=Y (Accessed: 1 February, 2022).

WWF-Australia. (2020). Australian renewable export COVID-19 recovery package. Available at: https://www.wwf.org.au/what-we-do/climate/renewables/renewable-export-COVID-19-recovery-package/securing-australia-s-future-renewable-export-COVID-19-recovery#gs.oebjhu

WWF-Australia. (2021). Renewable Superpower Scorecard #2: Australia's Race to a Renewable Future. Available at: https://www.wwf.org.au/what-we-do/climate/renewables/resources/renewable-superpower-scorecard-nov-2021#gs.oeeypr

York, R., & Bell, S. E. (2019). Energy transitions or additions? Energy Research & Social Science, 51, 40–43. https://doi.org/10.1016/j.erss.2019.01.008

Zero-Emission Vehicle Program | California Air Resources Board (no date). Available at: https://ww2.arb.ca.gov/our-work/programs/zero-emission-vehicle-program/about (Accessed: 16 December 2021).

Zhang, M & Magiure, G. (2021) 'China's builders slow construction material purchases on surging steel prices' Reuters Online. Available At: https://www.reuters.com/article/china-steel-idUSL2N2N400I (Accessed: 1 February,2022).

Zhang, Y. and Zhang, A., 2021. COVID-19 and bailout policy: The case of Virgin Australia. Transport Policy, 114, pp.174-181. https://doi.org/10.1016/j.tranpol.2021.09.015

Zhou, N (2020, 24 Nov) 'NSW government announces taskforce to investigate food delivery deaths', Guardian Online. Available At: https://www.theguardian.com/australia-news/2020/nov/24/food-delivery-driver-killed-in-sydney-is-the-fifth-death-in-two-months (Last Accessed: 1 January, 2022).

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