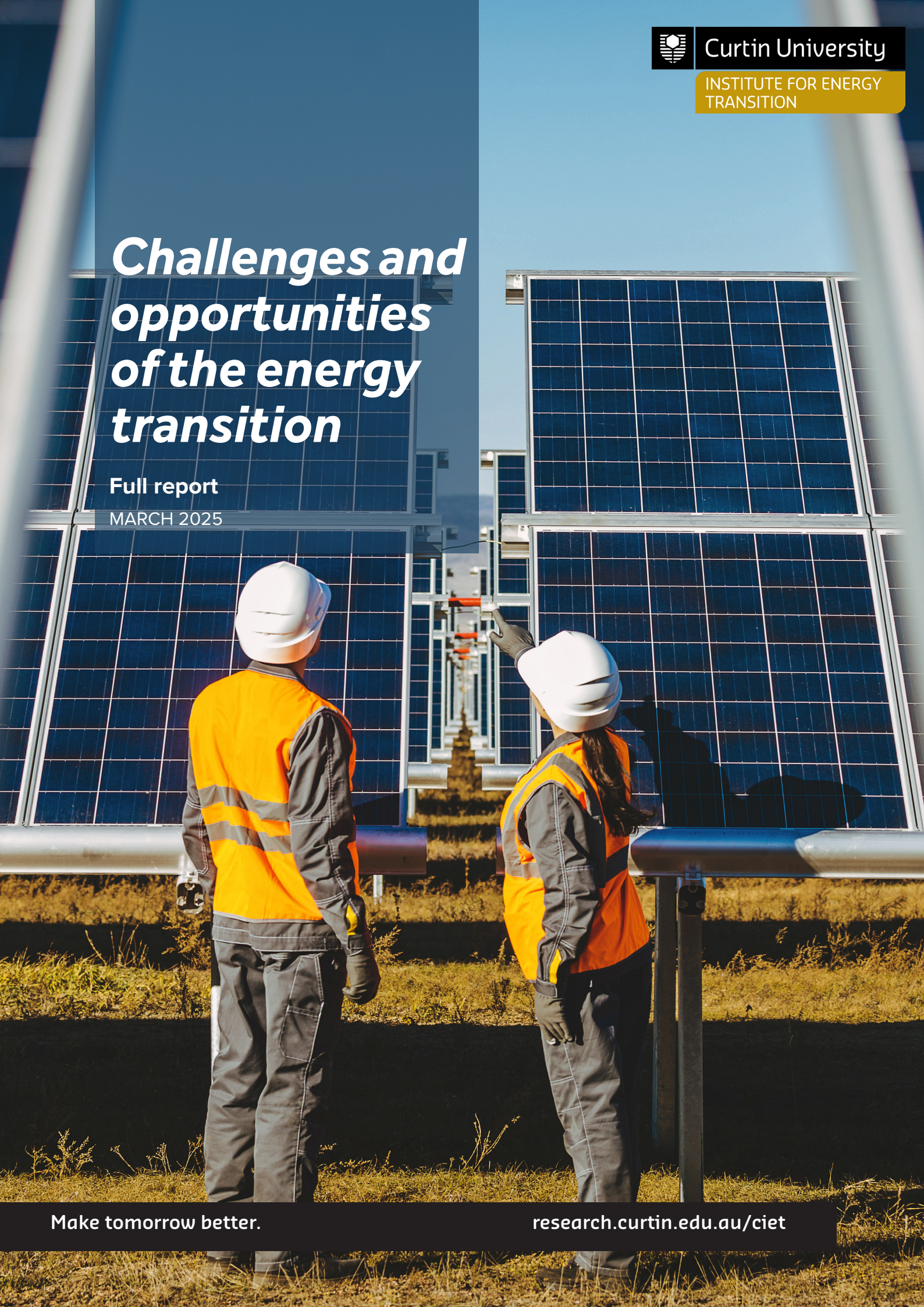

Curtin University
INSTITUTE FOR ENERGY TRANSITION

Challenges and opportunities of the energy transition

Full report

MARCH 2025

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Acknowledgement of Country

We respectfully recognise the Whadjuk Elders past and present as the Traditional Owners of the Nyungar boodja on which the Curtin Institute for Energy Transition is located.

We acknowledge the tens of thousands of years of Indigenous knowledge, culture and insight into living sustainably and caring for the natural world that have shaped this land and our ongoing research.

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EXECUTIVE SUMMARY

This report presents the results of a national survey of 600 Australians on the challenges and opportunities of the energy transition.

Data was collected between January–June 2024, with respondents identifying their top three global and national challenges and opportunities. Systematic analysis of the data resulted in the identification of the following key themes.

Cost of implementation and affordability

This was the most frequently cited theme and was perceived as a challenge and opportunity at both global and domestic scales. At the global level, references to cost spanned the whole energy supply chain, from raw materials to labour shortages, whereas the primary concern domestically was the affordability of electricity, and the cost of distributed energy resources (DERS) to consumers and businesses under existing economic pressures. While it was recognised that costs of new energy sources may decrease over time, respondents felt that traditional fossil energy sources currently appear cheaper, although they failed to acknowledge the subsidies that are involved in their supply.

Business owners stressed the extra burden of how the energy transition will affect their overall investment and business decisions. They expressed concern that expenses may rise even further due to infrastructure construction costs being incorporated into their bills. Within Australia, being able to balance economic growth with the process of decarbonisation was perceived to be difficult. Concerns were raised that the vested interests of the fossil fuel industry are affecting capital investments and willingness to transition. On the global scale, opportunities are thought to arise for alternative trading agreements and new business models for the commercial and domestic energy supply.

Reducing greenhouse gas emissions

This was also perceived as both a challenge and an opportunity. At the global level, geopolitical unrest and slower supply chain movements post-COVID were highlighted as challenges preventing emissions reductions and the construction of new infrastructure, whilst at the domestic level themes about a lack of ambitious federal policy, government ties to the fossil fuel industry, and a lack of social acceptance of renewable energy technologies and associated infrastructure were prevalent. Concerns were expressed over the waste from renewable energy products, such as end-of-life solar panels and wind turbines, will be disposed at both the domestic and global level.

Environmental opportunities emerging from the energy transition at the global level focused on the preservation of natural resources, increased energy stability and stabilised energy costs. On a domestic level, there was a greater focus on individual health, with participants believing that the energy transition would result in cleaner air and, therefore, fewer respiratory diseases.

Scale and complexity of energy transition

Respondents recognised the need for rapid system-wide changes supported by policy and regulation to enable the transition away from fossil fuels. At the global level, respondents described the challenges of changing entire energy systems, whilst in Australia the focus was more on addressing local infrastructure and skills gaps. Domestically, ensuring that all domains of the energy transition are synchronised was seen as challenging given that very few of the components needed for the transition are produced locally. This was seen as being even more challenging given that Australia will need to import such goods at a time when they will also be in high demand. There was also a sense of urgency over the time lost in the past decade, with a faster transition now required because of past inaction.

Innovation and new technology

This was seen as an opportunity domestically, with renewable energy systems perceived by some to become more reliable and efficient with time. Likewise, the creation of new technology

was recognised as opening up opportunities for innovation on a global scale. Alternatively, some participants expressed concern over whether the new energy systems would be accessible to those in hard-to-reach areas, and able to cope with increasing and variable demand.

Public awareness

Public awareness of the need, urgency and seriousness of the transition was believed to be lacking. Respondents attributed this to the enormity of the transition, as well as misinformation circulated by media, influencers and fossil fuel interests. It was suggested that people require information that is easily accessible and in plain language.

Political will

Political will was highlighted as a challenge at both the global and domestic levels, with respondents describing the need for effective policy at all scales. Global challenges included the need for international cooperation and the impact of geopolitical tensions on global politics and, ultimately, the energy transition. At the domestic level, respondents described the transition as being hampered by misaligned state and federal policies and short election cycles. Domestic political and policy challenges were also recognised in the form of political inertia, disagreements across government levels, lack of funding, lack of incentives for transitioning and the impact of the fossil fuel industry on shaping political priorities.

Policy shortcomings

Policy was perceived to be inconsistent and lacking both globally and domestically. On a global scale, international coordination was believed to be a challenge, while international collaboration was seen as an opportunity. The focus of challenges domestically was on vested fossil fuel interests, policy misalignment and regulatory fragmentation. Domestically participants called for more incentives and subsidies at the household level, and more tax and other disincentives for traditional fossil fuel energy industries. On both levels, there was a call to redesign policies to ensure greater support for the transition.

Energy systems

Energy systems were identified with a focus on the global challenge of finding the right energy mix to maintain a consistent energy supply along with an opportunity to improve energy security by diversifying energy sources. This was seen to be complicated by global competition for supply chain components. Domestically the scale of energy networks was flagged as a challenge, especially in sparsely populated regional and remote areas.

Employment issues

Declining employment in the traditional energy sector concerned respondents, particularly where large numbers of workers would need to reskill to find work in a new type of energy industry. On the other hand, it was recognised that those who do have relevant skills will be in high demand. Globally, this was thought to impact regions with large fossil fuel industries, whilst domestically, participants highlighted specific issues around ensuring affordable and streamlined training opportunities.

Infrastructure requirements

The need for infrastructure was predominantly a concern at the domestic level, where respondents focused on challenges associated with upgrading aging energy grids and securing funding for new projects with high initial capital outlay. Respondents expressed concern about the lack of infrastructure readiness along with the impacts it will have on the way the landscape will look. There was also concern about ensuring that infrastructure is fit for purpose in Australia's harsh and vast environment. Storage in parts of Australia that have extreme heat was flagged as needing to be fit for purpose. Similarly, it was suggested that Australia's roads will need additional maintenance to cope with the weight of electric vehicles.

Globally there was a focus on upgrading energy infrastructure and building manufacturing and energy storage facilities. A challenge to the needed construction was considerations around a social licence to operate, where participants highlighted a lack of social acceptance for the use of agricultural land for energy generation and storage.

Social licence

Social licence was perceived as a challenge domestically where respondents felt that regional communities oppose the development of renewable energy and transmission infrastructure due to loss of amenity, insufficient local benefits and lack of involvement in decision-making. Respondents saw a need to bring communities along on the transition through effective engagement, particularly in regions dependent on fossil fuels where jobs may be lost. Some also described the need for systemic change, which includes changing habits and disrupting the status quo.

Social equity

This was noted as a persistent challenge with many parts of the globe experiencing energy poverty. Equity issues were expected to improve with time with the inevitable decentralisation of energy systems providing clean and affordable energy to previously underserved areas, particularly in the Global South. Redistributing power from energy monopolies was thought to create opportunities for more local involvement and ownership models as part of new energy provision through renewable energy projects. In Australia, this was thought to reduce reliance on unstable supply chains and improve the possibility of a just transition.

Community cohesion

Increased community cohesion was described as an opportunity both domestically and globally. Participants highlighted that redesigning buildings and transport systems could improve both psychological and physical health. Domestically, opportunities for enhancing social and community improvements would provide improved outcomes around urban design, health and transport. Public education and awareness were identified as both a global and domestic opportunity. However, more specific examples were provided at the domestic level, with options for increasing public knowledge, including in-school education and higher education courses.

Global leadership

Over both global and domestic domains, many respondents saw an opportunity for Australia to become a global leader in the energy transition, particularly given its access to solar, wind and hydrogen resources. Decentralisation from global and corporate actors was thought to lead to greater energy democratisation as more diverse energy options become available.

1.

INTRODUCTION

Project background

Energy systems across the world are in the midst of unprecedented transformation. The dual challenge of limiting global warming and moving away from fossil fuel resources requires an urgent, system-wide shift to renewable energy sources. While this energy transition can bring a number of opportunities it is not without its challenges. To be successful it requires government, industry, and communities to work together to achieve a shared vision of a low carbon future.

The energy transition in Australia has been politically contentious, with division between the major political parties resulting in an inconsistent and piecemeal approach to decarbonisation. Australia has one of the highest per capita carbon emissions in the world (Sucahyo & Rahmani, 2023) and in 2024 coal remained the largest single source of electricity, accounting for approximately 52% of Australia's energy generation (AER & AEMO, 2024). Yet, given the size of Australia and its abundance of renewable energy resources, Australia remains well placed to be powered by renewable energy (Graham et al., 2024). The Australian Energy Market Operator (AEMO) estimates that Australia will need to install at least 6GW of utility scale generation per year from 2024 to meet the Government's target of 82% renewables by 2030 (AEMO, 2024).

Although Australia lags in some areas of the energy transition, it is a global leader in rooftop solar adoption. Approximately 3.7 million Australian households have installed rooftop solar (Clean Energy Council, 2024), making it one of the highest per capita of installations in the world (Clean Energy Regulator, 2023). In 2023, rooftop solar provided 11.2% of Australia's electricity (Clean Energy Council, 2024) and continues to dominate Australia's renewable energy landscape.

Wind is another key player, with several large on and offshore wind projects either in operation, proposed or under construction (Clean Energy Council, 2024). As of 2023, wind power contributed 33.9% of Australia's renewable energy generation, whilst wind and solar energy production is set to triple by 2030 (Clean Energy Council, 2024). Hydroelectricity has also been a strong renewable energy source and in 2023 contributed 6% of total electricity (Department of Climate Change, Energy, the Environment and Water, 2024a).

Given the concerns over reliability of wind and solar in particular, there are several energy storage solutions also being rolled out across the country. In South Australia, the Limestone Coast Energy Park with a capacity of 1,500 megawatt hours (MWh) is about to start construction. In Western Australia, the coal mining town of Collie is constructing the Collie Battery Energy Storage System, to provide 2,000 MWh when fully charged (Monaghan, 2024).

However, compared with 2023, 2024 has shown a considerable downturn in new financial commitments to large-scale energy generation projects (Clean Energy Council, 2024). Public opposition or social licence to operate (SLO) considerations have been a major contributor to slow progress. There is also greater awareness of the need to consider Indigenous rights and meaningfully consult with communities on issues such as land access, land use, and native title considerations. This means engaging communities on the topic of energy transition and new projects to build trust and understanding of the need for the transition have become extremely important if Australia is to deploy renewable energy at scale.

To better understand current perceptions of the challenges and opportunities that are present as part of the energy transition, The Curtin Institute for Energy Transition (CIET) conducted its first national survey of Australians' perceptions of the energy transition.

Research approach

The qualitative online survey required respondents to identify what they believed were the top three challenges and opportunities in order of significance arising from the global energy transition at both global and regional levels. The target audience was owners or decision makers within small to medium enterprises or industries.

Respondents were recruited through snowball sampling and a market research company. The research was approved by the Curtin Human Ethics Research Committee (reference HREC2023-0618).

A total of 3758 responses were obtained between 25 January 2024 to 10 June 2024. Of these, 84% were screened out due to ineligibility of respondent or incomplete responses, leaving a suite of 600 responses for analysis. The data was imported into NVivo® for coding. Summative content analysis was used, where similar challenges and opportunities were grouped together into themes, quantified and interpreted. First, two coders worked on the original 100 responses and then two more coders independently analysed the top 3 challenges and opportunities of 100 responses of the combined sample. The two coders then compared their themes for any inconsistencies to ensure ongoing congruency of their coding.

The coders recorded the number of references to each theme and used this to rank each theme (see Tables 1-4). The number of references to each theme within the three priority categories was also tallied. These may not add up to the total number of references as individuals may mention more than one aspect of the same challenge in their description.

During the coding it was noted that participants described more challenges than opportunities.

A second trend was that participants often used Australian examples when describing global issues. This is likely a result of the participants residing in Australia and therefore drawing on their lived experiences when describing challenges and opportunities. We only report on the responses corresponding to their correct categories (e.g., we did not code a challenge as domestic if it was entered in the global challenge section). Descriptions of each theme with supporting quotes are provided in Appendix 1.

The gender balance of the final 600 respondents was 54% male and 46% female. The most common age group was 30-39 years old which accounted for 28% of all respondents, followed by 41-49 (24%) and 51-59 (17%). Over half (60%) of respondents worked full time, with 67% working in commercial organisations. Respondents were either owners or managers of the business (32%) or key decision makers in the business (53%). Almost half (46%) of respondents held a bachelor's degree and 20% held a master's degree. On average, respondents had spent 14 years in their field and came from a wide range of occupational sectors. The top four sectors were professional, scientific and technical activities (16%), construction (10%) and education, health and social work (9%). Further details of respondents' backgrounds are provided in Appendix 2.

2.

GLOBAL CHALLENGES

KEY POINTS

- The current global economic and political situation is widely recognised as presenting significant challenges to delivering the energy transition
- Respondents were sensitive to the issues of equity and justice surrounding the transition to adopting renewable energy and how these need to be integrated into the planning process
- Structural and infrastructural constraints are impeding the transition towards renewables, necessitating co-ordinated, sustained policies and multilateral approaches

Table 1. Prioritised global challenges identified by participants (n=600)

Rank	Challenge	Total participants	Total references	Priority 1 references	Priority 2 references	Priority 3 references
1	Cost and affordability	342	695	316	217	129
2	Minimising GHG emissions	222	472	178	126	113
3	Political will and policy	201	437	110	139	156
4	Social licence, community engagement and equity	197	402	103	102	157
5	Technological and infrastructure	127	240	74	82	66
6	Reliable clean energy	104	178	64	62	43
7	Speed and scale	83	140	46	34	44
8	Slow supply chains	75	128	32	53	42
9	Lack of skills, jobs and expertise	74	99	15	29	50

Cost and affordability

Cost and affordability was the most significant and frequently cited global challenge associated with the energy transition. The affordability of the energy transition for both households and business is a common concern alongside the lack of will to deploy the necessary capital.

The most frequent references to affordability include the current high price of energy. Respondents stated that people and businesses were struggling to pay bills and hence upgrades to existing systems will be unaffordable. Additional economic pressures were felt to arise in the context of inflation, recession, housing crises, lower wages and higher costs.

While many participants believed that whilst initial costs associated with the transition would be high, over time, affordability would improve and cost-of-living impacts would be reduced. Some participants also maintained that traditional (ie fossil fuel) energy sources remain more cost effective than renewables.

Participants felt that the key to widescale energy system changes is capital deployment into infrastructure and technology, as well as investment in research and development. Investment decisions were believed to influence both the speed and the long-term cost of the transition.

There was a perception that business and government need to accelerate capital and investment in renewable energy. However, a lack of funds post-COVID, rising costs and an unfavourable economic climate were seen as making the substantial capital outlay required unappealing or even impossible. This lack of investment was linked to market instability arising from technology that is not yet fit for purpose, geopolitical tensions, limited global collaboration, and the scale of investment needs. As a result, businesses without access to the necessary capital were thought to have no options but to continue operating in a business-as-usual mode relying on higher-polluting fossil fuels. Additionally, the pace of change was viewed as problematic, with demand outstripping supply, creating bottlenecks and driving up the price of new technology.

Minimising GHG emissions

The need to minimise GHG emissions was highlighted by 37% of respondents, stressing the urgency of climate change mitigation measures and the phasing out of fossil fuels. With the escalating frequency of extreme weather events and natural disasters, participants noted the challenge of ensuring infrastructure is resilient and suited to changing environmental conditions. In particular, some participants questioned the suitability of battery storage technologies in extreme climates, underscoring the importance of “fit-for-purpose” solutions.

Complementing the focus on emissions reduction, some participants stressed that reduced energy demand and resource consumption is equally important. They suggested that a global cultural shift from a “consumption mindset” and shifting energy consumption to periods of high renewable energy availability to avoid shortfalls during peak usage times are challenging but necessary.

Some participants acknowledged paradoxes in minimising GHG emissions such as the demand for rare minerals for green technology driving further deforestation and land degradation in developing countries.

Political will and policy

This theme comprised perceived challenges relating to the geopolitical climate, bureaucratic red tape, vested interests and lack of long-term government planning.

Geopolitical conflicts, including the Israeli-Gaza conflict, the war in Ukraine and rising tensions with China were mentioned as factors slowing and creating uncertainty in the energy transition. In this context, becoming less reliant on international actors and ensuring a diversified energy mix was thought to be important for ensuring enhanced energy security and fostering a more reliable and resilient energy system.

Red tape and bureaucratic inefficiencies, coupled with a lack of practical knowledge were described as barriers to innovation and progress. Participants called for the streamlining of regulatory processes to accelerate the energy transition, whilst the short-term nature of election cycles was viewed as incompatible with the long-term systemic changes required to successfully transition.

Vested interests arising from government ties to fossil fuel industries were identified as slowing the rate of transition. Others suggested that the fossil fuel industry deliberately delays the transition through overt blocking and denial or covert expressions of power and influence.

Respondents felt that the lack of political action was exacerbated by the divided, fragmented and contradictory messaging that takes place in politics, mainstream and social media. They also pointed to the voluntary nature of meeting transition

targets and the lack of accountability for the biggest contributors of emissions from traditional fossil fuel sources.

Social licence, community engagement and equity

Social challenges at the global scale comprised concerns regarding a lack of social licence, the need for effective engagement and ensuring an equitable transition.

Social licence was mentioned most often in relation to infrastructure and land use, particularly in rural and regional areas where transmission lines, wind turbines and solar farms are usually located. Participants noted that rural and regional communities hosting projects often feel disproportionately burdened by projects, particularly when the perceived benefits such as reliable energy are often enjoyed elsewhere.

Social licence was also tied to broader societal challenges, including the public's reluctance to change consumption habits, scepticism toward new technologies, climate change denial and pervasive misinformation. Misinformation on the necessity of the energy transition and the types of technologies needed was seen to be perpetuated by both traditional and social media. Both nuclear and wind were identified as energy sources with limited public acceptance.

Suggestions to improve social licence included normalising the presence of new energy infrastructure and addressing public misinformation by providing accessible and transparent public education on the necessity and benefits of the energy transition. Effective community engagement emerged as a key recommendation to achieve these goals, with participants advocating for collaborative planning and consultation processes that respect the needs and concerns of affected groups and build the trust of the community.

However, participants warned of consultation fatigue, particularly in regions facing multiple overlapping projects, and noted that existing approval frameworks are often inadequate for addressing cumulative impacts.

All of the above were linked to concerns over inequitable outcomes, with participants emphasising the need for a just transition. There were concerns that power imbalances may lead to an exploitation of communities and countries characterised by poverty or diminished public services in the Global South. To improve equity, participants called for policies that prioritise inclusivity and fairness. Examples included supporting vulnerable communities, particularly those reliant on fossil fuel industries, and ensuring that First Nations and regional voices are included in decision-making.

Technology and infrastructure

Participants recognised that the energy transition involves the implementation of huge infrastructure projects combined with the technological challenges of decommissioning fossil fuel assets. Both were described as expensive and time consuming given the urgent need to transition.

A recurring concern was the insufficiency of ageing grid networks to accommodate inputs from renewable energy sources. Modernising and expanding grids, building transmission lines, and energy storage solutions were perceived as costly and logistically complex, exacerbating the already high financial demands of the transition.

There was also recognition that infrastructure requirements for the electrification of some sectors was not fit for purpose. For example, advanced battery storage systems, were described as either underdeveloped or prohibitively expensive for widespread use. In the transport sector, there was thought to be insufficient charging stations for electric vehicles, and the weight of batteries within the heavy vehicles were seen to create issues with existing roads.

Sourcing materials was also a challenge, with the reliance on imported components for batteries causing supply chain delays alongside environmental and social concerns associated with raw material extraction in the Global South. Moreover, participants highlighted the global challenge of managing waste from obsolete or expired components, such as solar panels, wind blades and batteries, stressing the need for better recycling and disposal systems.

Reliable clean energy

Participants believed it was essential that renewable energy options can match the reliability of traditional fossil fuels, especially during periods without sun or wind. Many participants expressed scepticism of the capacity of a fully renewable system to provide a consistent supply of energy. Solutions proposed to help with reliability included building large scale batteries and pumped hydro, but finding appropriate land and space to build new projects was a challenge. Natural disasters and geopolitical events were highlighted as threats to the reliability of global energy systems, with participants calling for diversification and decentralisation of energy systems as part of a risk mitigation strategy.

Speed and scale

The tension between the urgency of rapid decarbonisation and the realistic feasibility of achieving it within constrained timelines was identified as a major global challenge of the transition.

With respect to the speed of transition, most respondents believed the current pace and scale of the energy transition was insufficient to meet global climate targets. Respondents cited the slow pace of technological development, deployment, and infrastructure expansion required to support renewable energy systems. Adding to the complexity was the scale of the transition, which was perceived as presenting unprecedented challenges, including the need for extensive overhaul of how energy is generated, stored, and distributed at a global level.

Participants also highlighted delays caused by regulatory frameworks, poor decision-making, and logistical hurdles such as sourcing equipment and completing environmental assessments. These delays are compounded by competition for scarce resources, materials, and skills, leading to increased costs and slower progress.

Slow supply chains

Respondents indicated that slow supply chains were a challenge reflecting the scarcity of critical raw materials for renewable technology such as lithium and other scarce elements. This scarcity, coupled with growing global demand and competition for resources, was seen to delay projects and increase costs. In addition, vulnerabilities arising from an over-reliance on specific regions for supply underscores the need for diversified and resilient supply chains. Compounding these issues, participants described manufacturing and logistical bottlenecks, particularly post-COVID, including insufficient capacity to produce and transport necessary equipment and infrastructure.

Lack of skills, jobs and expertise

Respondents felt that the energy transition needs a workforce equipped with new skills and expertise, yet a pervasive lack of skilled labour, including engineers, tradespeople and technicians, was seen to delay the implementation of renewable energy projects. Participants from energy related industries noted difficulties in finding and retaining suitably qualified personnel to support the transition. Whilst upskilling and retraining was seen as essential, participants acknowledge that this would be time consuming and expensive. In addition to logistical and economic concerns, participants highlighted social implications of the transition including the displacement of workers from traditional energy sectors.

3.

GLOBAL OPPORTUNITIES

KEY POINTS

- Respondents displayed clear agreement on key global opportunities relating to long-term environmental, social and economic benefits associated with the energy transition
- Employment opportunities, re-skilling and more liveable communities were associated with enhanced individual and societal wellbeing
- Technological advances were seen as underpinning a move towards resilience, adaptive capacity and empowerment

Table 2. Prioritised global opportunities identified by participants (n=600)

Rank	Challenge	Total participants	Total references	Priority 1 references	Priority 2 references	Priority 3 references
1	Reducing human impact on the planet	267	554	208	153	67
2	Lower long-term costs and increased economic benefits	257	539	177	165	70
3	Development of new skills and employment	127	224	88	74	26
4	Improved community wellbeing	105	163	58	52	30
5	Redistribution of global and corporate power	95	158	53	50	36
6	Technological innovation	90	161	60	50	24
7	Improved energy systems	82	141	43	46	24
8	Australia as a global green energy leader	41	75	29	18	14

Reducing human impact on the planet

Opportunities to reduce the severity of human impacts on the natural environment were the most commonly cited and most significant global opportunity associated with the energy transition. There was a wide range of impacts cited, with climate change being the most common, followed by biodiversity loss and ecosystem health. Respondents envisioned clear links between achieving a successful energy transition and climate stabilisation, fewer heatwaves and a reduction in species extinction and habitat protection.

Lower long-term costs and increased economic benefits

Whilst the cost of the transition was previously identified as a global challenge in the short term, respondents also described several longer-term economic benefits associated primarily with the operational savings arising from renewable energy. This was anticipated to bring lower energy prices for households, businesses, and industries, increasing affordability and easing financial pressures. Additionally, the adoption of energy-efficient technologies was emphasised as a means of further reducing utility bills and production expenses.

Respondents also viewed the energy transition as a catalyst for investment and economic development, particularly through the establishment of new industries in electric vehicle manufacturing, battery storage and renewable energy infrastructure. These developments were expected to stimulate global markets, as well as create a more resilient, diversified and competitive economic landscape. The energy transition was generally perceived as helping to establish a circular, renewable economy disconnected from traditional fossil fuel-based industries.

Development of new skills and employment

The energy transition was considered to present significant opportunities for workforce transformation, resulting in new skills and employment opportunities across various sectors including manufacturing, installation, maintenance, and research and development. During the construction phase jobs were thought to be more short term, but over the longer term jobs in new energy industries would provide stability and a reduction in labour costs. Respondents also noted the potential for increased economic growth outside of major cities through sustained employment in renewable energy projects, particularly in underserved areas.

In order to fill new jobs, participants acknowledged the importance of developing new skills to meet the demands of a green economy. Upskilling existing workers was also mentioned, especially those transitioning from traditional energy industries like coal, to roles in renewable energy. Education and training programs were emphasised as critical to empowering the workforce and ensuring inclusivity in this economic shift. Alongside job creation, participants stressed the importance of aligning employment opportunities with community development. This includes protecting existing jobs in vulnerable sectors and fostering trust and social equity through a just transition.

Improved community wellbeing

Respondents suggested that the energy transition presents an opportunity to improve individual health, create more inclusive and liveable communities, and leave the planet in a better state for future generations.

At an individual level, participants linked the reduction in pollutants, particularly those associated with fossil fuel combustion, to improve respiratory and cardiovascular health, lower mortality rates, and enhanced overall wellbeing. Many link the energy transition to an opportunity to alleviate public health burdens and extend life expectancy.

At a societal level, responses highlighted the energy transition's potential to foster social cohesion and inclusivity. Participants envisioned a future where communities could play an active role in energy production and distribution. Decentralised energy systems such as off-grid solar or microgrids, were identified as a means to increase energy self-sufficiency and in turn greater social equity. These initiatives were seen as empowering underserved populations and enhancing participation in energy decision-making processes, thereby strengthening community bonds.

The need to build new infrastructure and electrify transport, cities and homes provides a window of opportunity for retrofitting and redesigning how we live. Participants noted the potential for the development of greener public spaces, cooler streets, and more comfortable and efficient housing. Sustainable transport systems and better public infrastructure were also identified as means to enhance the quality of urban life and mitigate climate-related stressors.

Finally, a strong focus on intergenerational

responsibility was evident in the responses. Many participants articulated the importance of the energy transition in safeguarding the planet for future generations. This emphasis reflected a collective desire to prioritise long-term wellbeing over short-term economic gains. Several responses called for a redefinition of economic value to encompass social and environmental wellbeing, emphasising the interconnectedness of community health and economic resilience.

Redistribution of global and corporate power

The transition to renewable energy was seen as an opportunity to reduce the dominance of large fossil fuel corporations, fostering a more competitive and equitable energy market. As the energy transition progresses and dependence on traditional energy declines, participants believed that energy systems would become more decentralised and countries less dependent on importing energy. This would alter the global balance of power currently favouring countries with large fossil fuel reserves and potentially foster a more cooperative and equitable international order. Similarly, the weakening of fossil fuel monopolies opens space for smaller businesses, local communities, and diverse stakeholders to thrive - fundamentally reshaping global energy and economic systems.

Participants envisaged that a successful transition would liberate countries from unpredictable and slow supply chains subject to wars and geopolitical tensions. With increased independence, countries would be more able to create local solutions to bring about greater equity and a fairer society. It was also suggested that an opportunity exists for improved global communication and collaboration through research which could allow for sharing findings and fast-tracking innovation. Wider diversification of the types of energy companies that currently exist was felt to reduce current monopolisation that occurs with many of the more traditional energy company structures.

Technological innovation

Participants emphasised the transformative role of technologies such as artificial intelligence (AI), machine learning (ML), and advanced data science in reshaping energy production, distribution, and consumption. New technologies and innovative solutions would need to be developed to match new energy system requirements, providing multiple opportunities for research into reducing emissions and developing new products and services. These would also foster cultures of collaboration and entrepreneurship. Participants were generally open and enthusiastic to the idea of innovation led by artificial intelligence leading to increased productivity. The impacts of these new technologies would be able to be monitored and reviewed in real time scenarios.

Improved energy systems

In contrast to the supply issues associated with renewable energy systems identified as a challenge in the global challenges, respondents embraced the way new energy systems could benefit efficiency, reliability, and system utilisation. Respondents felt that households, businesses and industries would have more reliable and diverse energy systems and that energy would be cleaner, cheaper, more efficient and more reliable. These benefits in turn were described as increasing energy stability and security while reducing dependence on others.

Australia as a global green energy leader

Australia was perceived as being in a prime position to lead the energy transition. This was based on the availability of land needed for large scale energy infrastructure projects, whilst abundant solar and wind resources meant Australia could become an international supplier of green energy resources. Together with boosting home-grown manufacturing of new products, these opportunities allow Australia and other countries, similarly placed, to become less dependent on others for energy.

4.

DOMESTIC CHALLENGES

KEY POINTS

- Household-level costs associated with the energy transition represent the overriding domestic challenge
- Sustained and bipartisan political commitment is necessary to overcome obstacles associated with the required changes to energy infrastructure
- Improved communication with affected stakeholders is essential to ensure justice and equity in the energy transition

Table 3. Prioritised domestic challenges identified by participants (n=600)

Rank	Challenge	Total participants	Total references	Priority 1 references	Priority 2 references	Priority 3 references
1	Cost and affordability	350	860	307	271	176
2	Social challenges	184	378	65	67	44
3	Political will and policy	169	395	93	129	146
4	Infrastructure upgrades	136	264	73	81	81
5	Energy system	116	236	56	54	45
6	Lack of skills, research and training	94	185	137	122	125
7	Mitigating GHG emissions and reducing environmental impact	94	179	28	88	69
8	Speed, scale and complexity	84	157	98	75	89

Cost and affordability

Cost and affordability was by far the most significant domestic challenge identified by respondents, receiving at least twice as many references as any other issue. This challenge reflects the unique dynamics of Australia's energy landscape, where affordability concerns, reliance on fossil fuels and a perceived lack of investor interest influence the pace and feasibility of transitioning to renewable energy.

Many participants expressed concerns about the ability of Australian businesses, industries and households to afford the energy transition. For Australian households, the upfront costs converting homes to renewable energy, including transitioning from gas to electric systems, was highlighted as a significant financial burden. This concern was attributed to a stressed economic situation where the cost of living has been rising rapidly and wage growth has been stagnant. Respondents highlighted limitations, particularly amongst low-income households, to invest in decarbonising their homes when they are faced with soaring energy bills.

The economic vulnerability of industrial sectors and regions reliant on fossil fuels was also highlighted as a challenge. Participants expressed concerns about stranded assets and the need for growth to counterbalance the impacts of decarbonisation in areas like the Hunter Valley and Queensland's Bowen Basin which depend on fossil fuel exports.

Developing new industries was perceived as difficult, with comments about the slow flow of capital into renewable energy projects a recurring topic in the responses. Respondents noted a lack of federal funding and hesitancy amongst private investors. Energy supply investment was characterised as generating low returns, necessitating the involvement of superannuation fund investors. Slow approval processes, dominance of short-term financial objectives and Australia's reliance on foreign capital were further believed to compound the lack of capital deployment into renewable energy.

From the consumer side, there was confusion around plans and funding for infrastructure. Participants recognised that, whilst building new infrastructure would be expensive, there was a lack of communication to consumers about the size of the investment required and the costs involved. Participants hoped to see clearer communication to consumers about the short-term and long-term costs of the transition.

Finally, a specific issue in the Australian context was the prioritisation of renewable energy exports over domestic energy use. Participants expressed frustration that renewable energy resources, such as hydrogen and solar energy products, are developed for export markets while domestic energy needs remain unmet or overpriced. This export-oriented focus was described as undermining the ability of Australian households and businesses to benefit from the energy transition.

Social challenges

Social challenges included community resistance and social acceptance of the energy transition, and concerns about a just and fair transition. Large-scale energy infrastructure projects, such as transmission lines and wind turbines, were believed to be met with widespread resistance by local communities. This was thought to be a combination of pervasive climate change denial, a perception that impacted communities bear the costs without tangible benefits, and community concerns that they are not meaningfully included in decision-making processes. Terms like "NIMBYism" (Not In My Backyard) and "community opposition" dominated many responses, and participants felt there was a lack of transparency in how projects are proposed and implemented. The perception that communities are being disregarded in this process fuelled further opposition to infrastructure projects.

Social acceptance of the energy transition was also believed to be being hindered by misinformation circulated by both mainstream and social media sources which are, in turn, influenced by those with vested interests in maintaining the fossil fuel industry. Changing people's attitudes and behaviours was recognised as being difficult at a domestic level, with a recognised need to bring individuals, businesses and the community along on the transition journey to improve social acceptance. Many responses stressed the importance of involving local communities in planning and decision-making to build trust and achieve social buy-in.

Similar to global challenges, participants were concerned that the energy transition will have a disproportional impact on some sectors of society and is therefore unjust. Australians living on low incomes, from marginalised communities and residing in regional and rural areas were all described as being adversely impacted.

Farmers and rural landowners were also thought to be at risk of losing productive farmland to energy projects, indicating a conflict between land-use priorities. Respondents indicated that scalable, affordable and efficient energy policies and solutions were required.

Participants also stressed the importance of support for communities who rely on the fossil fuel industry for employment, as well as renters with limited autonomy to electrify their homes.

Political will, policy and regulation

Lack of political will, poorly designed policy and insufficient regulation were mentioned by respondents. Political leadership at local, state, and federal levels was seen as fragmented, slow and lacking vision, fostering uncertainty and discouraging investment in renewable energy infrastructure. A lack of long-term vision was attributed, in part, to short election cycles and CEO tenures in Australia. Participants frequently cited the tendency of politicians to prioritise short-term electoral gains over the long-term structural changes necessary for decarbonisation. Participants suggested that rather than focusing on short-term goals, governments need to keep in mind the long-term nature of realising the transition to renewable energy. Bipartisan support for fossil fuel subsidies and entrenched relationships with the mining sector was further described as hindering progress.

Policy inconsistency is seen as slowing the transition, whilst Australia's regulatory environment was characterised by inefficiency and fragmentation. Participants repeatedly described "bureaucratic red tape" as a significant barrier, slowing project approvals, and generating widespread frustration with regulatory hurdles.

The regulatory framework's traditional focus on centralised, fossil fuel-based energy systems was thought to have stalled the adoption of renewable energy solutions. Participants identified this as a failure to modernise regulations to align with technological advancements and societal needs. Some participants also felt that the government fails to keep importers accountable for compliance and performance, whilst domestic energy use is over-regulated and excessively monitored. To improve policy and regulation, participants stressed the importance of a unified national approach to the energy transition similar to the National Water Initiative. Such a framework would provide a clear, bipartisan roadmap for emissions reductions and investment in renewable energy projects.

Infrastructure upgrades

Transitioning from centralised power systems designed for fossil fuels to a mix of centralised and distributed power systems was believed to pose significant challenges and many respondents expressed concerns that the amount of infrastructure required may not be achievable by 2030 to meet Australia's renewable energy targets. Participants described Australia's energy systems as outdated, not fit for purpose, and lacking the capacity to support the transition. Specific examples included a shortage of transmission lines to transport energy from regional areas to populous city centres, insufficient long-duration energy storage, ports already dedicated to other services, and roads unable to withstand the heavy transport required for the transition. Competing land use was also raised as a critical consideration, given the gigawatt-scale renewable energy and transmission infrastructure required. Participants highlighted the tension between agricultural, urban, and renewable energy needs, underscoring the importance of careful planning.

Infrastructure to support emerging technologies, such as electric vehicles, was seen as essential yet underdeveloped. Similarly, retrofitting buildings to move away from gas was compared to constructing new buildings, with both options deemed expensive. Cost-effective and scalable solutions, such as battery storage, were identified as necessary to ensure grid stability and reliability.

Energy system

Challenges associated with new energy systems centred on ensuring accessibility, reliability and availability of power once traditional energy sources are discontinued. Participants expressed concern that a grid powered by renewable sources, particularly solar and wind, may not provide adequate baseload power. This was attributed to factors such as the lack of sufficient storage technologies and rapid demand growth, particularly in electric vehicles. Respondents were also concerned that renewables provide insufficient backup if a primary system failed. The need for modernisation to accommodate decentralised and renewable energy sources was a recurring concern, particularly given Australia's vast landscape and uneven distribution needs.

Adding to these issues is the complexity of transforming energy systems. The technical jargon dominating discussions about energy markets was thought to create a barrier for public understanding

and engagement, fostering suspicion and resistance to change. Furthermore, delays in constructing essential transmission infrastructure impede the deployment of renewable projects, forcing continued reliance on fossil fuels.

Finally, the dual challenge of mitigating climate risks while adapting energy systems to withstand climate events was acknowledged. With the increasing frequency of extreme weather events, ensuring the resilience and reliability of clean energy systems was viewed as critical. These concerns point to the importance of balancing long-term climate goals with the immediate need for reliable, equitable, and robust energy infrastructure.

Skills and training

Participants identified a critical shortage of a skilled workforce to support the rapid and large-scale adoption of renewable energy technologies. A major concern was the lack of technical expertise needed to implement and maintain new renewable energy systems. Many organisations, particularly in regional areas where renewable infrastructure is concentrated, were described as struggling to attract qualified candidates. Participants also highlighted Australia's aging workforce and insufficient STEM skills among younger generations as factors limiting the domestic talent pool. At the same time a loss of jobs and economic disruptions caused to regional areas reliant on traditional energy was a concern.

To address these shortages, participants suggested retraining workers from traditional industries such as coal but acknowledged the upskilling processes as lengthy and resource intensive. Participants also noted a lack of coordinated training pathways, accredited courses, and government funding for clean energy research and education. While skilled migration was seen as essential for bridging workforce gaps, it was recognised as challenging as Australia is competing with international demand for talent.

Mitigating GHG emissions and reducing environmental impact

Respondents believed it was important to prioritise GHG mitigation over short-term economic objectives, and many criticised the ongoing dominance of coal, natural gas, and oil in Australia's energy mix. However, participants acknowledged substantial challenges to this shift, including the entrenched economic dependencies to sustain Australia's export economy, outdated infrastructure, and opposition from vested fossil fuel interests.

Participants also expressed confusion over when coal fired power stations should be closed, what will be used in place of coal, and how tangible reductions in emissions will be achieved by 2030. At the same time, participants were concerned with the environmental impacts associated with solar panels and wind turbine waste as well as the environmental damage caused by lithium extraction.

Speed, scale and complexity

The domestic energy transition is characterised by immense challenges related to the speed, scale, and complexity of implementation. Many participants expressed concerns about the slow pace of progress, particularly in constructing renewable energy facilities. The retirement of fossil fuel infrastructure was seen as outpacing the development of renewable alternatives, creating potential energy supply gaps. Participants emphasised that without significantly accelerating efforts, national energy goals may remain unmet. There was a sense of panic in participants' statements, and an urgent need to make up for lost time and inaction.

The scale of the transition was seen as a challenge at the domestic as well as global level. Participants pointed out that achieving ambitious energy targets requires vast investments in infrastructure and workforce development. Such efforts were described as demanding billions of dollars, robust governance, and coordinated planning at both state and national levels.

Finally, the demands of competing timescales associated with phasing out fossil fuels and introducing renewables was seen as adding to the complexity of the energy transition.

5.

DOMESTIC OPPORTUNITIES

KEY POINTS

- Respondents envisioned Australia as a global leader in the energy transition, enabling transformative economic benefits across rural and urban areas
- Opportunities relating to environmental, health and societal wellbeing are seen as integral to the energy transition
- Respondents favoured strong and consistent policies to incentivise equitable, fair and appropriate actions at the individual and collective level

Table 4. Prioritised domestic opportunities identified by participants (n=600)

Rank	Challenge	Total participants	Total references	Priority 1 references	Priority 2 references	Priority 3 references
1	Lower long-term costs and increased economic benefits	235	462	199	161	102
2	Climate change mitigation and improved environmental outcomes	177	357	131	105	121
3	Green skills revolution	122	232	91	93	48
4	Empowered, healthy communities	85	159	50	52	57
5	Improved energy systems	66	101	32	32	37
6	Decentralisation and diversification of energy	61	101	34	28	39
7	Regulation, policy, subsidies and support	46	93	28	38	27
8	Innovation and technological advancements	43	64	15	31	18
9	Public education and communication	39	66	20	15	31

Lower long-term costs and increased economic benefits

The main domestic opportunity associated with the energy transition, similar to that identified at the global scale, involved the lowering of costs and benefits to the economy, reflecting issues identified at the global scale. In the domestic context, respondents felt that the energy transition could stimulate economic growth through the creation of new industries powered by renewables. Australia's abundance of resources was seen to make it particularly well-placed to provide energy both domestically and internationally, generating export and trading opportunities. Many participants expressed the opinion that Australia's economy could become a more sophisticated one which transcends the current mining and export system.

Cheap and reliable domestic energy was seen to strengthen local manufacturing opportunities and improve supply chain resilience as Australia would become more self-sufficient. At the household level, the growth of rooftop solar energy was particularly emphasised to help reduce energy bills, increase household savings and improve quality of life. Cost savings were also associated with renewable energy storage technologies, such as batteries, which were noted as becoming more affordable over time.

Additionally, participants identified opportunities to establish new trading markets and business models, alongside a shift toward circular economies. These transformations were described as drivers for the creation of new companies and start-ups, further generating economic opportunities. Furthermore, an important dimension of the responses was the perceived potential for economic benefits to extend to First Nations communities. Participants also believed the energy transition would diversify energy providers, breaking the current monopoly and increasing competition, which in turn would drive down energy prices. This diversification was seen as a pathway to greater affordability and broader access to clean energy across the country.

Climate change mitigation and improved environmental outcomes

Responses revealed the significant perceived opportunities for Australia in leveraging the energy transition to combat climate change and achieve improved environmental outcomes. A recurring focus was on reducing carbon emissions through shifting the National Electricity Market (NEM) from predominantly coal to renewables. According to participants, other key sectors needing decarbonisation were heavy industries such as steel and cement, and transportation.

Beyond decarbonisation, participants emphasised co-benefits of the transition such as reduced ecosystem degradation, and increased sustainability. Initiatives like sustainable urban planning and renewable energy infrastructure investment could provide further long-term advantages, helping protect Australia's natural heritage while supporting economic growth. Environmental protection was also perceived to align with Australia's need to preserve cultural practices like reintroducing Indigenous-led controlled burns for reducing bushfire risks, which in turn safeguards energy infrastructure and fosters climate resilience.

Green skills revolution

Employment and training opportunities were the third most frequently cited opportunity. Participants described that the energy transition necessitates the creation of entirely new job sectors in construction, operation, and maintenance of renewable energy sectors, particularly wind and solar. Collectively, these promise a broad spectrum of employment opportunities across urban and regional areas.

The importance of reskilling and retraining programs to prepare the workforce for new energy systems was emphasised by participants. For instance, the energy transition is seen as a chance to redeploy workers from traditional fossil fuel industries into emerging green sectors, fostering job security while contributing to Australia's clean energy goals.

Participants saw local training programs as vital, and the success of training programs was believed to be dependent on strong partnerships between government and educational institutions. The focus on developing local talent was particularly salient in the context of regional Australia, where investments in renewable projects can act as catalysts for regional economic revitalisation. The transition can help to shape the future for generations of Australians, retaining young people for work, who can grow their careers in energy transformation. The generation of new industries was thought to lead to Australia becoming an international energy jobs destination.

Empowered, healthy communities

Respondents expressed opportunities for significant social and community improvements, offering enhanced equity, cohesion, and quality of life while addressing environmental challenges.

A recurring theme in survey responses was the potential for renewable energy to foster greater social equity and inclusion. Many participants emphasised the need for fair access to renewable energy systems, noting that benefits should extend beyond wealthy, metropolitan, white Australians to encompass all members of society.

Community-based solutions were highlighted as a means to reduce societal divides and ensure that vulnerable groups are not left behind. Additionally, participants underscored the importance of empowering First Nations communities through collaboration and co-design of renewable energy projects, presenting the energy transition as an opportunity to address historical inequities and strengthen inclusivity.

Improved quality of life also emerged as a social opportunity of the energy transition. Survey participants cited less water, air and noise pollution, more efficient homes, and more sustainable urban designs. Similarly, the transition is seen as a driver of urban and regional development. Participants envisioned smarter cities with community solar hubs and efficient energy use, as well as significant opportunities for economic growth and revitalisation in rural and remote areas.

By addressing regional disparities, the energy transition can create a more balanced and equitable distribution of resources and opportunities across Australia.

Improved energy systems

Participants described an opportunity to create a more efficient, resilient, and globally influential energy framework, leveraging Australia's unique advantages in renewable resources and technology.

Australia's vast landmass, high solar radiation levels, and favourable conditions for wind energy make it well-suited to host large-scale solar and wind projects. Participants frequently noted the opportunity to better harness these resources through advanced energy infrastructure, such as smart grids and integrated systems. Innovations like orchestrating smart loads to align energy supply with periods of abundance and scarcity were identified as key steps toward achieving efficiency, sustainability and energy security.

Decentralisation and diversification of energy

Responses relating to the decentralisation and diversification of energy highlighted the opportunity for a transformative shift in the nation's energy landscape, resulting in a more democratic and inclusive energy system.

Decentralisation emphasises the move from monopolistic, centralised systems to distributed energy models that make energy more equitable and inclusive. Participants highlighted increasingly localised generation and storage of energy, particularly through rooftop solar and battery systems, with consumers placed at the centre of decision-making processes. This was seen to reduce reliance on centralised grids and enhance resilience during disasters or unexpected system failures as well as reduce energy poverty through improved local access. As more types of energy become available, participants believed that traditional energy companies would lose their market share, resulting in lowering energy costs, increased competition and enabling smaller players to enter the market.

Diversification stresses the importance of strengthening Australia's energy portfolio by embracing the broader mix of domestic renewable energy sources to enhance energy security and independence. Diversifying energy sources was identified as critical for increasing resilience against global energy market fluctuations, geopolitical tensions and extreme weather events.

This strategic focus was felt to not only safeguard Australia's energy system but also position the country to leverage its renewable energy resources to become a decarbonisation hub for the Asia-Pacific region. By investing in diverse energy solutions, Australia can attract global investment, enhance local industry, reducing external dependencies and creating opportunities for long-term economic growth.

Regulation, policy, subsidies and support

Participants believed that actions associated with the energy transition should be regulated via robust frameworks. This includes mandates for energy-efficient construction, such as insulation requirements, double glazing, and banning gas installations in new buildings. Stricter fuel standards and corporate regulations to ensure fair pricing and quality in the energy sector were also suggested as key measures to support the transition.

The role of government was seen as facilitator rather than a controller. It was felt that governments are responsible for implementing and meeting targets to phase out fossil fuel use and to incentivise new industries including syngas (synthetic gas) and

green hydrogen. Participants favoured government investment in shared infrastructure to ease the burden on private entities and urged local councils to take on a more active role in managing green initiatives and rebate programs. Social equity was another critical focus, with suggestions to expand energy efficiency programs and subsidies to vulnerable populations to ensure they benefit from the transition.

Many saw the establishment of consistent and predictable policy settings as key to levels of government working together effectively. Subsidies were a commonly mentioned policy tool, with participants advocating for a reduction in fossil fuel subsidies and increased government support for solar panels, batteries and green hydrogen. Additional funding for energy-efficient infrastructure, particularly in rural and remote areas, was also identified as a priority.

Innovation and technological advancements

Opportunities for Australia to leverage its energy transition for innovation and technological advancement were mentioned by participants. Digital innovation solutions included using the Internet of Things, artificial intelligence, advanced computation and automation as transformative tools. Smart grids and energy storage were seen as essential for managing energy surpluses and shortages, particularly given Australia's high levels of distributed energy resources. Participants believed that investments in emerging technologies, including hydrogen fuel and battery storage, could position Australia as a global leader in renewable energy innovation.

The transition was also described as an opportunity for Australia to drive more specific advancements in manufacturing, battery production, and vehicle technology, attracting and retaining young talent who might otherwise seek opportunities overseas.

Australia was also envisioned as a pilot site for other cutting-edge energy solutions, particularly in rural and remote regions. Participants saw these solutions as exportable worldwide, creating economic opportunities while strengthening the domestic energy system.

Public education and communication

Respondents commented on the opportunity for public education and communication at the domestic level. It was felt that the energy transition provides an opportunity to correct misinformation, change attitudes, provide public and school education and implement much-needed educational courses in areas such as sustainable engineering.

Expanding opportunities for formal education in universities, TAFEs and schools was seen as important, with participants suggesting the targeted courses as well as more general integration of energy-related topics into curricula. Community-focused communication is equally important, with suggestions for training households on energy-efficient practices and engaging communities in holistic education efforts.

Other respondents recognised the importance of empowering individuals to take action on issues such as reducing carbon emissions and adopting clean energy solutions. Additionally, strategic use of media and outreach was frequently mentioned, with calls for impactful advertising campaigns and clear communication strategies to effectively convey the urgency and benefits of the transition.

Collaborations between governments, academic institutions, and industries was seen as key to ensure a unified approach to public engagement. By leveraging education and communication, Australia was thought to be able to become an informed and proactive society, accelerating its path towards a sustainable energy future.

6.

CONCLUSIONS AND NEXT STEPS

Respondents understood that climate change challenges are ongoing and referred to the increasing burden being placed on society and the environment.

Most emphasised an urgent need to mitigate the world's unabated greenhouse gas emissions. However, overwhelmingly, the cost of implementing the energy transition and resultant affordability of electricity were the dominant concerns. These concerns reflect anxieties about the financial pressure of the energy transition for households, businesses and industries.

A principal finding from this research was the perceived lack of an overarching plan for Australia's energy transition. Respondents highlighted the need to focus our efforts on developing a long-term bipartisan strategy that transcends politics and avoid excessive delays.

Despite the challenges in Australia of achieving such an outcome there are clear international examples that demonstrate that an overarching, bipartisan strategy is possible. In the United Kingdom, the Climate Change Committee's advice is accepted by all in Parliament. This was recognised in a recent policy review by the International Energy Agency which stated:

> "
>
> *...the country is a leader in clean energy deployment, particularly in offshore wind. This is in part thanks to strong climate policies, notably carbon pricing and the creation of an independent body, the Climate Change Committee, with statutory authority to track the government's progress toward its climate targets.*
>
> (IEA 2024)

Similarly in 2004, the Danish Board of Technology ran a Future Panel, comprised of 20 politicians, alongside an expert steering group. Over three years, the panel was able to set a long-term energy strategy for the country which has been subsequently implemented.

To overcome the lack of bipartisan support in Australia, there is a need for an independent body that sits outside of government, tasked with developing an overarching long-term energy strategy for Australia. The Australian Climate Change Authority (CCA) is an independent body established in 2011 which advises the Government on climate change policy. As part of its 2024 Progress Report, the CCA suggested the establishment of an Energy Transition Coordinator to deliver an 'economically efficient, reliable and low emissions' electricity system. Furthermore, the Net Zero Economy Authority created in 2024 is responsible for promoting a just net zero transition through coordinating initiatives and investment.

However, it is not yet clear if the NZEA on its own can develop a long-term energy plan, the need for which has clearly been identified in this research. Implementing the Danish Future Panel process could help, especially if the NZEA was tasked to oversee the implementation. Combined with the CCA's monitoring of greenhouse gas emissions reduction, this could establish Australia as a world leader in its mitigation efforts.

The most important next steps identified by respondents to assist Australia's energy transition included:

1. Development and coordination of a long-term, strategic bipartisan energy transition policy: Creating a coherent national strategy that aligns policies across all jurisdictions and removes political ideologies.
2. Planning for energy skills transition: Developing a skilled workforce to meet the demands of the energy transition, both in moving away from fossil fuels but also delivering increased renewable energy and associated infrastructure.

3. Community engagement strategy: Ensuring inclusive, transparent engagement with communities, and consistent messaging to create increased buy-in for what the transition will involve.
4. Industry empowerment and accountability: Supporting industry transitions while enforcing compliance to ensure we meet our required emissions reductions.
5. Innovation and global leadership: Positioning Australia at the forefront of clean energy technology and commercialisation by championing research and development

The remit of the NZEA aligns with the challenges and opportunities identified by the survey respondents, reflecting an appetite for change by the Australian public. It appears the challenge will be to ensure the NZEA can bring all sides of politics along and the public on the journey. Without harnessing this desire for change Australia will continue to wax and wane on its journey to net zero. It would also be a missed opportunity for Australia's innovation agenda that can help to generate further economic benefits.

Ultimately, failure to act now will have serious consequences for our industry, society and the environment.

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APPENDIX 1: THEMES, DESCRIPTIONS AND QUOTES

Please note that these example quotes have been reproduced exactly and may contain errors.

Table 5. Global challenges

#	Theme Name	Description	Example quotes
1	Cost and affordability	Challenges related to the securing capital and ensuring affordability for families and communities.	"Ensuring supply is affordable to all the community" "People will not transition if they are worse of financially or effects their company" "Not enough investment and funding"
2	Minimising GHG emissions	Challenges related to the environmental impacts both traditional energy industries and new construction and production, including climate change, pollution, and sustainability.	"moving away from coal and petrol is hard" "Getting off gas and oil" "Creating new infrastructure also releases carbon into the atmosphere"
3	Political will and policy	Challenges related to lack of political will, government structures, policies and regulations, that affect the. transition.	"(Un)Supportive or inconsistent policy and regulations" "The weaponisation of energy policy for political purposes in Australia for over a decade has prevented a coherent energy policy that has slowed adoption of renewables and exacerbated the problem" "No incentives for residential homes to be built environmentally friendly"
4	Social licence, community engagement and equity	Challenges related to public awareness and support of the transition, as well as ensuring impacts of the transition do not exacerbate social inequalities.	"Public awareness of the need to do this" "Rural community backlash regarding infrastructure" "The misinformation around the sustainability of certain energy technologies"
5	Technological and infrastructure challenges	Challenges related to the development, implementation, and maintenance of new technologies.	"The transition needs a huge amount of infrastructure which is using roads which are not used to such heavy and constant heavy vehicles" "How best to transport power generated to the area where it is to be used" "Relatively novel technologies may need further experimentation large-scale, leading to friction"
6	Reliable clean energy	Challenges related to ensuring a reliable and secure supply of energy during the transition.	"There needs to be confidence in industries, businesses and communities that the energy transition can deliver the same reliability as traditional sources" "Without power there is chaos" "Finding the optimal mix of renewables and fossil fuel generation that lowers emissions while keeping the grid reliable and dampening consumer electricity cost hikes."
7	Speed and scale	Challenges related to the speed at which change needs to happen at a global scale.	"The scale of the change needed is so big the public needs to accept that it is not just solar panels on roofs and some big wind turbines but a lot of different and maybe yet to be really technically ready by 2030" "Transition to renewables not at a rate where gas use can be terminated" "Pace is too slow to meet global decarbonisation targets"

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8	Slow supply chains	Challenges related to slow supply chains resulting from strong demand, geopolitical threats, a post-covid context and manufacturing capacity.	“Not enough capacity in the supply chain locally to fulfill demand” “Security and reliability of global supply chains” “Critical shortage of necessary downstream minerals”
9	Lack of skills, jobs and expertise	Challenges related to securing and keeping expertise as well as unemployment of workers from traditional industry.	“Not enough skilled engineers and trades to build out an alternative to the current fossil fuelled systems” “Unemployment of existing workers” “We don’t have the correct skills in house to transition smoothly”

Table 6. Global opportunities

#	Theme Name	Description	Example quotes
1	Reducing human impact on the planet	Opportunities related to avoiding the most catastrophic impacts of climate change, reducing polluting industries and improving human health.	"Not sure it is an 'opportunity' but staving off the worst of climate change is existential and the most important outcome from the transition (recognising that our contribution is small etc, but we need to stay focused on the 'why')" "Being sustainable to improve environment and reduce carbon emissions" "Improving our climate for future generations"
2	Lower long-term costs and economic benefit	Opportunities related to reduced energy costs in the long run as homes, businesses and industries electrify.	"New sources of energy has made energy system more diversified and this should potentially lead to better energy systems and lower cost to customers." "Higher return on investment as scale builds up" "Whilst the initial cost may be more, the long term cost may be cheaper"
3	Development of new skills and employment	Opportunities related to the creation of a new, more stable and more diverse job market.	"The shift towards renewable energy is creating new jobs in sectors such as manufacturing, installation, and maintenance of renewable energy infrastructure" "Huge amount of jobs will be created" "Eradicating unsafe work in mining"
4	Improved community wellbeing	Opportunities related to creating more liveable, healthy and resilient communities today and for the future.	"Local communities to get involved with energy production and the transition presents opportunities to advance energy equity, inclusiveness and community engagement." "Leaving cleaner air, water and food for future generations" "More energy efficient, liveable cities and homes"
5	Redistribution of global and corporate power	Opportunities for communities to take back control of how their energy is sourced and avoid energy security issues created by global conflict and inequality.	"Energy resources have traditionally been inequitably distributed across the world (e.g. oil and gas reserves). Renewable energy resources are better distributed across the world and are more diverse." "Eliminate poverty and global tension arising from energy supply issues" "Poorer countries rich in raw materials could rise from poverty"
6	Technological Innovation	Opportunities to develop and implement new technologies to improve efficiency, environmental credentials and reduce the cost of energy.	"Opportunities for huge developments in distributed energy resources, storage, energy management" "Renewable energy technologies, energy storage, smart grids, and energy efficiency are driving breakthroughs that can transform the way we generate, distribute, and consume energy." "Energy transition means more opportunities to develop innovative solutions for operations requiring energy."
7	Improved energy systems	Opportunities to improve the accessibility, efficiency, reliability and utilisation of energy systems.	"Improved network / system utilisation" "Improve efficiency by reducing waste and inefficient systems" "A lot more people can access energy"
8	Australia as a green energy leader	Opportunities to position Australia as a global green energy leader. Geographic and geopolitical strengths which make an ideal context for renewable energy generation and export.	"Land, Sun and Surf...we have the plans in place, they just need to be made a reality (ignoring the politics)" "Spearheading Australia into green hydrogen industry" "We live in Australia where we have an abundance of natural resources, why are we not using them to create a better future?"

Table 7. Domestic challenges

#	Theme Name	Description	Example Quotes
1	Cost and economic challenges	Challenges related to current cost of living pressures, inflation and raising capital.	"Energy supply traditionally is low return and unless the superannuation industry invests in a big way Australia will have to source the capital needed from overseas" "Upfront costs associated with switch for households" "The public is finding it hard to meet basic standards"
2	Social challenges	Challenges related to gaining social licence, educating the public, engagement and acceptance, as well as ensuring equitable social outcomes.	"General public is relatively disengaged due to either a scepticism of the need or other pressing demands e.g. cost of living." "Changing people's perspective and attitudes" "Ensuring equal access to renewable energy"
3	Political will, policy and regulation	Challenges related to the perceived lack of incentives for households to electrify and disincentives for the fossil fuel industry to halt production.	"Policy makers lack the vision and long-term view needed to make the necessary changes that will implement change." "Lack of leadership from Australian politicians to eager to worry about the next election. No Energy Transition can be beholden to election cycles [or CEO tenures for that matter]" "State governments not willing to act cooperatively with federal government"
4	Infrastructure upgrades	Challenges related to the updating or constructing and operation of critical infrastructure in hard-to-access or retrofit locations.	"Where are the renewables going to be placed" "Roads and other facilities are not suitable for the truck movements and loads associated with construction and the damage to the roads will require substantial extra funding to repair and maintain the roads." "Upgrading grid to accommodate integration of renewable energy sources, and to cater for increasing population and demand"
5	Energy system challenges	Challenges related to finding the right mix of technology, infrastructure, supply types and planning for maintenance.	"Orchestration and monetisation of energy supply, storage and related services during the transition" "We can't guarantee services to everywhere because of the geographic distance between places" "The integration of renewable generators into the electricity market presents challenges that must be overcome to ensure system security and reliability"
6	Skills and training challenges	Challenges related to finding employees with green skills and employment for workers in traditional industries.	"Australia's population, skillset, literacy skills, STEM skills, global market attractiveness...to build a solid foundation and population (especially in regional locations where transition technologies will operate)." "There will need to be a massive undertaking to retrain energy industry workers to operate within the new and emerging energy market." "We can't find the right staff with the correct skill set."
7	Mitigating GHG emissions and reduce environmental impact	Challenges related to limiting the GHG emissions green technology and reducing Australia's dependence on the fossil fuel industry.	"How to reduce emissions intensity of the minerals sector in a way that does not offshore (and therefore add additional global burden to emissions)." "Australia is one of the world's largest exporters of coal and natural gas" "Manufacture of green technology parts has high greenhouse emissions"
8	Speed, scale and complexity	Challenges related to the complexity, urgency and enormity of the energy transition.	"The rate of build of new energy is very low compared with the stated retirement of fossil fuels. We will need to build renewables at a faster rate (probably 2 or 3 times faster) if we are planning for a smooth energy transition." "The transition has been slow in this country" "Too complex"

Table 8. Domestic opportunities

#	Theme Name	Description	Example quotes
1	Lower costs and economic improvements	Opportunities related to lower energy costs and a strengthen economy in the long term.	"It would be hoped that by moving away from a cost intensive energy supply that is powered by fossil fuels we could see the cost come down." "Cheaper energy in the long run" "If we innovate, develop and manufacture green technology expertly, we will be able to export our goods for the benefit of our economy"
2	Climate change mitigation and improved environmental outcomes	Opportunities related to emissions reduction, improved air quality, better human health.	"The NEM still has huge amounts of coal. This is an opportunity to rapidly reduce emissions by replacing with renewables and gas" "Save plants and animals" "A better world to live in health wise without pollutants"
3	Green skills revolution	Opportunities related to more secure domestic jobs as a result of new industry particularly in regional areas.	"A huge opportunity to enable skilled people/build skills in local people for our big power build." "More local jobs, better for the economy" "Jobs for locals on Australian shores"
4	Empowered and healthy communities	Opportunities related to greater social equity, improved regional infrastructure, involvement and ownership of First Nations communities.	"If large areas of land and some areas offshore are needed for renewables and transmission we now truly have the opportunity to engage, collaborate and empower First Nations people through co-design from the start. This could be the lever that is pulled to truly close the gap." "Making local people happier now" "Homes will be better"
5	Decentralisation, democratisation and diversification of energy	Opportunities related to increased energy security and redistribution of corporate power related to diversified and increased domestic energy production.	"There is the potential for smaller players to become involved in the energy market, as opposed to the near-monopoly we work under here in WA at present. That should mean more choice for consumers, and better prices down the track." "Less mining of Australia's natural resources" "Energy cost would be reduced with less dependence on other providers."
6	Improved energy systems	Opportunities related to more reliable, affordable, efficient and productive energy systems.	"The reliability of power in remote and rural areas can be very unreliable, it is hoped as part of the energy transition that this would rectify especially during serious weather events." "Energy will be delivered faster and locally" "More efficient energy production"
7	Regulation, policy, subsidies and support	This opportunity for the government to increase the speed of the transition by regulating industry and incentivising households and small businesses.	"Driving change through regulation - climate change state means we don't have time to wait for more arguing and voluntary behaviour change" "Providing rebates to those who use/support clean energy sources" "Introduce more incentives to drive EV adoption"
8	Innovation and technology	Opportunity for research and implementation of new technologies including AI and digitisation.	"Implementing technology changes that enable a commercial advantage" "Opportunity to embrace new technology" "Digital technology as an enabler."
9	Public education and communication	Opportunities to shift public attitudes through formal education and the media.	"Change population, change attitudes, education, creating a desired future." "To change Australia's mind about renewable energy." "Need to provide info to the general public of challenges and opportunities"

APPENDIX 2: RESPONDENT DETAILS

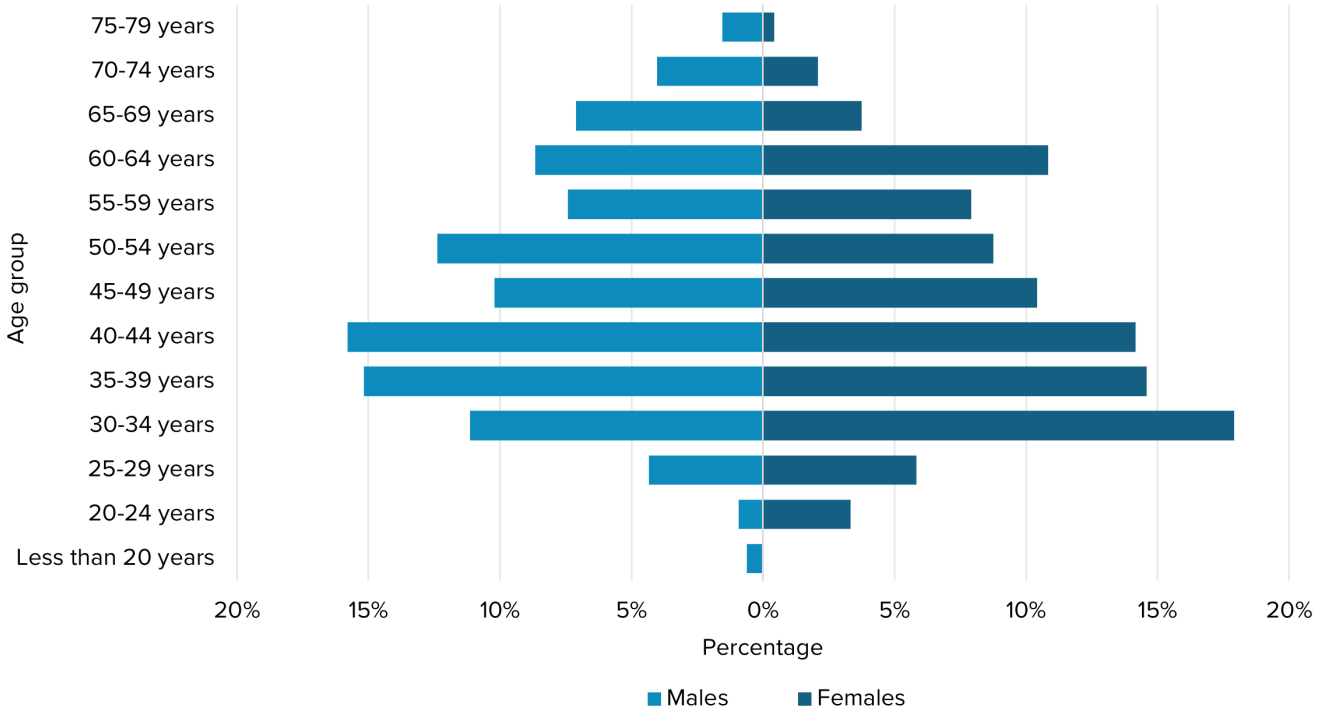

Figure 1. Age and gender of respondents

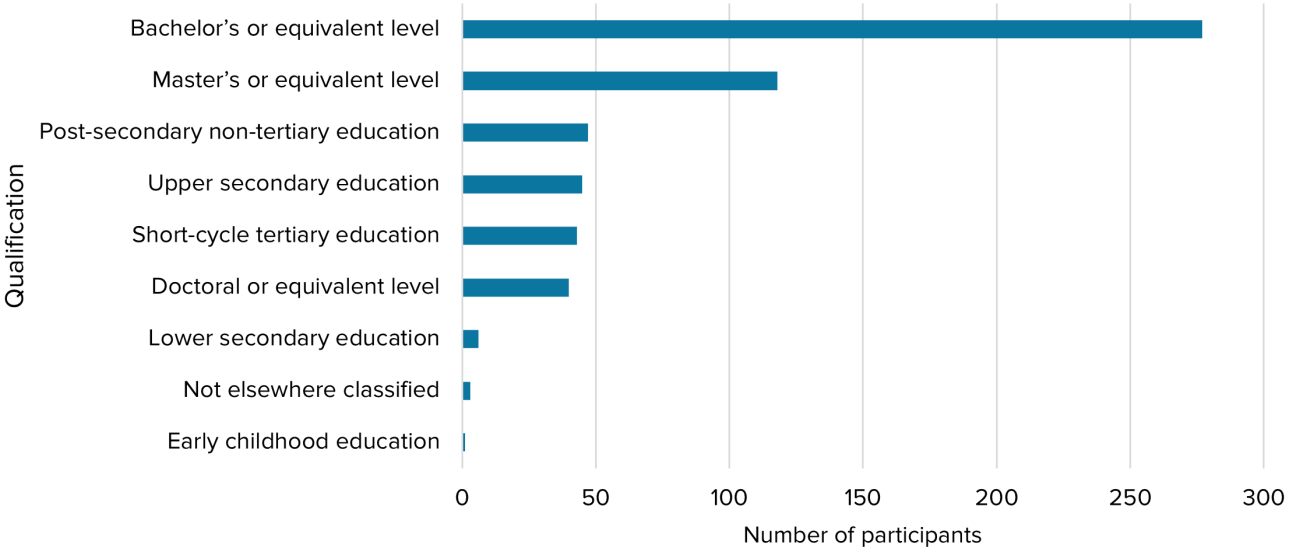

Figure 2. Educational background of respondents

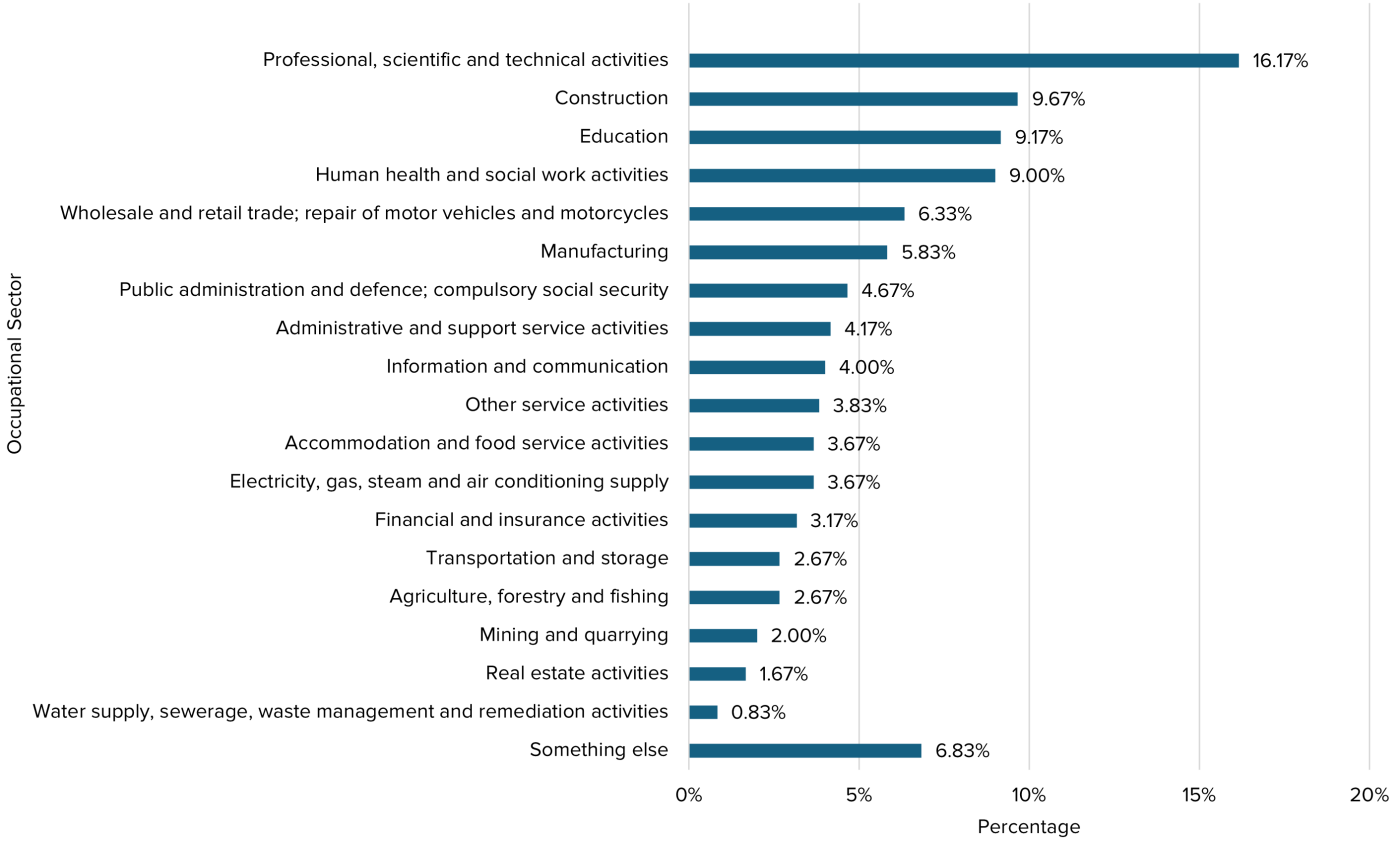

Figure 3. Occupational sector of respondents

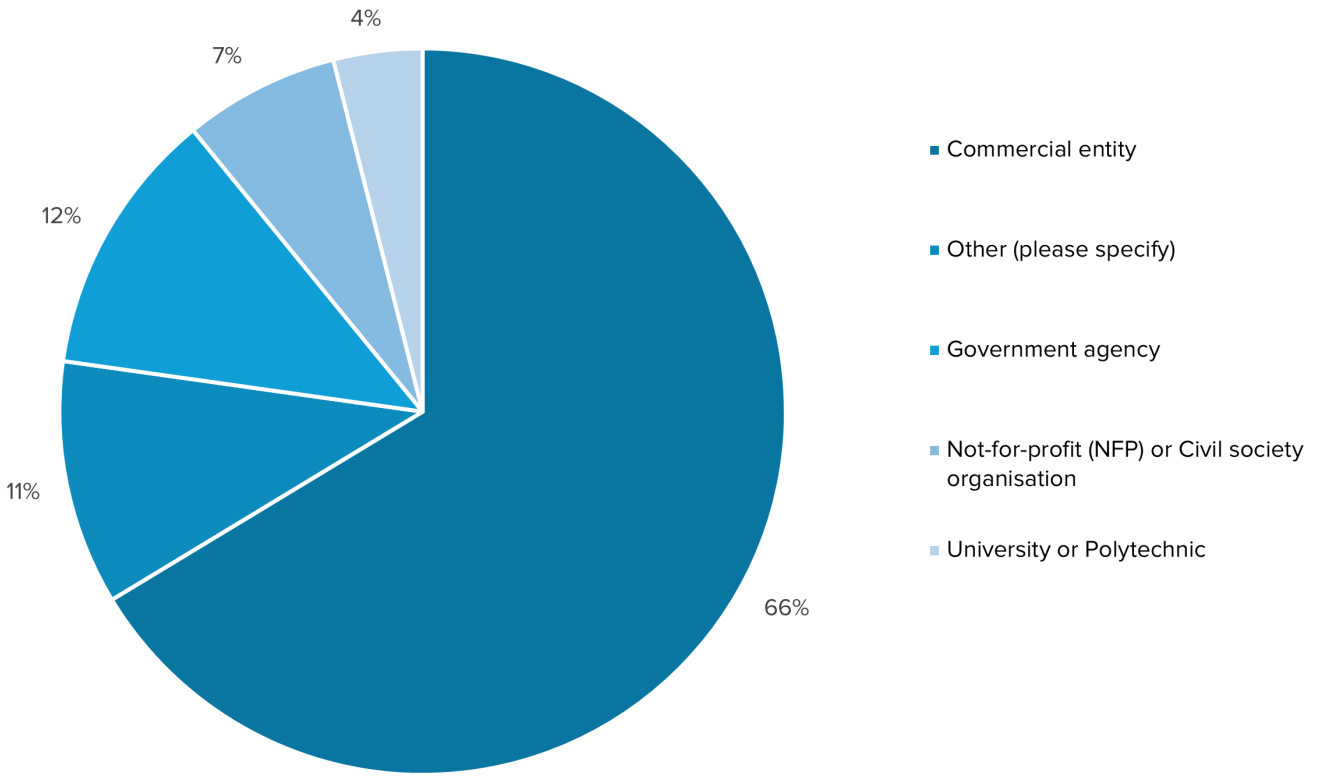

Figure 4. Employment category of respondents

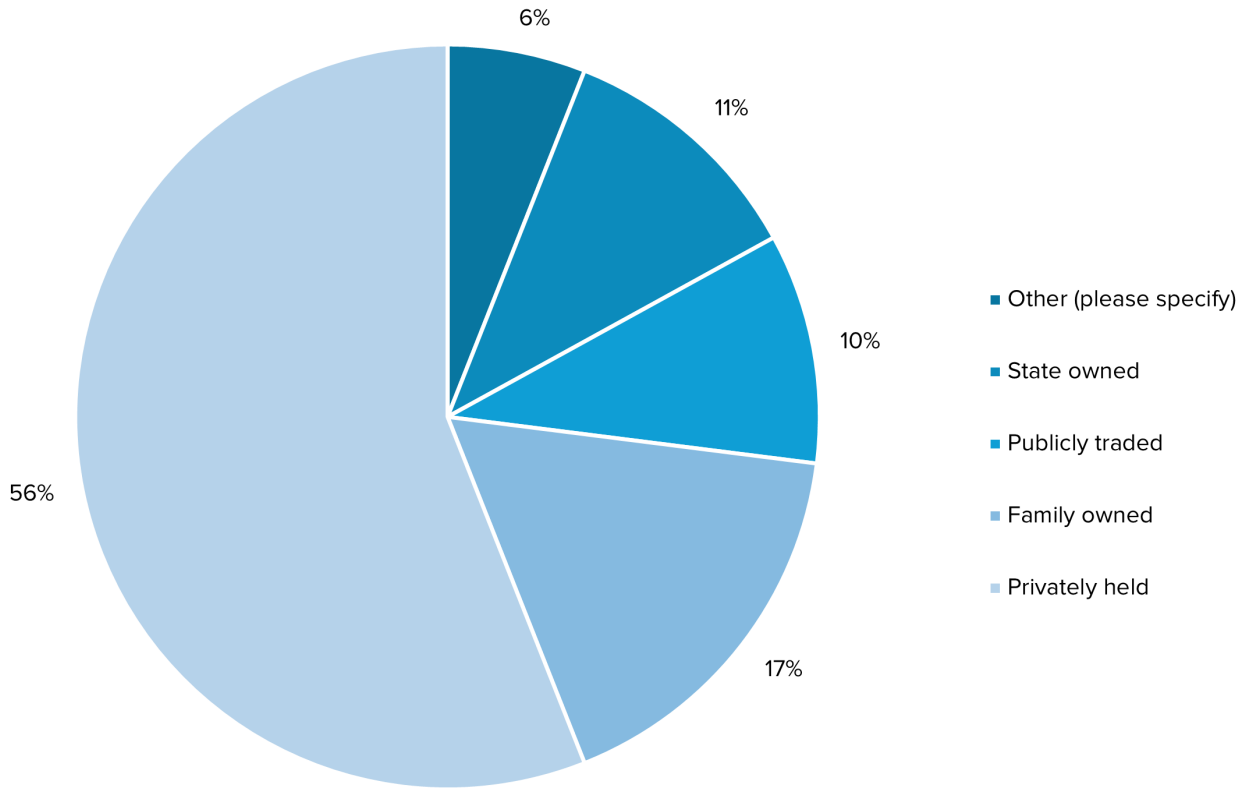

Figure 5. Employment sector of respondents

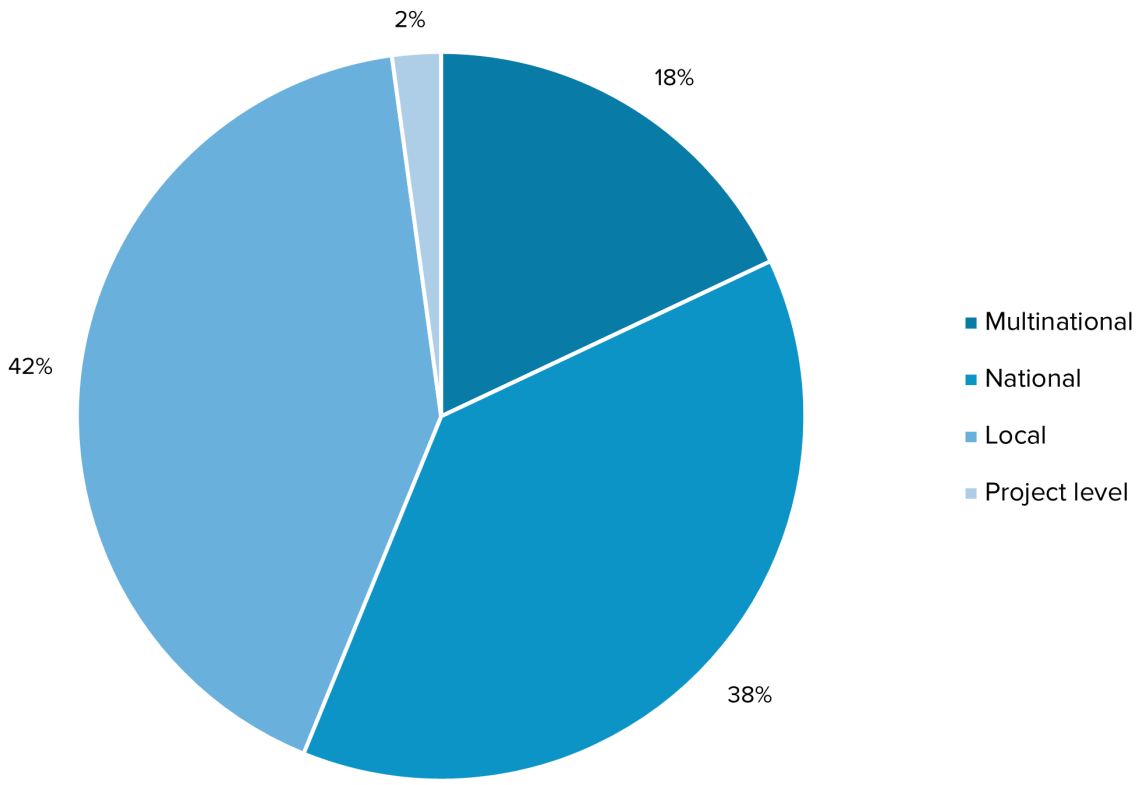

Figure 6. Geographic scope of respondents' work

APPENDIX 3: INFOGRAPHICS

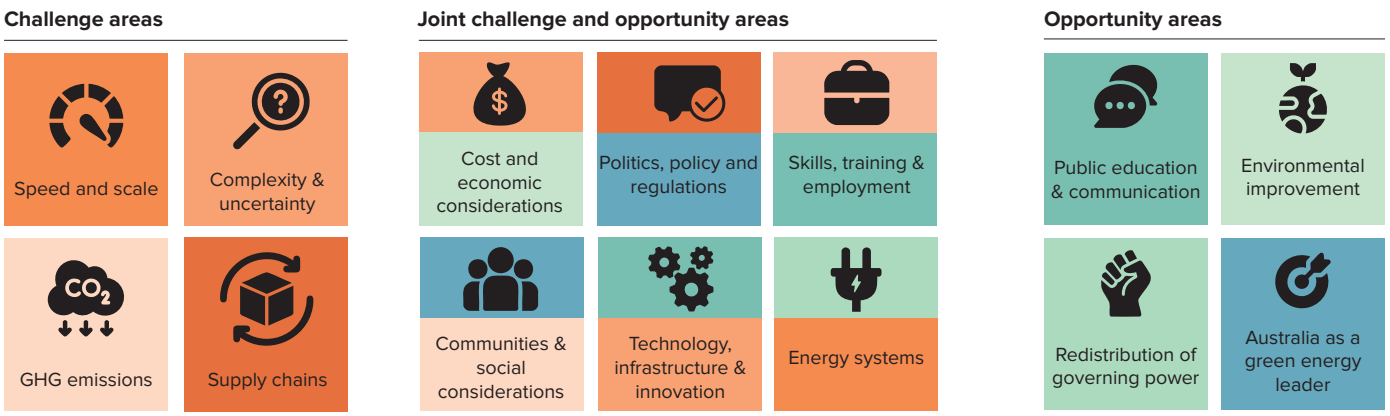

Figure 7. Challenge, opportunity and joint challenge–opportunity areas

Figure 8. Global challenges and opportunities

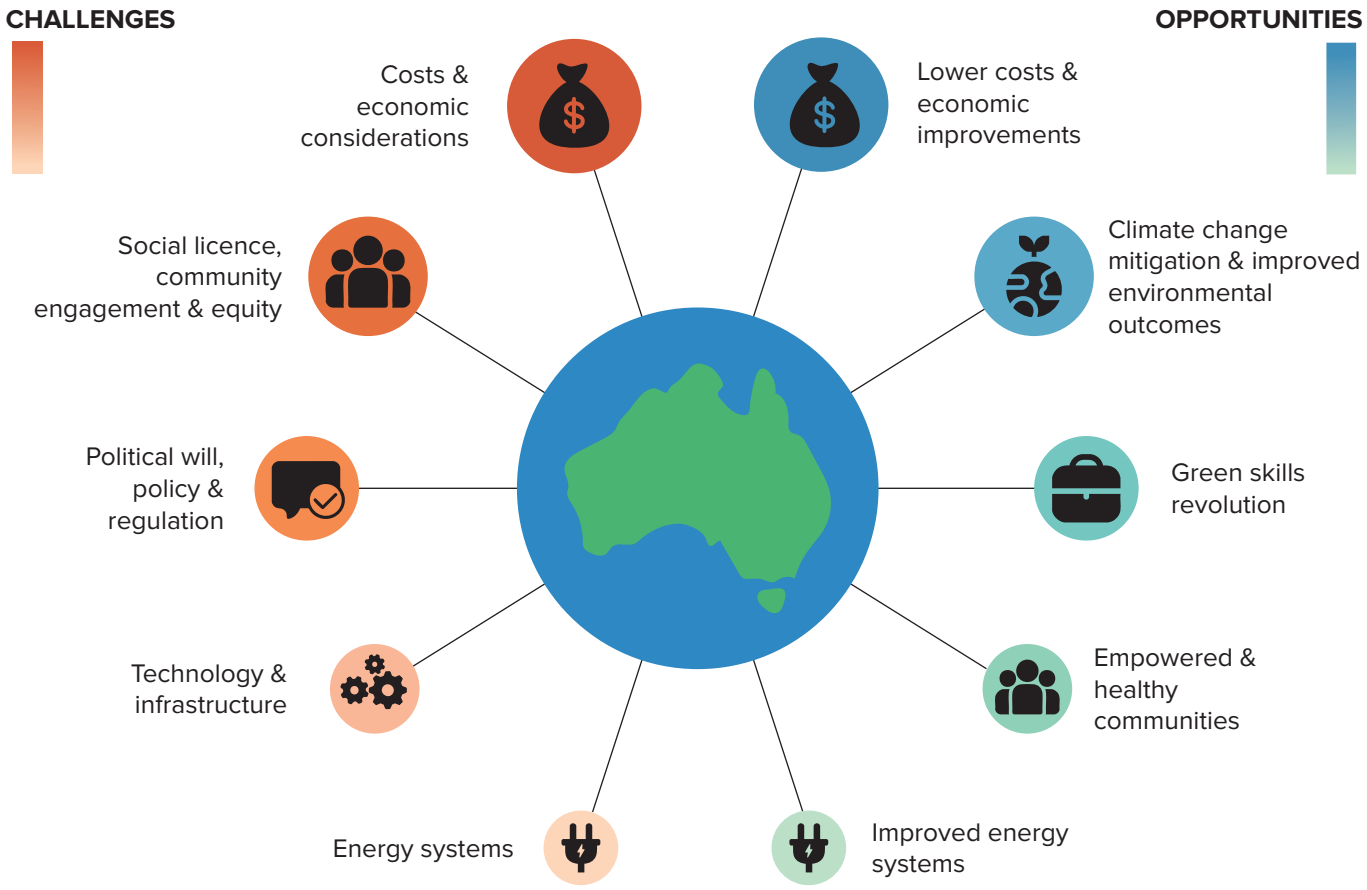

Figure 9. Domestic challenges and opportunities

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