RACE for 2030

Scenarios for Future Living

The State of Grid Transition 2026

Scenarios for Future Living

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Project team

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- University of Technology Sydney
- Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Industry partners

- Ausgrid
- CitiPower/Powercor/United Energy
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What is RACE for 2030?

RACE for 2030 CRC is a 10-year cooperative research program with AUD350 million of resources to fund and support research towards a reliable, affordable, and clean energy future. https://www.racefor2030.com.au

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KEY FINDINGS

The State of Grid Transition 2026 is a report of the Scenarios for Future Living project, an initiative of the RACE for 2030 Cooperative Research Centre. The report aims to stimulate and initiate a new wave of industry engagement by evaluating the current state of electricity grid transition.

This first report focuses specifically on transition in the National Electricity Market and associated grid. It informs a program of work for 2026 including five Grid Transition Masterclasses and a Consumer Grid Summit.

The National Electricity Market (NEM) and associated electricity grid is in a state of profound but uneven transition. The interplay between landscape pressures such as climate urgency, global economics, the rise of AI, and maturing niche innovations has successfully destabilised the incumbent fossil-fuel regime. The technical dimensions of this shift are accelerating: renewable penetration is breaking records, emissions are in structural decline, and storage technologies are graduating from niche to mainstream deployment. However, a disconnect exists between this technical momentum and the socio-political reality. While the grid decarbonises, energy equity is at risk, and the social licence for transformation is fraying under the weight of affordability concerns and a "predict and provide" engineering mindset.

The sector lacks a shared, whole-of-system vision for the future. Australia lacks a coherent vision for the future of grid transition, and responsibility for developing such a vision is diffused across multiple jurisdictions and regulatory bodies. Consequently, there is no obvious space within existing arrangements for a shared vision to emerge, leaving the sector to navigate unprecedented uncertainty without a unified direction.

Current industry scenarios contain critical blind spots. The industry relies heavily on "plausible" scenarios, such as those in the Australian Energy Market Operator's (AEMO) Integrated System Plan (ISP), which focus on a relatively narrow slice of possible futures, ignoring disruptions that may emerge from the margins. This narrow focus creates significant blind spots, particularly regarding:

- **Household practices**: Planning relies on un-evidenced assumptions that people will act rationally to support grid objectives, ignoring the reality of diverse household aspirations and comfort levels with automation.
- **Social licence**: Industry visions have not fully caught up to the reality of community opposition to infrastructure, often "presuming benevolence" rather than preparing for futures where social licence is actively withdrawn.
- **Political disruption**: Current scenarios ignore political volatility, such as changes in government or the potential repeal of net-zero targets, despite politics being a primary driver of transition outcomes.

A "fairness gap" is emerging, threatening a Just Transition. The transition is creating a fundamental split between those who can access the benefits of Consumer Energy Resources (CER) - such as rooftop solar and batteries - and those who cannot. Renters, apartment dwellers, and low-income households are disproportionately vulnerable to rising costs, while wealthier households can insulate themselves from price hikes. The report identifies four critical tests of fairness in future visions:

1. Will disadvantaged households access clean energy benefits or be left to bear the costs of legacy infrastructure?
2. Will the socio-economic position of First Nations Australians be improved?

3. Will coal regions experience a just transition into alternative economies?
4. Will regions hosting Renewable Energy Zones see long-term socio-economic benefits?

There are deficits of Anticipatory Governance and Futures Literacy. Governing a system in transition requires "anticipatory governance" - the ability to steer in the present to adapt to uncertain futures. However, the sector currently suffers from low "futures literacy," perpetuated by biases towards familiar, positive, and short-term thinking and a tendency to extrapolate the future from past trends. Barriers such as a lack of perceived value, time constraints, and organisational silos prevent the adoption of deep foresighting practices that could reveal risks and opportunities.

Design Principles for a Participatory Futures Program. To address these challenges and unlock a resilient future grid, the report proposes a participatory foresighting program governed by eight core design principles:

- **Build futures literacy**: Integrate capacity building and "learning by doing" to normalise working with uncertainty.
- **Increase the focus on exploring low probability futures**: Engage with "wild cards," weak signals, and improbable futures to identify resilient present-day strategies.
- **Use systems thinking to provide clarity**: Utilise frameworks like the multi-level perspective to navigate grid complexity and identify intervention points.
- **Empower whole-of-system participation**: Involve stakeholders from across the entire system to reveal blind spots and build legitimacy.
- **Use the full methodological spectrum**: Employ a complete range of foresighting methods, from horizon scanning ("What is changing?") to scenario exploration ("So what?") to roadmapping and policy stress-testing ("Now what do we do?").
- **Do not exclude any driver categories**: Ensure drivers often excluded from official channels, such as customer aspirations, social justice, and political contestation, are central to the analysis.
- **Create imaginative, deliberative safe spaces**: Provide "imagination infrastructure" that allows for deep, generative dialogue outside of established political institutions.
- **Take a people-centric approach**: Prioritise people's needs and perspectives, acknowledging that the grid ultimately exists to provide energy services to people.

Key findings at a glance

ANTICIPATORY GOVERNANCE CHALLENGES FOR THE NEM	RECOMMENDED FORESIGHTING RESPONSES
Low literacy with futures concepts and methods	Capacity building in foresighting
When uncertainty is high, strategies are vulnerable to futures that once seemed unlikely	Test resilience of strategies by engaging with weak signals, wild cards and marginal futures
Too busy "putting out fires" to see the big picture	Create space to step back and do system analysis
Foresighting is fragmented and partial	Empower whole-of-system participation
Forecasts and roadmaps dominate	Use a more complete set of foresighting methods
Industry visions have political & social blind spots	Systematically consider all drivers
Spaces to debate, develop and experiment with shared visions for the grid are lacking	Create imaginative, deliberative spaces to step out of the everyday and nurture innovations
Citizen perspectives and practices are backgrounded	Take a people-centric approach

The 2026 agenda

These principles inform the RACE for 2030 Consumer Grid Summit (https://www.racefor2030.com.au/consumer-grid-summit-2026/) to be held on 24-25 June 2026. To build futures literacy, the summit will be preceded by a series of five online Grid Transition Masterclasses in the second quarter of 2026, on the following topics:

1. The current status of Australia's grid transition
2. The need to collaboratively reimagine Australia's grid
3. Futures thinking for informing Australia's grid transition
4. Change mechanisms for accelerating Australia's grid transition
5. Bringing it together in Three Horizons.

The purpose of the Masterclasses is to help build a cohort of informed and futures literate "transition leaders" who represent a diversity of perspectives yet share a common language and a set of navigational tools. Informed by the Masterclasses, Summit participants will work toward a shared vision for Australia's power systems in general — and the National Electricity Market (NEM) in particular.

To ensure all possible pathways are considered, the Summit will emphasise open, imaginative exploration beyond the constraints of today's thinking, with all options on the table. Through a dynamic, facilitated process, Summit participants will converge on a robust vision for a transformed grid in 2035 that balances consumer, societal and system priorities and can efficiently scale to meet Australia's 2050 commitments.

After the Summit, we anticipate designing and delivering additional activities to carry forward the recommendations of the Summit and continue to build futures literacy in the sector.

Australia's energy future is being redefined with the launch of "Scenarios for Future Living", an initiative from the RACE for 2030 Cooperative Research Centre (RACE for 2030 CRC).

This three-year initiative provides a more plausible, people-centred understanding of future Australian energy consumption. The Institute for Sustainable Futures at the University of Technology Sydney is leading a package of work that aims to engage energy experts, industry leaders, and policymakers to expand the scope of energy foresighting and ensure that future planning reflects the realities of everyday energy users.

INTRODUCTION

This section provides background to the Scenarios for Future Living project and outlines the focus and structure of this report

The Scenarios for Future Living project includes seven work packages that work together to support better decision-making capacity for the Australian energy sector.

Background

The Scenarios for Future Living (SFL) project aims to support better decision-making capacity for the Australian energy sector through scenarios, models, tools, and design innovations that centre people's everyday lives and expectations alongside emerging technology and energy trends. This requires both engagement with energy sector actors and an understanding of how industry expectations about probable, possible and preferable futures shape current decision-making. The project comprises seven work packages.

WP1: Understanding how people use energy	We will deliver real-world foresights into how diverse households and home businesses will interact with energy in the future — tracking changing expectations, and analysing the impact of future everyday life values and practices to guide industry and policy decisions.
WP2: Anticipating emerging technologies	From smart home innovations to next-gen energy solutions, we're analysing new technologies and industry trends to understand their potential impact on energy use in homes and businesses.
WP3: Developing future energy scenarios	Using social and design research, technology trends and climate science to create Scenarios for Future Living — rich, evidence-based narratives that help industry and government plan for plausible energy futures.
WP4: Advancing energy forecasting tools	Designing new modelling tools and processes that integrate real-world social trends into energy sector planning, ensuring more accurate predictions and better decision-making.
WP5: Designing people-centred energy solutions	Exploring how new energy products and services can align with people's evolving needs — helping deliver a low-cost, net-zero future while ensuring fair access for all consumers.
WP6: Leading Australian energy transition workshops	Convenes representative groups of actors from across the energy system to explore alternative futures for the Australian energy transition. It also seeks to build industry capacity in advanced foresighting practices.
WP7: Scaling and sustaining knowledge	Through collaboration with CSIRO's National Energy Analysis Centre (NEAC), we're extending the impact and longevity of our research — integrating new insights into national energy planning.

These seven work packages combine to deliver scalable, impactful, and long-lasting contributions to Australia's energy transition. The State of Grid Transition 2026 report has been prepared by Work Package 6 to

1. Report on our activities during the first year of the SFL project
2. Start the process of connecting industry actors with the customer-focused futures emerging from the SFL project
3. Stimulate and initiate a new wave of industry engagement by evaluating the current state of electricity grid transition.

The State of Grid Transition 2026 report aims to stimulate and initiate a new wave of industry engagement by evaluating the current state of electricity grid transition.

Our intent is to publish annual State of Grid Transition reports for the three years of the SFL project.

During the first year of the project, Work Package 6 has completed literature reviews on the value of foresighting practices, how foresighting influences thinking and practice and international examples of multi-stakeholder, future-focused energy fora. We have analysed the current state of grid transition in Australia and reviewed industry visions for the future. We have also collaborated closely with RACE for 2030 and Energy Catalyst on the design of a Consumer Grid Summit to take place in the second quarter of 2026.

The design process for the Summit included interviews and workshops conducted by Energy Catalyst and RACE for 2030 with 15 diverse senior leaders in the energy sector. It also included a foresighting session for energy researchers held at the State of Energy Research Conference 2025. The emerging design for the Summit is for a collaborative, multi-stakeholder process that responds to a broadly perceived gap in the strategic transformation arrangements of the NEM. It aims to bring together current and future leaders in grid transition to develop visions for the future of the grid and identify enablers of that vision. This Report is one input to that process.

The value of foresighting

The OECD defines strategic foresight as 'a structured and systematic approach of exploring plausible futures to anticipate and better prepare for change'.[1] It is not about predicting the future. Rather, the aim is to explore and analyse probable, possible and preferable futures to support better decision-making in the present. It is a practice that can help us to identify opportunities, challenges, risks and disruptions that may arise over the coming years and allow us to prepare for them.

Foresight, or futures thinking, can seem like a luxury when there are urgent, present priorities that need to be addressed. But without that forward view, we run the risk of working urgently on things that don't really matter - that don't align with our long-term goals. This is a particular risk at times of rapid change and uncertainty.

The energy system is facing exactly this challenge. The increasingly present impacts of climate change are driving a global energy transition towards a zero-carbon energy system. While the direction is clear, much remains uncertain. As incumbent models of energy supply

[1] https://www.oecd.org/en/about/programmes/strategic-foresight.html

break down, what exactly will replace them? How fast will decarbonisation take place? What mix of technologies will emerge and how resilient are these technologies to changes in the climate? How will governments, customers and businesses participate in this energy transition? Will these energy transitions be just and inclusive?

Foresighting provides a suite of systematic methods for mapping and exploring this uncertainty and charting a preferred path. It can offer the following benefits:

Futures thinking can increase resilience, improve decision-making, accelerate innovation, support collaboration and build leadership capacity.

1. **Increased preparedness for and resilience to possible futures**: The world is inherently unpredictable and traditional linear planning is no longer sufficient to navigate this complex reality. Futures thinking prepares us for a range of plausible futures and builds resilience and adaptability.
2. **Superior strategy and decision-making in the present**: Futures thinking offers a structured way to explore future implications with the goal of making informed and robust decisions in the present. It can reveal blind spots, challenge assumptions and biases, point to overlooked risks and unlock new possibilities.
3. **Accelerated innovation**: Futures thinking can inspire creative innovations that respond to the unprecedented conditions that lie ahead for the energy system. It helps to identify future customer needs and emerging trends and technologies so that we can respond proactively rather than reactively.
4. **Collaboration, engagement and shared vision**: Futures thinking activities can help to break down silos, build networks, enrich cross-disciplinary discussions and unite stakeholders around a shared vision. Participants in futures thinking are more likely to feel ownership of the visions that emerge and act together to achieve them.
5. **Building individual leadership capacity**: Participants in futures thinking activities can improve their capacity to tolerate uncertainty, their empathy and appreciation of alternative perspectives, sense of agency and system literacy. Cultivation of these capacities can increase their leadership skills.

Appendix A is a literature review exploring how foresighting influences thinking and practice, providing evidence for the above benefits.

Report Structure

Before exploring the future it is crucial to have a clear view of the current state of electricity grid transition. This is the focus of the next section (**The Current State of Grid Transition**). It is followed by an evaluation of probable, possible and preferable futures for the Australian electricity system expressed in sector publications (**Future GRID Visions**). This section identifies several 'blind spots' in current visions for the future of the grid. One of these, relating to fairness and justice, is explored in detail in the section **Towards a Just Transition**. In the final part of the report, we turn to the design of possible interventions to improve participatory foresighting on the future of the grid. We report on a literature review on **Building Futures Literacy** and the results of a **Pilot Foresighting Intervention** before outlining a proposed **Participatory Futures Program** for 2026.

THE CURRENT STATE OF GRID TRANSITION

This section uses a systems thinking tool called the multi-level perspective to structure an evaluation of the current state of transition in the National Electricity Market and associated grid.

A multi-level perspective on the energy system

The multi-level perspective (MLP) is a systems thinking framework that is widely used to understand processes of transition in large-scale socio-technical systems such as energy systems. The MLP views transitions as the outcome of dynamic interactions between three analytical levels: landscapes; socio-technical regimes and niches.

Level 1: Landscape

The landscape is the external context for the socio-technical system, including structural socio-economic, demographic, political and international developments, but also events like wars or environmental disasters. The theory here is that the regime is usually quite stable and evolves only slowly, unless there are pressures from outside that cause disruption. Climate change, population growth, financial crises, pandemics and political crises are examples of the kind of pressures that can create openings for transition.

Level 2: Regime

The regime is the currently dominant form of the socio-technical system. It is the current configuration of technologies, policies, institutional structures, industry practices, markets, social norms and knowledge practices in the system. In normal times, all of these elements support each other, creating a dynamic stability or 'lock-in'.

The multi-level perspective views transitions as the outcome of dynamic interactions between the external landscape a socio-technical regime and innovative niches.

When considering sustainability transitions, we can identify a current state of the regime that is no longer fit for purpose, and a desired future state of the regime that we want to transition towards. For example, the current energy regime is centralised and reliant on fossil fuels, whereas our desired future state might be a decentralised regime that is efficient, renewable and equitable.

Level 3: Niches

A niche is a 'space' where innovations such as virtual power plants, electric vehicles or batteries can be developed before they are ready for full deployment. Niches are protected in various ways, such as through subsidies, so that they do not have to fully compete with mainstream technologies, practices or institutions.

System boundaries

Before applying the MLP a clear definition of the system we are focusing on is necessary. The State of Grid Transition 2026 Report will focus specifically on the state of transition in the NEM, while recognising that much of the analysis would also apply to the smaller electricity grids in Western Australia and the Northern Territory.

The focus of the analysis is primarily on transition dynamics that are relevant to residential customers, consistent with the focus of the Scenarios for Future Living project. Reports in future years could potentially expand the scope, for example to consider natural gas or additional customer types.

Landscape pressures

Climate change

The most significant landscape pressure driving energy transition is undoubtedly climate change and associated social and political demand for reductions in greenhouse gas emissions. Globally, more than three-quarters of greenhouse gas emissions come from the production and use of energy (Ge et al., 2024). In Australia, about 35% of total net greenhouse gas emissions came from electricity in 2024 (DCCEEW, 2024a). This substantial contribution of the electricity grid to climate change has driven changes to energy policy aimed at reducing electricity-related greenhouse gas emissions. For example, the National Electricity Objective that guides rule-making in the NEM was amended in 2023 to include emission reduction for the first time, responding to this landscape pressure.

Geopolitical uncertainty

The rise in geopolitical conflict and uncertainty in recent years due to conflicts in Ukraine and the Middle East and aggressive USA trade policies also creates landscape pressures for and against energy transition. While these conflicts have little direct impact on the NEM, they do highlight the value of seeking energy independence and potentially create opportunities for Australia to position itself as both a 'renewable energy superpower' and an alternative supplier of the critical minerals that are essential to energy transition. Recognising the economic advantages that could come from energy transition creates positive pressure for transition in Australia.

On the other hand, geopolitical instability creates supply chain vulnerability, cost inflation, higher cost of capital and investor uncertainty, which make investment in capital-intensive, grid-scale renewable energy projects risky. On balance, geopolitical uncertainty is a short-term drag on energy transition but a long-term accelerant.

Data centre construction to serve the needs of generative AI is growing rapidly around the world and will put upward pressure on electricity demand in the NEM.

Generative AI and data centres

The rapid global rise of generative AI is increasing demand for data centres, which require electricity. According to the International Energy Agency, data centres were responsible for about 1.5% of global electricity consumption in 2024, but that is set to more than double by 2030 (IEA, 2025a). In Australia, data centres accounted for about 2% of grid-supplied electricity in the NEM in 2024-25 but this is projected to grow to around 6% by 2029-30 under AEMO's central Step Change scenario (AEMO, 2025a). These figures are very uncertain, depending on the rate of technological progress in AI applications, their uptake by customers and energy efficiency improvements. Nevertheless, it is reasonable to assume that the ongoing rise of AI applications will put upward pressure on electricity demand around the world and in the NEM. Any increase in electricity demand makes grid transition more challenging, as renewable energy needs to not only replace ageing fossil fuel infrastructure but also supply growth in demand.

On the positive side, AI applications offer potential to help with planning and orchestrating complex distributed electricity grids, improving energy efficiency, security and reliability, and supporting demand-side participation.

Developments in adjacent fields

Alongside the growth in data centres, developments in other adjacent sectors have the potential to increase electricity demand. Electric vehicles now account for almost 10% of vehicles sold in Australia and their charging requirements will increase total electricity demand as well as changing patterns of demand on the grid. Other technologies and household applications on the horizon also have the potential to affect electricity demand, including quantum computing, robotics, the Internet of Things and ongoing changes in flexible work. The scale of these impacts remains highly uncertain. Work Package 2 of the SFL project is currently exploring the potential impact of these and other landscape trends on future energy practices and demand.

The NEM is perhaps 15 years into an accelerating transition away from centralised, coal-fired generation. Citizens have become agents of this transition rather than passive consumers of energy services.

The current state of the NEM

Continuing our multi-level analysis, we now consider the current state of the regime, defined as the NEM and its associated interconnected grid. The NEM commenced operation in December 1998 and covers interconnected electricity grids in Queensland, New South Wales, the Australian Capital Territory, Victoria, South Australia and Tasmania.

This regime was relatively stable for about a decade before accumulating landscape pressures such as those described above initiated a rapid increase in the contribution of renewable energy to the grid. The NEM is perhaps 15 years into an accelerating transition away from centralised, coal-fired generation. The transition has seen distributed renewable generation providing an increasing proportion of electricity. The social, technological, economic, environmental and political state of the transition is summarised below.

Social contribution and customer outcomes

Citizens have become agents of transitions rather than passive consumers of energy services. Household choices have led to Australia's world-leading levels of rooftop solar installation per capita. Now, households are adopting batteries at pace and gradually turning to electric vehicles, although affordability and infrastructure access are still constraining uptake of the latter (Kaviani et al., 2025). Households are making these choices for diverse reasons, seeking financial benefits, responding to environmental concerns or responding to new social norms.

However, participation in energy transition is uneven. Rising electricity prices (see below) mean that **affordability and energy hardship** are growing issues in the NEM. Energy Consumers Australia (ECA) found that around 1 in 5 households are vulnerable to, or experiencing, energy hardship (Energy Consumers Australia, 2025). A survey of more than 5,000 households by Work Package 1 of the SFL project in 2025 found that more than 1 in 3 households reported experiencing hardship in the prior year, most commonly experienced as an inability to afford essentials or to pay energy bills on time (Kaviani et al., 2025). Renters are disproportionately vulnerable and those experiencing difficulty paying bills may put their health at risk by reducing heating or cooling of their homes. The Australian Government's Energy Bill Relief Fund provided temporary relief through rebates but these expired on 31 December 2025.

Uneven distribution of the costs and benefits of transition is threatening energy equity and undermining the social licence for transition.

The ongoing transition is also creating **energy equity** concerns. Households that own freestanding homes and can afford the upfront capital costs of CER such as rooftop solar, batteries and electric vehicles are able to protect themselves from rising electricity prices. Renters, apartment dwellers and low-income households are left to bear increasing costs. Taxpayer-funded subsidies for CER are paid for by all but primarily benefit wealthier households. Further, the complexity of market offerings means that only those with higher levels of education and energy literacy are likely to engage with the market sufficiently to secure the best deals, and even then the time required to do so is a significant disincentive. The transition is creating a fundamental split between those who can access the benefits of transition and those who cannot.

Uneven distribution of the costs and benefits of transition is undermining the **social licence** for transition. This manifests in two ways. First, the transition to an electricity grid dominated by renewable energy requires a massive rollout of generation and transmission infrastructure. Local communities affected by these infrastructure projects have raised concerns related to social, cultural, environmental and economic impacts. The issue of social licence is now receiving a great deal of attention (e.g. AEMO, 2025b), as it is recognised as a key potential bottleneck on the pace of transition.

Second, to minimise overall costs of transition requires orchestration of distributed energy resources. While recent evidence indicates that many households are willing to accept a degree of automation of their smart appliances and electric vehicle charging, this is contingent on the ability to override external control (Kaviani et al., 2025). In an era of declining trust in institutions, household concerns about privacy, data security and control may deepen if more is not done to build social licence for the transition.

Closely connected to the issue of social licence is the **lack of genuine public participation** in shaping the direction of the energy transition. While citizens are always invited to make submissions to public consultations related to the NEM, the complexity of the points under discussion and time pressures prevent most people from participating. Despite the broad attention to social licence, there is little coordination of dialogue with affected communities, with consultation largely left to the individual project developers.

Technological mix

The NEM is **transforming away from black and brown coal towards renewables**, as summarised in Figure 1. In 1999, coal supplied more than 91% of electricity generation, with gas providing 5% and renewables in the form of hydroelectricity providing 4% (*Open*

The NEM is experiencing a structural megashift from a centralised, unidirectional grid to decentralised, bidirectional systems and this creates significant orchestration challenges.

Electricity, 2025). By 2025, coal generation had dropped to 52% and renewables had increased to 42% with gas generation remaining steady. The growth in renewables has come primarily from solar and wind, as shown in Figure 2. Renewable energy generation in the NEM for December 2024 to 2025 includes rooftop solar (13%) which is on one third of all detached homes; utility-scale solar (8%), wind (15%) and hydro (6%) (*Open Electricity*, 2025). In September 2025, renewable generation reached a record level in the NEM of 78.6% during a single market dispatch interval..

The NEM's **coal-fired fleet is ageing and becoming less reliable**. AEMO anticipates that two-thirds of the coal fleet will retire by 2035 as they reach the end of their economic life, although the final Queensland plants are now expected to operate for longer, retiring by 2049 (AEMO, 2025b). No new coal-fired generation has been built since 2013, with almost all grid-scale generation investment since 2012 directed to renewables (AER, 2025b). While coal remains in place for longer in AEMO's draft 2026 Integrated System Plan, it is expected to be less reliable, with coal plants likely to be fully available only three quarters of the time between 2027 and 2035 (AEMO, 2025b).

Alongside the transition to renewable generation, the NEM is undergoing a **structural megashift from a centralised, unidirectional grid to decentralised, bidirectional systems**, expanding to millions of distributed resources (Energy Catalyst, 2025b). Variable renewable energy (VRE) and distributed energy resources (DER)/CER are being deployed at a pace that challenges the NEM's markets, networks and operations (AEMO, 2024). Specific challenges include the incompatibility of legacy grid structures with bidirectional flows; siloed, issue in isolation approaches and absence of holistic transformation; and lack of end-to-end operational visibility, including of CER/DER (Energy Catalyst, 2025d).

A **major build out of the transmission network is also underway**, with 6,000km of new transmission lines needed by 2050 under AEMO's Step Change scenario,of which 2,800km is already committed or anticipated (AEMO, 2025b). This is a 13% increase in the current network (AEMO, 2025b). However, transmission projects are facing risks of delays and cost overruns due to social license issues, supply chain constraints and labor shortages (AEMO, 2025b; AER, 2025b). Much of the transmission is required to connect new renewable sources and allow optimal balancing of variable sources across the NEM.

After a decade of relatively flat electricity demand in the NEM, 2024 saw a new record in electricity use (*Open Electricity*, 2025). **Electrification of transport, buildings and industry is driving increased demand**, along with the **emergence of data centres** as a growing source of demand driven by AI and cloud computing (AEMO, 2025a).

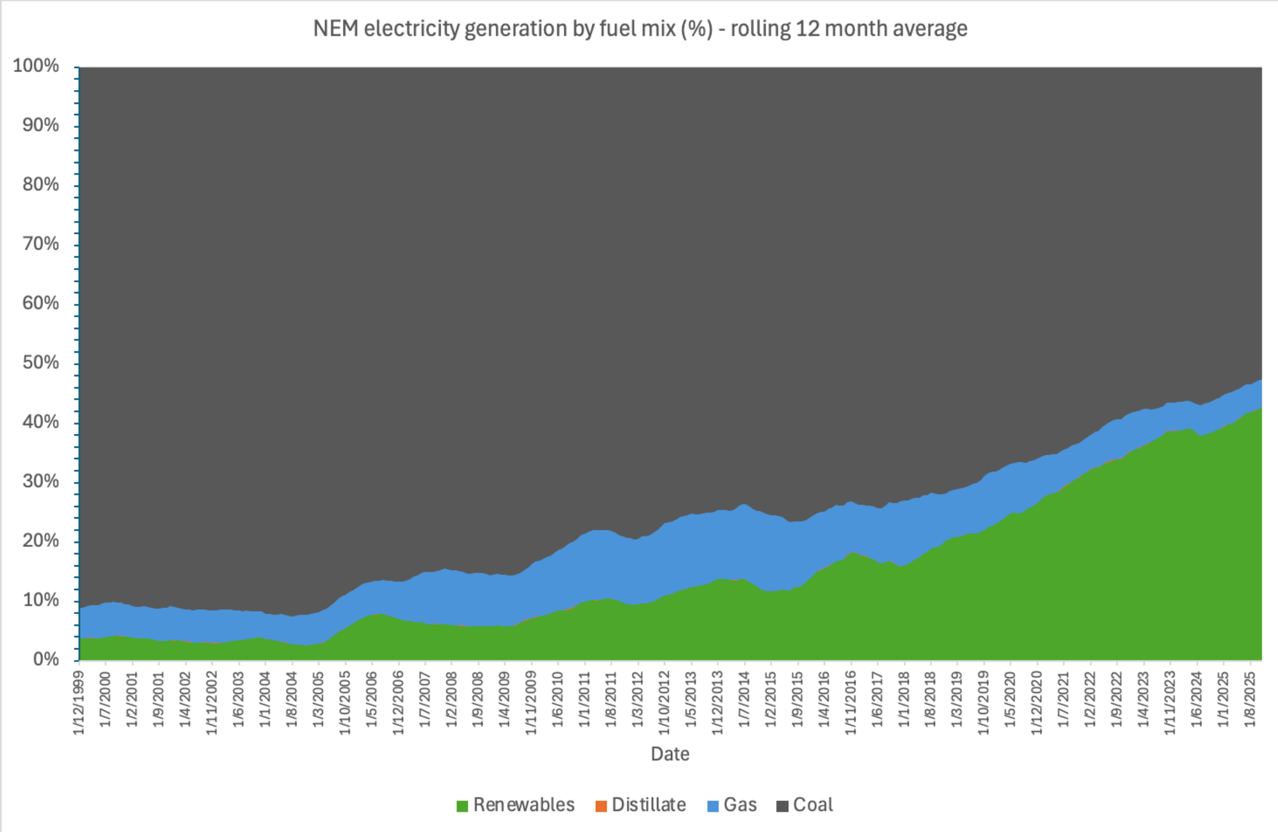

Figure 1. The proportion of coal, gas and renewable electricity generation in the NEM, 1999-2025. Source: Open Electricity (2025).

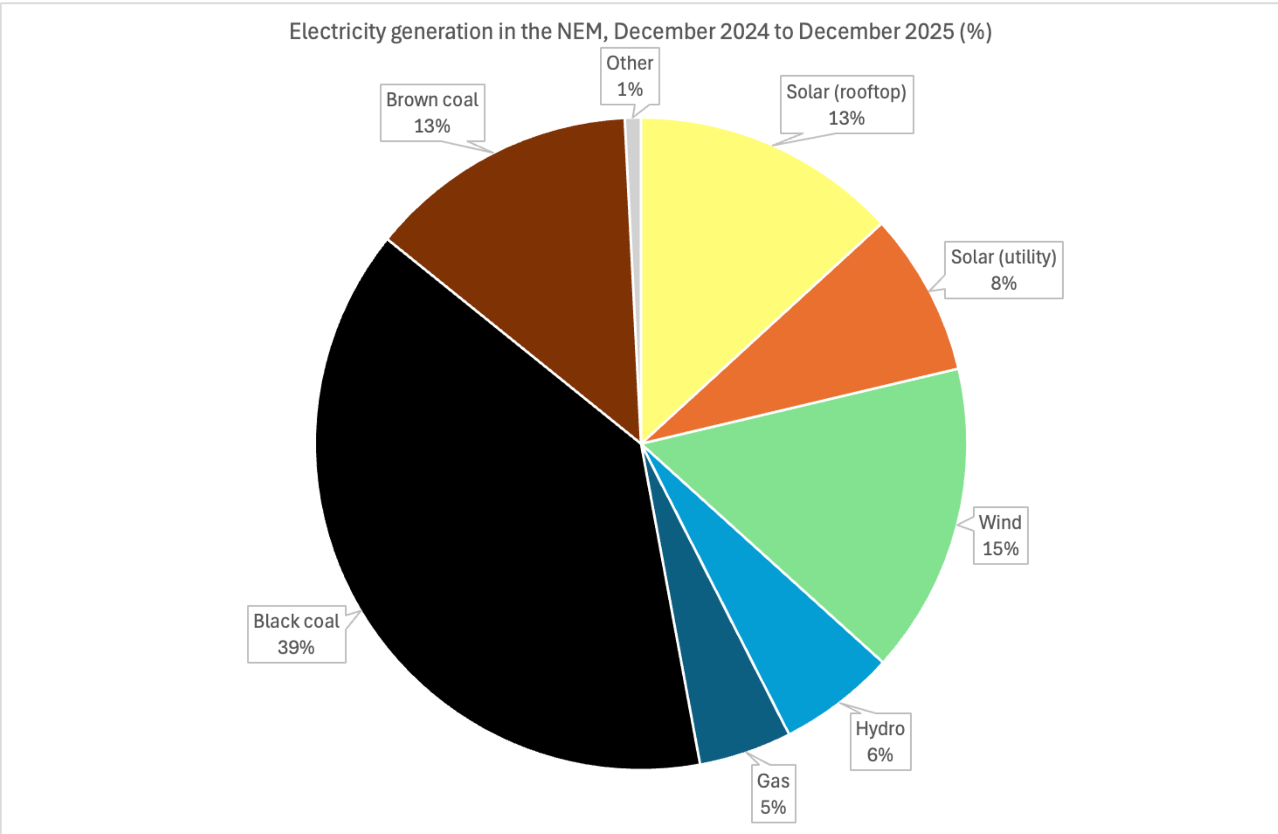

Figure 2. Electricity generation in the NEM, December 2024 to December 2025. Source: Open Electricity (2025).

Energy economics

Electricity prices have increased in most jurisdictions in recent years and further prices rises are projected in the coming decade due to inflation, the cost of capital, global supply chain disruptions and labour shortages.

Consistent with the shifts in fuel mix discussed above, **renewables, firmed with storage and backed up by gas-powered generation now represent the lowest-cost** replacement technology in the NEM**.** Scale economies and technological improvements have made wind and solar highly cost-competitive, while battery costs have fallen sharply. According to CSIRO's GenCost report (Graham et al., 2025), solar PV costs continue to decline, battery costs dropped by 20% in 2024—25, and wind costs have risen slightly. The levelised cost of energy for solar and wind with integration costs is now lower than for new coal or gas plants (Graham et al., 2025).

Despite the increase in low-cost renewable energy generation, **electricity prices have increased in most jurisdictions** in recent years (AER, 2025a), driven by rising inflation, increases in the cost of capital, global supply chain disruptions, labour shortages, and the scale of required power system expansion (Energy Catalyst, 2025b). The Australian Energy Market Commission (AEMC) anticipates temporary relief in this trend over the next five years, driven by the renewable build out, but still sees prices rising by 0.8% per year, on average, across the NEM over the next decade (AEMC, 2025a). As a result, **affordability remains a significant concern**, particularly in regional areas where transmission costs are higher.

The composition of energy bills is changing. Generation, transmission, distribution, and retail all contribute to the final cost, but **transmission and distribution costs are increasing** due to the need for new infrastructure to connect renewables and manage two-way energy flows. In 2024, investment commitments in large-scale renewables surged by 500%, reaching $9 billion (CEC, 2025). However, **major infrastructure projects face delays** and cost overruns from investor uncertainty, complex environmental and planning approvals and social license issues. Supply chain constraints create further challenges. Australia has to compete in a global market for supply chain, skills and investment.

Household behaviour is reshaping market dynamics. Rooftop solar met one-third of the increase in electricity consumption in 2024 (AER, 2025b), reducing daytime grid demand and contributing to negative wholesale prices in 14% of dispatch periods (AEMC, 2025b). Coal plants are struggling with low daytime demand, while gas demand continues to decline, creating stranded asset risks and equity challenges for households unable to electrify.

Environmental impacts

Electricity generation is responsible for about a third of Australia's greenhouse gas emissions, although emissions in the NEM have declined rapidly relative to other sectors.

Electricity generation was responsible for 34% of Australia's greenhouse gas emissions in the year to June 2025, the largest single contributor (DCCEEW, 2025f). However, electricity sector emissions are 30.3% lower from the peak recorded in the year to June 2009 due to the rollout of renewable energy and storage, displacing coal for electricity generation. Emissions from the NEM declined by 31.8% between June 2005 and June 2025 due to the increasing contribution of renewable energy (DCCEEW, 2025f). This declining contribution to climate change is an encouraging outcome of the ongoing energy transition.

While the contribution of the NEM to climate change is its primary environmental impact, the **ongoing build out of transmission and generation infrastructure has the potential for local environmental impacts** through land conversion, construction and operation. While impacts are project-specific they can include biodiversity, land use, visual, water and waste impacts. This infrastructure also requires significant resource use, with the demand for critical minerals receiving particular attention. Mining these materials can also have environmental impacts.

Politics and governance

Governing a system in transition is a fundamentally different challenge to governing a stable regime. The transition from a centralised, unidirectional electricity grid to a highly distributed, bidirectional and dynamic grid is a '**structural megashift**' requiring significant policy and governance innovation (Energy Catalyst, 2025a). Existing governance arrangements evolved to govern incremental reform rather than the long-term structural and paradigm shifts associated with energy transition.

Australia lacks a coherent, whole-of-system vision for the future of the NEM and responsibility for developing such a vision is diffused across multiple jurisdictions and regulatory bodies.

One of the primary governance challenges has been the **lack of coherent whole-of-system foresight and planning**. While the Energy and Climate Change Ministerial Council (ECMC) provides a space for intergovernmental policy collaboration, it oversees multiple market institutions with divided responsibilities. No single entity holds ultimate responsibility for facilitating convergence on an envisioned future or the enabling architecture required to achieve it. Responsibility is diffused across multiple regulatory bodies, system operators, market participants, and policymakers. As a result, there is no shared vision for the future of the NEM and no obvious space within the existing arrangements in which it could emerge.

To date, AEMO's systems planning processes have **optimised at the scale of transmission networks**, which potentially neglects more cost-effective investment options in distribution networks and decentralised energy or consumer energy resources (Riedy et al., 2022). Community opposition to new transmission infrastructure highlighted the risks associated with this narrow approach. Directives from the ECMC and a rule change by the AEMC have broadened AEMO's remit for its 2026 Integrated System Plan, as discussed in the section on niches below.

In this complex governance environment, various governance tensions are emerging. One is the tension between **keeping the lights on while fundamentally transforming the grid** for a distributed, zero carbon future (AEMO, 2024). Retiring fossil fuel generation needs to be replaced and the rush of consumer energy resources into the grid needs to be managed so that the pace of transition does not threaten the stability and reliability of electricity supply.

There is another governance **tension between the broader public good and the impacts on local communities** (AEMO, 2024). Guiding the grid towards a zero carbon future is in the public interest as part of Australia's contribution towards reducing the impacts of climate change. However, the transformation of the grid requires new transmission and generation infrastructure. Local community opposition to some of these infrastructure projects is growing, as communities feel that the negative impacts on them outweigh the distributed benefits for the many. There is a related tension between the need for a rapid transition to renewable energy and the need to navigate **complex environmental and planning approval processes** that can delay infrastructure investment.

There is also substantial **uncertainty about future policy and regulatory settings**, partly stemming from ongoing **political differences over energy transition**. After a few years of bipartisan support for net zero emissions by 2050 at the Federal level, the Coalition has now withdrawn support for this goal, creating uncertainty about the long-term direction of the NEM. Political change at the state level can also shift the goalposts, as seen in the Queensland Government's recent repeal of its previous renewable energy targets. This political uncertainty is frequently ignored in system planning, which assumes current policy settings will be maintained, even if those settings do not produce the most optimal result for grid transition.

Niche status

Niches are innovations with potential to contribute to energy transition but which are still under development and not yet in mainstream deployment. In the midst of a global energy transition, innovations are numerous and we cannot cover them all here. This section highlights prominent recent innovations that are receiving attention in the Australian context or have potential to address some of the transition challenges raised above.

Social contribution and customer outcomes

Many social innovations, like the new Solar Sharer Offer, assume that households are interested, engaged and able to shift their demand profile when most just want dependable, affordable energy services that they don't have to think about.

Addressing the affordability of electricity requires both long-term adoption of the most cost-effective technologies for meeting demand for energy services and short-term measures to support households experiencing hardship. The Australian Government's **Energy Bill Relief Fund** was an innovation that temporarily eased bills for all customers, regardless of their ability to pay. The ECA has suggested that government funds could be much better used by **targeted bill relief** for those that need it the most (Energy Consumers Australia, 2025).

Arguably the most important measure for improving energy affordability is to reduce energy demand by **improving the efficiency of homes**, particularly for those who are most vulnerable to energy hardship. The ECA has suggested strengthening minimum energy performance standards for rental properties (Energy Consumers Australia, 2025). Another RACE for 2030 project is exploring how to accelerate home energy upgrades.[2]

Recognition of the inequitable access to the benefits of energy transition is leading to significant innovation. The Australian

[2] See https://www.racefor2030.com.au/project/energy-upgrades-for-australian-homes/.

Government recently announced the **Solar Sharer Offer**, requiring retailers to offer free electricity to households for at least three hours in the middle of the day as part of the Default Market Offer. As with many innovations, it is not yet clear whether this will improve or worsen energy equity. Households may end up on offers with higher prices at other times and find they are unable to move much of their energy demand to the free times. Wealthier households with electric vehicles and smart devices may benefit more by being able to shift load to the free period. Other innovations such as **peer-to-peer trading**, **community batteries** and **local energy hubs** also aim to spread the benefits but need to be evaluated to understand actual impacts.

There has so far been less innovation in Australia around building social licence for the energy transition and giving citizens a voice in shaping that transition. **Innovative forms of citizen participation**, such as citizen assemblies, have seen significant use around the world, including in Australia. These processes invite ordinary citizens, often randomly invited, to learn about an issue and deliberate together on how best to respond. For example, Climate Assembly UK brought together more than 100 people in 2020 to discuss how the UK should achieve its 2050 net zero target. A similar process in Australia could help to generate social licence for energy transition and uncover innovative policy responses.

Other proposals explore the possibility of broadening the objectives of the NEM to recognise a **more complete set of customer objectives**: Dependable, Affordable, Sustainable, Equitable, Empowering, Expandable, Adaptable, and Beneficial (Energy Catalyst, 2025c).

Technological innovation

Batteries and electric vehicles are rapidly moving from niche to mainstream deployment, creating a significant resource for energy storage in the grid that requires smart technologies to orchestrate.

Solar photovoltaics and onshore wind power are no longer niche innovations, as they currently dominate new generation infrastructure. However, many other renewable energy options are in various stages of development but not yet commercially viable in Australia, including **offshore wind power, tidal and wave generation and solar thermal technologies**. Offshore wind power is arguably the closest to readiness. Six priority areas for offshore wind have been identified but the technology is estimated to be a decade away from readiness (CCA, 2024). Nuclear power is another niche technology that has received some attention in Australia although its cost is currently prohibitive (Graham et al., 2025).[3]

The increased role of variable renewable energy in electricity generation has prompted **significant interest in energy storage and firming technologies**. Battery storage is the most prominent technology, with more than 2GW of distributed battery storage and 1.5GW of utility-scale battery storage installed by mid-2024, most of which was added during 2023-24 (AEMC, 2025b). Installations have continued to grow since then, supported by the Australian Government's Cheaper Home Batteries Program. **Battery storage is arguably moving from a niche to a mainstream technology**, although questions remain over how to best orchestrate this growing resource.

[3] Nuclear power is categorised as a niche innovation in the Australian context where it has not been installed. In some international contexts it is already part of the regime.

Other firming technologies such as long-duration lithium ion energy storage, compressed air storage, iron air or flow batteries, pumped hydro and hydrogen turbines and engines are niches that need further investment.

The adjacent **emergence of electric vehicles** as a significant part of the transport market has implications for the NEM. In FY2024-25, electric vehicles accounted for 12% of new car sales, up from 7% the previous year (Electric Vehicle Council, 2025). Electric vehicle batteries can provide additional grid support, with considered and planned integration. Vehicle to grid technology could support all the world's short term grid storage requirements by 2030 with a participation rate of 12-43% (Xu et al., 2023).

With the increased variability of generation and decentralisation of the grid, use of **smart technologies to manage the grid** is receiving much attention. Orchestration of consumer energy resources through Virtual Power Plants is a growing niche (AEMO, 2024). Home energy management systems and smart devices are emerging to help Distribution Network Service Providers (DNSPs) to manage voltage fluctuations and congestion caused by two-way power flows (Energy Catalyst, 2025b), although household acceptance of these options is still uncertain.

Energy economics

Fundamental market and financial structural reforms are being proposed to improve investment signals and manage risk in the NEM. The draft report of the Australian Government's National Electricity Market Wholesale Market Settings Review (Nelson et al., 2025) proposes an **Electricity Services Entry Mechanism (ESEM)** to facilitate investment in new generation, storage, and firming capacity. It aims to address the tenor gap—the mismatch between long financing timeframes required by sellers and the short contracting horizons of buyers. It would procure bulk zero emissions energy, shaping, and firming services using standardised, fungible financial derivative contracts, focusing on the later years of a project's life (where risk management is currently lacking). **Reforms are also proposed that target the derivatives market** to manage volatility and enhance transparency, which is vital for providing long-term investment signals (Nelson et al., 2025).

The inclusion of a Value of Greenhouse Gas Emissions Reduction in system planning processes is an important innovation with the potential to shift optimal development paths.

Other innovations are emerging with a focus on **unlocking the latent value stored within customer-owned resources**, promoting efficiency, and avoiding expensive infrastructure investment (AEMO, 2024; Energy Catalyst, 2025a). **Virtual Power Plants (VPPs) and distributed energy resource aggregators** are gaining traction, enabling flexibility and household participation but adding complexity that requires integrated system design (AEMO, 2024; Nelson et al., 2025). Battery subsidies and community battery programs are accelerating storage deployment, supported by trials of dynamic tariffs and local energy hubs. **Falling battery costs and government incentives are driving rapid uptake**, complementing rooftop solar and electric vehicle adoption. Global supply chain vulnerabilities for batteries and renewable technologies could drive cost volatility and delay projects.

The inclusion of a **Value of Greenhouse Gas Emissions Reduction** in system planning processes, responding to the inclusion of emission reduction objectives in the National Electricity Objective, is an important innovation with the potential to shift optimal development paths (AEMO, 2024). In the absence of a real carbon price, this ensures that the value of avoiding emissions is captured in modelling.

Australian Government financial support includes the $5 billion **Net Zero Fund** to support industrial decarbonisation and the $1.3 billion **Household Energy Upgrades Fund** that provides discounted loans for home energy upgrades and social housing retrofits, delivering significant economic benefits and avoided abatement costs. The **Rewiring the Nation program** invests in new transmission lines through the Clean Energy Finance Corporation, which is also investing in renewable energy and storage.

State governments also support niche innovations, although support is inconsistent across states. For example, the NSW Government and South Australian Government currently provide incentives for connecting batteries to a Virtual Power Plant but these are not available in other states..

Environmental impacts

The main innovation to reduce the environmental impacts of the NEM not discussed in other sections is the use of targets to guide the pace of the transition. The Australian Government has set national targets to reduce emissions 43% by 2030, 62-70% by 2035 and to net zero by 2050 (from 2005 levels) (DCCEEW, 2025a). The Government is also **targeting 82% renewable electricity by 2030** (DCCEEW, 2025c). Targets provide signals to investors and other actors in the energy system but need to be supported by technological innovation, policies and market signals, as discussed in other sections.

Efforts to reduce impacts on biodiversity from the rollouts of new infrastructure include strategic planning to avoid biodiversity hotspots, careful site design to retain and reconnect fragmented habitats and sensory technologies to reduce bird and bat strike by wind turbines.

Considering the environmental impacts on the electricity grid is also important. Australia's first Climate Risk Assessment found that Australia's **energy infrastructure is increasingly vulnerable to extreme heat events**, where temperatures outside of safe operating temperatures will force network operators to increase outages (Australian Climate Service, 2025). There are also risks of damage to infrastructure caused by fires, storms and extreme winds (Australian Climate Service, 2025). **Weatherisation of energy infrastructure** is an innovation that is likely to become increasingly important to reduce vulnerabilities to extreme weather.

Climate change also feeds back to the energy system through emerging changes in lifestyles and energy-using practices. For example, the Digital Energy Futures project explored the potential for households to **respond to extreme weather by 'hunkering down' at home or by changing sleeping patterns** to include a siesta during the hottest part of the day (Strengers et al., 2023). Work Packages 1 and 3 of the SFL project are continuing to explore the implications of extreme weather for future energy use.

Efforts to **reduce impacts on biodiversity from the rollout of new energy infrastructure** are growing. Specific innovations include strategic planning of infrastructure sites to avoid biodiversity hotspots, circular economy practices to reduce mineral demand, careful site design to ensure wildlife corridors remain connected and revegetation can contribute to habitat and species regeneration, and the use of new sensory technologies to reduce bird and bat strike by wind turbines (Ruoso et al., 2024). Prioritising development of transmission lines along existing corridors is another option receiving attention. The Australian Government's Environment Protection Reform Bills, passed by the Australian Parliament on Friday 28 November 2025, were intended to **streamline approvals for clean energy projects** while aiming for **nature positive development**.

Politics and governance

Several formal governance innovations have emerged in recent years or are currently underway to address some of the challenges and tensions raised in the regime discussion. The **inclusion of emissions reduction** within the National Electricity Objective in 2023 is an important innovation that empowers AEMO to consider emissions in its system planning. The establishment of the **Energy Advisory Panel** in the same year to improve coordination between the Australian Energy Regulator, AEMC and AEMO has the potential to improve whole-of-system planning. Further, **rule changes** made by the AEMC require AEMO to include greater consideration of demand side factors and expand its gas analysis for the 2026 ISP, and the ECMC has asked AEMO to have regard to community concerns about infrastructure siting. These are important experiments in moving towards whole-of-system planning.

From a policy perspective, the Australian Government released **Australia's Net Zero Plan** in 2025, supported by an **Electricity and Energy Sector Plan**. It provides a roadmap for energy transition that prioritises energy efficiency, electrification and scaling of clean energy supply. More broadly, the **Future Made in Australia** agenda seeks to support industries to develop in Australia that contribute to net zero transformation. At a state level, **Renewable Energy Zones** have emerged as an important innovation aiming to contribute to regional development goals while also capturing economies of scale for large-scale renewable energy development.

An independent review of NEM wholesale market settings is currently underway that aims to recommend ways to promote investment in firmed renewable generation and storage capacity in the NEM following the conclusion of the Capacity Investment Scheme.

Specific policies include the Australian Government's **Capacity Investment Scheme (CIS)**, which aims to accelerate investment in renewable energy generation and clean dispatchable capacity through a competitive tendering process. The CIS currently runs through to 2027 and is seeking up to 26GW of renewable generation and 14GW of dispatchable capacity. The **Rewiring the Nation program** is investing in new transmission lines to support grid transformation. An **Orderly Exit Management Framework** has been established to guide actions in response to exit of coal-fired power stations during the energy transition.

A particularly interesting innovation that is very consistent with the idea of supporting niches is the Australian Energy Regulator's **policy-led sandboxing**, which grants a time-limited trial waiver on compliance with specific laws to eligible projects that accelerate understanding of ways to integrate consumer and distributed energy resources. This approach has the potential to allow experimentation with approaches that could contribute to transition but would otherwise be difficult to get started.

Several reviews and research projects are exploring ways to improve governance of the NEM. An **independent review of NEM wholesale market settings** is currently underway that aims to recommend ways to promote investment in firmed renewable generation and storage capacity in the NEM following the conclusion of the CIS. Other work is exploring the potential for **Distribution System Operator (DSO) models** to provide orchestration of distributed energy resources and improve transmission-distribution coordination. The ECMC developed a **National Consumer Energy Resources Roadmap** in 2024 and consulted during 2025 on aspects of its technology and markets workstreams (DCCEEW, 2025d). Finally, the RACE for 2030 CRC and Energy Efficiency Council are undertaking a **review of energy governance**, due to release findings in early 2026.

There have been few notable innovations in participatory governance of the NEM, although the Digital Energy Futures Project and its successor Scenarios for Future Living are exploring ways to bring household perspectives on the future of energy into planning processes.

Summary

Applying the multi-level perspective reveals a National Electricity Market in a state of profound but uneven transition. The interplay between landscape pressures—principally climate urgency and global economics—and maturing niche innovations has successfully destabilised the incumbent fossil-fuel regime. The technical dimensions of this shift are accelerating: renewable penetration is breaking records, emissions are in structural decline, and storage technologies are graduating from niche to mainstream deployment.

However, a worrying disconnect exists between this technical momentum and the socio-political reality. The transition currently lacks a genuine customer focus. While the grid decarbonises, energy equity is deteriorating, and the social licence for transformation is fraying under the weight of affordability concerns and a "predict and provide" engineering mindset. Governance remains fragmented, hindering the development of a coherent, whole-of-system vision that integrates technical requirements with social outcomes.

The next section explores how actors in the NEM are using foresight and futures thinking to respond to these risks and prepare for alternative possible futures. In the absence of a shared vision for the future of the NEM, it looks at the competing visions that currently exist and where they are coming from.

FUTURE GRID VISIONS

While it is clear that a transition is underway in the NEM, the endpoint is far from clear. This section examines probable, possible and preferable futures for the NEM and explores how well the sector is preparing for these futures.

A core idea in futures thinking is that **the future is not fixed** – there are different types of future that could emerge. The way that complex socio-technical systems like the electricity system will behave in the future is inherently uncertain and beyond our ability to predict, so futurists try to map possible futures rather than predicting a single future. This idea is commonly illustrated using a futures cone, as shown in Figure 3.

The futures cone

The futures cone depicts the range of potential futures spreading out from the present as a cone that gets wider as time flows on. Everything beyond the present moment is a potential future. Close to the present, the opportunity for the future to be radically different to now is constrained. But as time goes on, there is the potential for futures to diverge radically from what we might expect.

In the centre of the cone is the **projected futur**e, which is often called the 'business as usual' future. It's what we get if we assume the future will be much like the present. If we pay more attention to current trends, we can see a slightly broader range of **probable futures** that seem likely to happen if those trends continue. In practice, these futures rarely happen because trends rarely continue unchanged. Particularly in a time of transition like the NEM is experiencing, disruptions and trends breaks are the norm.

Plausible futures are those that we think could happen based on our current knowledge. The trends might not currently be pointing in that direction but we can develop a plausible argument for how that future could come about. AEMO positions its scenarios as plausible scenarios (AEMO, 2025a). They diverge from simple trend projections, for example, by imagining an Accelerated Transition scenario where positive conditions allow more rapid reductions in emissions.

This is where prominent industry scenarios tend to stop but there are a range of **possible futures** beyond what currently seems plausible. Some of these are **preposterous futures** that we judge to be ridiculous or impossible. The pioneering futurist James Dator once said that "any useful idea about the future should appear ridiculous". There is value in thinking about such futures because what once seemed preposterous often comes to pass. Many things that are now commonplace, such as carrying a powerful computer in your pocket, would once have seemed preposterous. Exercising our imagination to consider how the future of energy could be radically different to today helps us to prepare for those possibilities.

The futures cone also recognises that only some of the futures we can imagine are **preferable futures**, sometimes called desirable or normative futures. Different people and organisations will prefer different futures, so a key sectoral challenge is to negotiate conflict between values to find a pathway that actors can accept. Having established these different types of futures, we will now explore how the sector is imagining the future of the NEM.

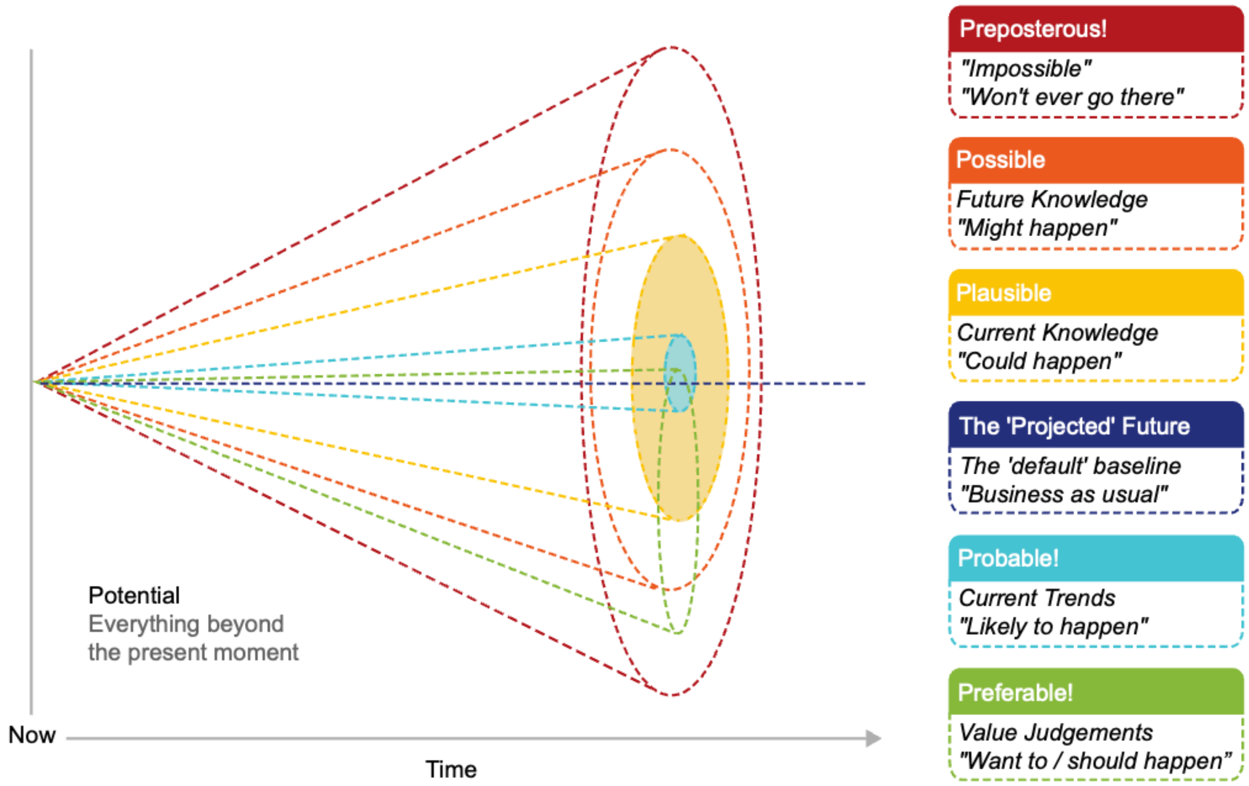

Figure 3. The futures cone. Adapted from Joseph Voros (2017).

Industry visions

AEMO's scenarios

AEMO's scenarios have become the de-facto industry standard and consider low (Slower Growth), medium (Step Change) and high (Accelerated Transition) pace of decarbonisation.

AEMO's scenarios have become the de-facto industry standard, given their central role in planning for the future of the NEM. AEMO has used scenarios to explore the implications of alternative futures in all of its Integrated System Plans, starting with its inaugural ISP in 2018.

There has been a **significant narrowing in the scenarios considered by AEMO over time**. In the 2018 ISP, five scenarios were considered with additional sensitivity analysis. Five scenarios were also considered during development of the 2022 ISP, although one was dropped for the final ISP. In the 2024 and draft 2026 ISPs, only three scenarios are considered (AEMO, 2024, 2025b).

The current set of three scenarios are named Slower Growth, Step Change and Accelerated Transition (AEMO, 2025a). While AEMO claims that these scenarios explore critical uncertainties relating to economic growth, global support for emissions reduction, development of demand-side factors, technology cost outlooks, the emergence of hydrogen and biomethane and the changing nature of commercial and industrial loads, **the scenarios essentially boil down to low (Slower Growth), medium (Step Change) and high pace of decarbonisation (Accelerated Transition)**, closely coupled to economic growth assumptions. Step Change keeps warming under 2 degrees, Accelerated Transition keeps it under 1.5 degrees and Slower Growth fails the Paris Agreement targets (about 2.7 degrees) (AEMO, 2025a).

These scenarios are arguably sufficient for the purpose they are being put to, which is to plan the pace at which major transmission and generation infrastructure needs to be put in place to support energy transition under current policy settings. Crucially, **this does not mean they adequately explore the range of possible futures that the energy sector and NEM needs to prepare for.** There are several reasons why the AEMO scenarios are not fit for this broader purpose.

First, **exploratory scenarios typically consider a broader range of drivers and various combinations of drivers to more comprehensively map possible futures**. A simple, common approach is to identify the two most critical uncertainties and create four scenarios on a grid where these uncertainties are the two axes. AEMO's scenarios lack this variation; they can be arranged along a single axis, where the only uncertainty is the pace of transition.

While arguably appropriate for system planning, AEMO's scenarios do not consider a sufficiently broad range of possible futures for the NEM, ignoring political drivers, weak signals and wild cards.

Second, these scenarios are described by AEMO as 'plausible' and should be understood as futures that are close to the centre of the futures cone in Figure 3. A strong indicator of this is the relatively high probabilities assigned to each of the scenarios by expert stakeholders. 46% chose Step Change as most likely and 27% chose each of Slower Growth and Accelerated Progression (AEMO, 2025b). **A lot of the value of scenario sets comes from exploring possible futures that might be seen as having a lower probability right now but would have significant implications if they came to pass**. Our inability to predict the future means that futures that currently seem unlikely can rapidly become our reality. It is important to prepare for these futures by considering weak signals of emerging trends and 'wild cards' that point to different futures.

Finally, in keeping with AEMO's remit, **these scenarios ignore questions of politics**. The history of Australia's energy transition cannot be accurately told without referring to the influence of political change and the same is true of the future. The major political parties no longer share bipartisan support for net zero targets and differ on many other aspects of energy policy, so future elections could significantly alter the landscape for energy transition in the NEM. The energy demand associated with data centres is also leading major technology companies to seek political influence over energy policy. It cannot be AEMO's role to consider political drivers but a comprehensive set of scenarios for the future of the NEM cannot ignore politics. Major international scenario sets from the International Energy Agency and World Energy Council include politics as a key driver (IEA, 2025b; World Energy Council, 2024).

While AEMO's ISP has become the dominant industry vision for Australia's NEM, several other industry, research and civil society organisations are either challenging its legitimacy and implicit assumptions, or positing alternative visions for the grid, including the SFL project (particularly through Work Package 3). Some of these organisations aim to broaden discussion by exploring alternative possible futures, while others remain focused on plausible futures but propose alternative modes of service delivery in the energy system transformation. Other visions for the NEM are explored below.

Australia's Net Zero Plan

As noted above, government policy and programs play a crucial role in shaping future pathways. At the federal level, **the recently announced Net Zero Plan establishes a pathway to reduce greenhouse gas emissions by 62-70% below 2005 levels by 2035**, building toward net zero by 2050 (DCCEEW, 2025b). Underpinning the 2035 target are six sector plans, including one focused on electricity and energy.

The Electricity and Energy Sector Plan sees **the electricity sector (and grid) delivering approximately half of the emissions reductions to 2035** (DCCEEW, 2025c). It proposes three core strategies to transform Australia's energy system and reach net zero by 2050:

1. **Energy performance**: using energy more efficiently to reduce demand and infrastructure needs;
2. **Electrification**: fuel-switching and increasing electrification to take advantage of cheaper, cleaner energy sources including renewable electricity;
3. **Increasing renewables supply**: scaling clean energy supply to power homes, businesses and industry as fossil fuel use declines.

Treasury modelling to support Australia's Net Zero Plan developed a Baseline Scenario that efficiently achieves domestic targets, a Renewable Exports Upside Scenario that sees additional benefits to Australia from renewable energy exports and a Disorderly Transition Scenario without credible 2035 targets.

Electrification is a core element of the broader zero carbon vision, which means that in addition to reducing current electricity-related emissions, the grid must simultaneously expand capacity to power transport, industry, and buildings transitioning away from fossil fuels.

Australia's Net Zero Plan draws on Treasury modelling of three scenarios to compare potential transition pathways (The Treasury, 2025). The **Baseline Scenario** presents an efficient pathway consistent with existing policies and expected technology availability, while the **Renewable Exports Upside Scenario** additionally considers a future where Australia capitalises on emerging renewable energy export markets. Both scenarios achieve the government's 2035 target of 65% emissions reduction compared to 2005 levels and reach net zero by 2050 (DCCEEW, 2025b). To contrast, Treasury also modelled a **Disorderly Transition Scenario**, which assumes Australia does not set a credible 2035 emissions reduction target, and climate policy action stalls between 2030 and 2040 resulting in heightened policy uncertainty, less investment, and a more costly abatement path (The Treasury, 2025).

Like AEMO's scenarios, these scenarios stick close to the centre of the futures cone and do not attempt to explore and prepare for a full range of possible futures. Rather, they seek to demonstrate the economic benefits of the Australian Government's policy settings – a disorderly transition without targets will be costly and pursuing the Future Made in Australia agenda has significant economic upsides for Australia.

A synthesis of industry scenarios

Researchers from Monash University conducted a multiyear research project, **Digital Energy Futures: Scenarios for Future Living 2030/2050**, in response to an identified gap in existing energy futures scenarios: an understanding of ways in which people will live — and therefore use and interact with energy — in the future (Strengers et al., 2023). The project first conducted a qualitative review of 14 Australian energy industry plans/visions to analyse the representation and consideration of individuals and households in energy system planning and visioning (Kaviani et al., 2023). These were synthesised into three categories of industry scenarios:

1. **Disruptive Technology**: Scenarios that illustrate the disruptive impact of CER and assume that people ultimately seek energy independence. The grid is portrayed as ill-prepared and household actions create instability.
2. **Prosumer Participation**: Scenarios in which the network has more time to prepare for CER and rational energy users are incentivised to act as prosumers and engage with Virtual Power Plants, CER trading and demand-side management.
3. **Automated Futures**: Scenarios in which there is a network of integrated, active and automated CER. People embrace set-and-forget technologies, adapt to the availability of renewable energy generation, and allow network intelligence to have control over CER to maximise grid efficiency.

Industry scenarios are built on un-evidenced assumptions about people, assuming levels of interest and engagement with energy technologies and comfort with automation that are unlikely to be realistic.

These scenarios were arranged on a spectrum from low (Disruptive Technology) to high levels of automation (Automated Futures), with higher levels of automation assumed to provide greater certainty for management and planning of the grid (Strengers et al., 2023). The authors found that **energy system planning too narrowly focuses on "un-evidenced assumptions about people".** Technological solutions, and the values of the scenario-forecasting organisation are prioritised, ultimately limiting perspectives on the future.

Digital Energy Futures scenarios

The researchers then drew on ethnographic research with households to develop four alternative people-centred scenarios exploring ways of life in 2030 and 2050, unpicking the normative industry assumptions about technology and household behaviour (Strengers et al., 2023):

1. **Creature Comforts** (2030) — an individualised future, where homes have become a site of 'comfort, entertainment, and convenience' through a huge uptake of consumer electronics, smart home tech and luxury. Demand on the grid at peak times is increased as override functions are common, placing strain on the grid.
2. **Sharing the Load** (2030) — a community-oriented future, where households take responsibility for sharing and managing renewable energy resources. CER assets are used for both household and community benefit, leading to greater grid resilience and faster decarbonisation. Yet this future vision lacks equitable solutions for those locked out of CER options.
3. **Hunkering Down** (2050) — a future where homes are refuges from extreme weather events, reliant on CER and automation, with smart systems in place to control energy efficiently. "Override peaks" emerge as households prepare for outages or heatwaves, and equity issues arise from CER emphasis.

4. **Sunrises & Siestas** (2050) — a future where society aligns energy use in response to climate impacts and solar availability. People in their workplaces and homes adapt their schedules, with community and public spaces becoming sites of safety and resilience. While the energy system is more resilient as people modify their practices, supply chain and fairness issues persist.

As these scenarios outline, **customer practices, aspirations and desire to engage with energy are diverse and differ from industry assumptions**. How actual customer behaviours and practices will shape future energy system demand needs greater consideration in future planning. The SFL project intends to update and augment these scenarios, drawing on a broader evidence base and stakeholder input.

Energy Networks Australia

Energy Networks Australia has proposed the All Levers Pulled scenario as an alternative to those in AEMO's 2024 ISP, with a focus on tapping into the existing and potential capacity of the distribution network.

Since the Digital Energy Futures project, several other visions for Australia's energy system have emerged, vying to capture the energy system imaginary. **Energy Networks Australia (ENA) have articulated a vision for energy system transformation that is network-led**, tapping into the existing and potential capacity of the distribution network. In, *The Time is Now*, ENA lays out an **'All levers pulled' scenario**, which ensures Australia achieves its 82% renewable target by 2030, while delivering $7 billion in consumer benefits through distribution-connected resources (ENA & LEK, 2024).

The scenario can be understood as an alternative to those presented in AEMO's 2024 ISP, **addressing the critique that insufficient attention was given to opportunities in the distribution network**. It expands the range of possible futures covered in the futures cone, while also expressing a preferable future from the perspective of DNSPs. 'All levers pulled' is modelled alongside a 'Missed opportunities' scenario, the pathway of no intervention, with assumed delays and costs to energy infrastructure development (ENA & LEK, 2024).

The All Levers Pulled scenario would require:

- Increased uptake of rooftop solar through incentives
- Local Energy Hubs (also called Community Power Networks) in under-utilised areas of the network
- In-front-of-the-meter home batteries connected to the distribution network to increase storage capacity
- Installation of EV chargers on distribution network infrastructure (ENA & LEK, 2024).

Distribution company AusGrid has recently secured a policy-led waiver from ring-fencing rules to **establish a five year trial of Community Power Networks in two regions**, which will test some aspects of this scenario. Some critics have argued that this regulatory waiver will enable the DNSP to further monopolise its operations by adding shared batteries to its asset base (Rae, 2025), although households remain free to install their own batteries.

Renewable Energy Superpower

The Clean Energy Council (CEC) — Australia's peak body for the renewables sector — has its own vision for the energy system. In its Power Playbook publication (CEC, 2023), it laid out a pathway to the full decarbonisation of the electricity sector by 2035 driven by supercharged investment in renewable capacity (100 billion over ten years) . Through a range of policy and program recommendations, the CEC **articulates a future vision of Australia as a 'Renewable Energy Superpower'.** It recommends that in order for us to act urgently on climate, while securing Australia's position in the global clean energy economy, we must:

The Clean Energy Council articulated a vision of Australia as a Renewable Energy Superpower, which aligns with the Australian Government's Future Made in Australia agenda and the more recent Renewable Energy Exports Upside scenario in Australia's Net Zero Plan.

- Develop a Renewable Energy Superpower Masterplan
- Commit to a $100 billion Clean Energy Transformation Investment Package
- Extend the LRET and prioritize electricity system decarbonisation
- Expedite planning, workforce development, and supply chain strategies
- Support green hydrogen and minerals processing with substantial funding and policy mechanisms.

With industry needs and aspirations at its core, the CEC's future plans for the NEM (and beyond) expand the range of possible futures under consideration and identify what the renewable energy sector defines as a preferable future. Some elements of this vision align with the Australian Government's Future Made in Australia agenda and the Renewable Energy Exports Upside scenario modelled for the Net Zero plan.

Policy visions

The Grattan Institute has also weighed in on the future of Australia's grid, offering two future scenarios guided by policy interventions to ensure an emissions free energy system by 2050 (Reeve et al., 2025). The Institute points out that the Renewable Energy Target (RET) and the Capacity Investment Scheme, both key drivers of the clean energy shift to date, expire by 2030. It argues that new guardrails need to be in place to guide Australia toward net zero by 2050, while protecting households.

Its primary scenario, the ***Safeguard Mechanism scenario*****, hinges on the mechanism being extended to include electricity generation in 2030, ultimately asking for a price on carbon**. By design, this scenario includes a baseline-and-credit system applied to all generators; individual baselines based on emissions intensity; and credits awarded for below-baseline performance. All carbon budgets would be aligned with Climate Change Authority pathways. This future would see emissions fall rapidly, with coal exiting by the mid-2030s, and household bills only $70/year higher than the no-policy case, while overall energy costs halve by 2050.

The alternative, ***No New Policy scenario*****, assumes current policies remain in place but no new carbon constraint is introduced after 2030**. Coal exits gradually based on announced closure dates and the market builds new capacity based on least-cost economics without explicit carbon pricing. This future leaves us with high emissions—about 30 MtCO_2-e in 2050. Despite Australia's chequered history with carbon pricing, and in particular where energy generation is concerned (Grudnoff, 2020), the Grattan Institute's vision presents as a plausible future — an electricity system rapidly decarbonised, with industry bearing the cost.

ourPower

The Australian Council of Social Services (ACOSS) joins the chorus of actors articulating future directions of the NEM, with a vision that has social justice at its core. The "ourPower" framework (ACOSS & TEC, 2022), developed in partnership with the Total Environment Centre (TEC) and ECA is a set of principles for designing an energy system that places people at the centre. OurPower has **a vision for 'an inclusive, sustainable, zero emissions energy system that actively improves outcomes for all people, communities and the environment'** (ACOSS & TEC, 2022). It positions energy as an essential service and establishes five principles for decision-makers tasked with stewarding the energy transition:

- Make sure it works
- Deliver clean and healthy energy
- Be people focused
- Be just and fair
- Think long-term and be flexible.

Like other organisations, ACOSS, TEC and ECA express a vision for a preferable future. A key difference is that equity, fairness and justice are deeply embedded in their vision.

The most prominent scenarios focus on plausible futures and most alternative visions are futures preferred by specific organisations, leading to a high risk of industry blind spots – possible futures for the NEM that have not been adequately considered.

Potential blind spots

This review of industry visions suggests that the most prominent scenarios focus on the plausible futures near the centre of the futures cone. Other industry visions expand the range of possible futures under consideration but are motivated by the specific preferences of the organisation publishing those visions. In this context, there is a high risk of industry blind spots – possible futures with significant implications for the NEM that have not been adequately considered and for which the sector is poorly prepared. Potential blind spots are summarised below. One of the primary intentions of the SFL project is to draw attention to these blind spots and address them, particularly through Work Package 3.

Household practices and aspirations

In energy system planning there is a tacit assumption that 'consumers and technology will form a rational alliance with grid objectives' (Kaviani et al., 2023, p. 7). Yet as research has shown, **households vary in their willingness and ability to engage with and adapt their behaviour to manage their energy use** (Collingridge & Merhab, 2025; Kaviani et al., 2025; Strengers et al., 2023). Many of the visions for the future of the NEM rely on households being willing to install specific technologies, modify their demand in response to price signals or allow demand management via networked devices and orchestration.

For many customers, there is **deep discomfort with the idea that third parties would have access to their data and capacity to control their energy consumption**. There is also little understanding of how household practices are likely to change in the future, which is the key motivation for the Scenarios for Future Living project. Future customer practices and aspirations are a potential blind spot that still requires more attention.

Many customers are uncomfortable with the idea that third parties would have access to their data and capacity to control their energy consumption.

One recent example of this blind spot around household aspirations is the response to the Australian Government's Cheaper Home Batteries Program. A **program designed to support installation of 1 million home batteries by 2030 has already seen 146,000 batteries installed in just five months**, with the average size of the batteries installed under the program roughly double what a regular household requires to meet its energy needs (Best, 2025). The unexpected demand illustrates how poorly household motivations are currently understood in the sector.

Similar challenges may arise with respect to participation in Virtual Power Plants, electric vehicle uptake and charging practices and smart home energy management systems. Other challenges are likely to emerge unexpectedly from adjacent fields, such as **new classes of energy-using consumer products on the horizon** that are not currently considered in future planning.

The ways in which people use energy in their homes will continue to influence how the energy system at large operates and how we plan for its future. Will these trends in the micro scale of the energy system curtail the need for volumes of macro scale capacity investment? Some observers (such as ENA) see a need to invest in CER innovation, to reduce the need for larger scale infrastructure development —

especially transmission lines — particularly given the social backlash against new transmission.

Social licence and support for the energy transition

Social licence refers to the level of trust, support and acceptance communities and individuals have for the process of change that impacts them. In the case of regional communities hosting renewable infrastructure projects, social licence is an ongoing negotiation that plays out in the relationship with a developer, project or process (such as the gazetting of a Renewable Energy Zone). It is built through meaningful relationships, trust, early and genuine community engagement and a sense that the benefits outweigh the impacts (Stronge et al., 2024).

A majority of Australians support renewables (CSIRO, 2024), and the energy transition more broadly. Most surveys in regional communities also show a clear majority in favour of renewable energy projects. Nevertheless, **community pushback against large scale renewable projects — transmission, solar, wind and BESS — is emerging as a critical challenge in the energy transition** (Gerrard & Crofts, 2025). There are several reasons we are witnessing vocal backlash and a lack of social support for renewables at the project level, and for the wider energy shift. These include:

- The speed and scale of transition, including cumulative impacts in REZs
- The new geographies, and associated tensions between urban and regional and rural communities
- A history of chequered and poor engagement practices in the industry
- Vested interests actively inflaming debates.

While renewable resources might be abundant in regions, the changes infrastructure development brings, such as landscape shifts, increased construction traffic, noise and FIFO workforces, are significant.

The rapid deployment of renewable energy and supporting infrastructure in new locations has been called 'energy sprawl' (Sweeney, 2024). Energy sprawl is being experienced in regional and rural communities across Australia, where the sun and wind are abundant, as is available land. **While renewable resources might be abundant in regions, the changes infrastructure development brings, such as landscape shifts, increased construction traffic, noise and fly-in, fly-out (FIFO) workforces, are significant**. Furthermore, in Renewable Energy Zones (REZs), some communities are facing the cumulative impacts of multiple concurrent developments, putting pressure on regional services and infrastructure.

Meanwhile, the demand for electricity is largely concentrated in Australia's capital cities. As Colvin (2025) puts it, 'these geographical realities of the renewables buildout provide a narrative framework of urban demands for renewable energy causing change to regions — often unwanted — via new renewable energy infrastructure development'. The perennial (perceived) divide between rural and regional and urban Australians is being inflamed again. One attempt to address this issue is by establishing REZs in urban areas. TheIllawarra REZ in NSW is the first of its kind and seeks to integrate consumer energy resources in an urban region to support growth of new low carbon industries.

In 2023, the then Australian Energy Infrastructure Commissioner commissioned a review into community engagement and the renewable energy sector. The review found **cases of poor engagement practices** in the sector, which contributed to community pushback (Dyer, 2023). It made recommendations to improve community engagement through a developer rating scheme.

The net zero and energy transition are fraught processes, with conflicts being waged in party rooms, across media publications and within communities. Vested interests are exploiting the heightened atmosphere, leveraging genuine community concerns and using misinformation to foment fear and resistance (Gerrard & Crofts, 2025).

After the 2024 ISP, AEMO was called to consider community sentiment and social licence in their ISP modelling as there is a perceived risk that AEMO has been developing technically feasible pathways that are politically unachievable due to community opposition. The recently released draft 2026 ISP (AEMO, 2025b) has included aspects of social licence, showing that disregarding the social dimensions of energy infrastructure planning is no longer feasible (i.e. using a technology and least cost approach, might have the opposite effect when not considering the social support context).

Specifically, **the Draft 2026 ISP considered both the social acceptance for the energy transition and community scale acceptance of developments**, incorporating a "land use complexity analysis" to identify areas with high social/environmental sensitivity early in the planning process. It also updated the Transmission Cost Database to include higher costs for meaningful community engagement and route diversions.

This increased attention to issues of social licence is welcome. However, we would argue that **industry visions for the future of the NEM have not yet fully caught up to the reality on the ground and continue to 'presume benevolence'** (Bice, 2024) when it comes to renewable energy infrastructure. The prominence of social licence issues in the energy transition means that scenarios for the NEM should explore how to respond to (and avoid) escalating community opposition to energy transition infrastructure, for example by giving greater attention to futures that rely more heavily on investment at the scale of distribution networks.

Politics

A 2022 review of Australian energy foresighting practices found that the influence of political drivers on possible futures for the energy system was particularly neglected (Riedy et al., 2022). In one sense, this is not surprising. Government and market bodies need to focus their attention on current policy settings and industry actors are understandably unwilling to jeopardise their relationship with the government of the day by exploring alternative political scenarios.

On the other hand, **changes in political power and government policy are one of the most important influences on the future of energy transition**. Taking just one obvious example, if the Coalition were to win an upcoming election and repeal the 2050 net zero target (as is now their policy), the future grid would start to move in a very

It is completely understandable that government and market bodies focus their attention on current policy settings and industry actors are unwilling to jeopardise their relationship with the government of the day by exploring alternative political scenarios but changes in political power and government policy are one of the most important influences on the future of energy transition.

different direction. Current energy visions and scenarios in Australia ignore this important source of future variability.

The World Energy Council recognises the important role of politics in its 2024 Scenario Foundations (World Energy Council, 2024), which discards the idea of a cooperative globalised world, assuming instead a **fractured geopolitical landscape into the future**. It considers two possible foundations for full scenarios. The **Rocks** scenario foundation describes a fragmented world where geopolitical blocs and national self-interest create structural constraints and policy fragmentation that slow energy transitions and delay fossil fuel phase-outs, with collaboration primarily restricted to established institutions or political allies. The **Rivers** scenario foundation describes a fluid, adaptive world characterized by dynamic change driven by digitalisation and market forces, where energy transitions are accelerated by swift fossil fuel substitution and emerging alignments formed by common pressures, market opportunities, and innovation across diverse actors.

How such scenarios might impact Australia has not been adequately explored. For example, in a **Rocks** world, Australia's delicate straddling of an Asian trade bloc and the AUKUS security bloc could become untenable. Perhaps Australia would be locked out of regional trade in key energy transition resources and technologies that it can only secure through trade. The 2025 World Energy Outlook (IEA, 2025b) draws particular attention to these questions of **energy security and the vulnerability of supply chains for critical minerals**.

Or, applying the Rocks thinking to Australia, perhaps we could see a breakdown in the cooperative arrangements of the ECMC, with **states moving in different directions and at different paces on energy transition**.

In a **Rivers** world, it is not hard to imagine a future where the growing energy needs of hyperscale data centres leads **technology companies to become key players in energy transition**, forming alliances to secure their own renewable energy resources. Perhaps the scale and pace of these projects would intensify community opposition and infrastructure blockades, eroding social licence for energy transition.

There is currently no independent, well-resourced space to explore political scenarios like these that go beyond the lifetime of the current government in power, leaving the sector poorly prepared for such disruptions.

Anticipatory governance

What emerges from this review of visions for the future of the NEM is the **lack of any shared vision or any suitable space in which to develop such a vision**. Beyond the 'official future' presented in AEMO's Step Change scenario, a cacophony of voices present their competing visions for alternative futures. In a fragmented energy governance system, with responsibilities split between multiple actors, it is not clear where these discordant visions can be harmonised.

This matters because the **scale and pace of the energy transition are unprecedented and the primary risks to its success are not technological but social and political**. Growing community opposition to infrastructure projects and unanticipated customer responses to interventions are helping to make this reality apparent. What is needed are spaces where all actors can participate in settling social and political differences over the direction of transition.

We need better **anticipatory governance, i.e. governing (or steering) in the present to engage with, adapt to or shape uncertain futures** (Riedy, 2025). Such governance would:

We need better anticipatory governance that engages more imaginatively with possible futures, explores resilient policy responses, involves the whole system and scrutinises social justice implications.

- Engage more imaginatively with possible futures through consideration of weak signals, wild cards and developments in adjacent fields
- Explore policy responses and actions that are resilient across multiple possible futures
- Involve the whole system, including customers, in co-creating preferred futures for energy transition to build ownership, mobilise participation and generate social licence
- Scrutinise the social justice implications of possible futures and steer towards futures that improve rather than threaten equity.

The remaining sections of the report explore ways to build a foundation for better anticipatory governance in the NEM grid. We start by addressing one of the major blind spots in current futures thinking – exploration of futures that deliver just transition.

TOWARDS A JUST TRANSITION

The accelerating energy transition has many benefits for Australia but our review of the current state of transition shows that a just transition is at risk. This section examines the existing fairness gap and explores how we can test if energy transition scenarios improve fairness.

The fairness gap

As with all major structural transitions, there are risks that costs and benefits of grid transition will not be distributed equitably and that people, organisations and regions that are disadvantaged or vulnerable find themselves worse off. Major industry reports from the AER and AEMO recognise that **vulnerable customers such as renters and low-income households are missing out on the benefits of CER** (AEMO, 2025b; AER, 2025b). At the same time, the impacts of new grid infrastructure are experienced disproportionately by certain communities, raising **concerns about social licence for the transition** (AEMO, 2025b).

Momentum is gathering to address the fairness of grid transition. In 2022, the AER developed the **Towards Energy Equity strategy**, which includes 15 actions to make the energy market more inclusive by reducing barriers to participation, supporting households experiencing hardship and improving affordability (AER, 2022). The AER's annual review of the State of the Energy Market evaluates progress against the Strategy.

In 2025, the Energy and Climate Change Ministerial Council released a **National Energy Equity Framework** to guide consideration and inclusion of equity into energy policies and programs (DCCEEW, 2025e). Energy Consumers Australia also publishes an annual Consumer Energy Scorecard based on survey data to track changes in energy hardship (Energy Consumers Australia, 2025).

On the specific issue of social licence, AEMO's Draft 2026 ISP introduces a land use complexity analysis to identify areas with high social or environmental sensitivity and includes the cost of 'meaningful engagement' in its Transmission Cost Database (AEMO, 2025b). These innovations aim to ensure that **social licence is considered in identifying the optimal development path** but do not directly address how to better engage with affected communities.

Despite all these efforts, a recent evaluation concluded that the **Australian energy transition 'lacks clear, calculable and consistent ways to measure fairness and inclusion'** (Taylor, 2025). In a related report based on a review of international literature, Bice and Parsons (2025) conclude **vulnerability and fairness are under-researched for the Australian energy transition**. Taylor (2025) advocates for the development of metrics to evaluate the fairness of the Australian energy transition using a 'JUST' framework (Justice, Universality, Space, and Time) and to guide policy and industry decisions.

Many of these efforts take a narrow focus, either on energy affordability and hardship, or on social licence. There have been **few attempts to define what is fair at the holistic scale of grid transition**, taking into account vulnerable energy users as well as outcomes for First Nations Australians, coal communities and regional areas hosting the new energy infrastructure. Whilst there are a number of annual reviews of the state of the energy transition in relation to economic or technical criteria, there is no equivalent evaluation of the fairness of the energy transition.

Further, most of this work does not adopt a future orientation to explore scenarios or visions for a fair energy transition. In particular, **when evaluating future visions or scenarios for grid transition, how can we determine which of these competing futures are fairest?** Our contribution in this section is to propose four major tests to determine if the energy transition is fair.

Four tests for a fair grid transition

A just transition broadly refers to ensuring the shift from fossil fuels to low-carbon energy happens in ways that protect workers, communities, and vulnerable groups from economic and social harm (ILO, 2015). Born from the union of the labour and environment movements, the goal of a just transition served to bridge the perceived intractable divide between 'jobs and the environment' (Rosemberg, 2010; Stevis & Felli, 2015). Organisations like the International Labour Organisation (ILO) articulate **just transition as a multi-actor process, including deliberative practices, such as social dialogue**, and initiated to protect workers when fossil fuel or polluting industries are facing closure (ILO, 2015). Over a decade ago, the labour movement fought hard to have a just transition included in the Paris Agreement.

A just transition broadly refers to ensuring the shift from fossil fuels to low-carbon energy happens in ways that protect workers, communities, and vulnerable groups from economic and social harm.

While the term just transition has now spread into common vernacular, and includes more expansive conceptions of what justice can and must look like as we shift towards a cleaner economy and energy system, justice is still theorised in three core ways. Justice is applied to any area or process impacted by climate action and subsequent transition, and thought of as:

- "**Distributive**" (emphasising fairness in the distribution of harms and benefits)
- "**Recognition**" (highlighting questions of prejudice and discrimination in the transition process)
- "**Procedural**" (attentive to the process and fairness in decision-making) (MacNeil & Beauman, 2022; Taylor, 2025).

Energy justice, on the other hand, is often thought of as the '**application of human rights across the energy life cycle ... from extraction to production to operation (and supply) to consumption to waste management (inc. decommissioning)**' (Heffron, 2022, p. 4). In this way, scholars, advocates and activists see energy justice as a means to make the theoretical tangible by calling out rights-based approaches to energy inequities.

As an illustrative exercise, for the purposes of evaluating energy transition scenarios and visions, we have identified **four major equity and fairness tests.**

1. Will disadvantaged households get access to clean energy and its benefits or conversely be left to bear the costs of legacy infrastructure?

Households that can install consumer energy resources such as rooftop solar panels, electric appliances and batteries can realise major savings on their electricity bills, generate new revenue and improve their resilience to a changing and hostile climate. Disadvantaged households that are unable to access CER due to household type (e.g. apartment dwellers), location (e.g. remote communities) or income to purchase new technologies could not only miss out on the cost savings and new revenue streams, they could find themselves paying higher energy bills — in particular, if gas networks increase charges to cover fixed costs from a dwindling customer base — and living in uncomfortable homes exposed to climate change. There is a **risk of a divide between CER and non-CER households** based on class and socio-economic lines.

The equity dimensions of household access to clean energy are arguably the best analysed of the four fairness tests for the energy transition. Nonetheless, **energy transition scenarios do not project out different futures based on different outcomes for household access to clean energy.** Additionally, Bice and Parsons (2025, p. 23) conclude Australia lags other nations in the volume of research on energy vulnerability and poverty and that 'the nation "lacks an official definition of energy vulnerability" '.

Energy transition has the potential to improve the socio-economic position of First Nations Australians by improving access to affordable electricity, providing employment and training opportunities and offering equity and ownership of renewable energy.

2. Will the socio-economic position of First Nations Australians be improved through the energy transition?

The socio-economic position of First Nations Australians has changed little in recent decades notwithstanding waves of economic development in regions with First Nations Australians, most notably mining booms which have generated extraordinary wealth. For example, the employment participation of First Nations Australians has not increased in three decades amidst these waves of economic development and many of the socio-economic indicators tracked in the Closing the Gap initiative have not improved (The Treasury, 2023).

The **impact of the energy transition on the socio-economic position of First Nations Australians** has now been highlighted in a series of reports and the Federal Government has developed a First Nations Clean Energy Strategy (DCCEEW, 2024b). In addition to household access to clean energy already discussed, the key aspects of the energy transition which could influence the socio-economic position of First Nations Australians are:

- **Access to affordable electricity in remote areas**: approximately 15,000 households with 65,000 First Nations Australians are on pre-payment electricity arrangements in remote First Nations communities in Western Australia, Northern Territory and Far North Queensland. Under these arrangements, electricity tariffs are high and when credit runs out the system is disconnected with impacts on health, food security, well-being and economic participation. In edge-of-grid locations with significant First Nations communities, reliability of supply can be very poor with impacts on basic household amenity such as food security (Riley et al., 2023).
- **Employment and training opportunities**: only around 1-in-2 First Nations Australians are in employment relative to around

2-in-3 of the rest of the population. The energy transition presents opportunities to increase First Nations employment and training participation; for example, there is a higher than average First Nations population in the renewable energy zones where much of the large-scale infrastructure will be built (Briggs et al., 2025).

- **Free and informed prior consent**: the active involvement and agreement of First Nations peoples to development on their lands is a core feature of a fair energy transition.
- **Ownership and equity**: ownership and equity shares in renewable energy development in other nations (notably, Canada but also New Zealand) have created revenue streams that have enabled other forms of economic development (e.g. local industry) and social development (e.g. health services).

Whilst the issue of First Nations benefits and involvement has become recognised and there is a growing body of research (see Taylor, 2025), **there are no energy transition scenarios projecting out different outcomes for First Nations Australians** or tracking measures on progress against these key dimensions. Taylor (2025) further notes there are no metrics or frameworks being applied to measure processes and outcomes for First Nations Australians and highlights international examples such as the Indigenous Services Canada Wellbeing Index.

Australia has multiple regions with high dependence on fossil fuel sectors which are vulnerable to disruptive change without advance planning and investment.

3. Will there be a 'just transition' for coal regions into alternative economies?

For coal producing countries such as Australia, one of the key challenges is **how to avoid a 'disruptive' energy transition with social and economic dislocation in coal regions**. As one of the leading global users, producers and exporters of fossil fuel energy, there are **multiple regions with high dependence on fossil fuel sectors which are vulnerable to disruptive change**. If there is a wave of coal power stations or mine closures in coming years at short notice without advance planning and investment, there could be devastating social and economic impacts in regional communities. Almost one-in-two coal workers are semi-skilled machine operators or truck drivers (Briggs et al., 2020). The tragic privatisation of the Latrobe Valley region in Victoria during the late 1990s, showed us that poorly managed restructuring in coal regions leaves lasting intergenerational poverty and disadvantage (Musil & Gerrard, 2024).

In 2024, the Australian Government established the Net Zero Economy Authority (NZEA) through the Net Zero Economy Authority Act 2024 (NZEA Act). The NZEA is mandated to:

- "Promote orderly and positive economic transformation
- Facilitate greenhouse gas emissions reductions
- Ensure regions, communities and workers are supported to manage the impacts, and share in the benefits, of the net zero economy".

NZEA has established some programs and initiatives to embark on the complex task of managing the net zero transition in vulnerable regions. The **Energy Industry Jobs plan**, for example, provides a framework to ensure all workers in eligible gas and coal fired power stations facing closure, get access to the same supports (NZEA, n.d.). NZEA is early on in its formation and remit, but like other nations such as Scotland and its Just Transition Commission, it is considering how to monitor and track the impacts of coal phase out for communities.

4. Will the regions hosting the REZs be the site of a FIFO construction boom or will there be longer socio-economic benefits?

Regions hosting Renewable Energy Zones could experience positive or negative socio-economic impacts depending on whether the build-out of energy infrastructure is managed to deliver local benefits or not.

Regions hosting **REZs will be the site for most of the infrastructure build-out for large-scale renewable energy**, storage and transmission. There are two primary types of REZs — industrial regions in transition from fossil fuel based economies (covered above) and inland regions with economies built primarily around agriculture and resources, supported by construction and health services with the remainder of the economy mostly comprising a long tail of small services. These regions have little energy infrastructure. In the largest NSW REZ in New England, for example, electricity, gas and water is the 17^{th} largest sector.

For these regions, the **socio-economic impact of the energy transition could be negative or positive depending on how the build-out of the energy infrastructure is managed.** Whilst there has sometimes been an assumption that the infrastructure development will be positive for these regions (presumed benevolence), there are costs and benefits that need to be weighed. The costs include the negative impacts of a construction boom on housing availability and prices, social infrastructure (e.g. health), transport etc. Once the different economic benefits are unpacked, it becomes clear they are are highly uncertain and contingent:

- The construction phases will bring economic activity (e.g. accommodation) but could also 'crowd out' other types of economic activity, which can damage the viability of longer-term economic activities. The **extent of local benefit also depends on the extent to which companies use a FIFO workforce** as an alternative to local employment and businesses. Conversely, if there are employment and training opportunities for young people and the unemployed, expanding the local labour force and reducing social disadvantage could have longer-term benefits for these regional communities.
- There is demand for supply-chain inputs for renewable energy, but most of these industries are located elsewhere and so are likely to have a modest impact within these regions.
- **Operations and maintenance is a smaller source of employment than construction** but in some regions on-going jobs (e.g. wind technicians) can still be important in supporting the viability of local economies. There could be other industries (e.g. recycling and circular economy precincts).
- **Landholders receive payments which are lucrative for individual recipients** but the volume is very small relative to the size of regional economies.

- **Community benefit funds** can be the source of important infrastructure and services that have on-going social and economic benefits for the region.

When these pathways for economic benefit are totalled up, renewable energy could approximate the size of a small-to-medium sized sector within these regional economies, but that will depend on how the infrastructure build-out is implemented within these regions. If it is not implemented well with regard to maximising local benefits, these regions could incur substantial costs as part of the energy transition. There is work underway to examine regional impacts of the energy transition, but the focus of socio-economic analysis is mostly fossil fuel regions in transition rather than the new energy regions.

Ultimately, effective governing for a just transition requires those that have the potential to be negatively impacted by transition to have a strong voice in policy and decision-making.

Towards just transition

There are other dimensions of energy fairness and vulnerability that are also under-researched. Bice and Parsons (2025) note that gendered experiences of the energy transition and intersectionality of diverse identity and social characteristics are under-studied. They advocate for research to address key knowledge gaps and for the incorporation of energy fairness and vulnerability into policy frameworks noting: 'Much of the existing research focuses on the logistics and practicalities of the energy transition (i.e. technological, engineering, construction, financial, policy and planning challenges)'. Bice and Parson advocate for three cross-cutting themes to be researched to fill this void - structural dimensions of vulnerability (to energy transition), lived experiences of vulnerability and methodologies to advance a fair, equitable and just transition.

Ultimately, effective governing for a just transition requires those that have the potential to be negatively impacted by transition to have a strong voice in policy and decision-making. As noted in earlier sections of this report, while opportunities for public consultation are frequently available, very few affected people are in a position to take up such opportunities. The very structural factors that lead to vulnerability also work against active participation. Further action is needed to improve the quality of public participation in shaping a just energy transition.

BUILDING FUTURES LITERACY

To improve the quality and diversity of industry visions, address potential blind spots and build capacity for better anticipatory governance we need to improve futures literacy across the sector. This section reports on a review of how to increase participation and reduce bias in foresighting practices.

To improve the quality and diversity of industry visions, address potential blind spots and build capacity for better anticipatory governance we need to improve futures literacy across the sector.

Futures literacy is the capability of understanding why and how to use the future to prepare, plan and interact with complex, uncertain systems. People that are futures literate are familiar with the concepts, language and tools of futures thinking and can apply them to take action in the present.

The narrow range of future visions for the grid that currently dominate industry discourse reflect the limited use of advanced foresighting tools and methods in the sector. Other jurisdictions around the world have actively sought to build futures literacy to improve foresighting outcomes. For example, the UK Government Office of Science (2024) has developed a futures toolkit that provides guidance on the use of 12 different futures thinking tools and seven different pathways for combining the tools. Such a resource, tailored for relevance to energy transition, could be an important contributor to futures literacy in Australia.

However, before proposing a specific approach to improve futures literacy it is important to understand why futures literacy is not more widespread in the energy sector. Our team conducted a literature review at the intersection of psychology and futures studies to address two research questions:

1. What are the barriers to organisations participating in foresighting and how can these be overcome?
2. What are the biases that affect foresighting, and what strategies reduce them?

Results are outlined below with the goal of informing future activities to build **futures literacy** across the sector.

Increasing participation in foresighting

Barriers to participation

The research indicates there are consistent barriers to organisations taking part in foresighting or incorporating foresighting into their practice. These barriers occur at both an executive and a staff level. Where there are barriers at an executive level, staff lack an authorising environment to undertake foresighting and to share insights. When there are barriers at a staff level, foresighting is deprioritised relative to other work. We identified three main types of barriers.

Motivational barriers:

- **Lack of perceived value** — management and staff may not perceive the practical value of foresighting (Nestik, 2018)
- **Short-term thinking / present bias** - staff and management are incentivised to think short-term in their organisations and as a result tend to focus on being reactive rather than

proactive. This kind of immediate problem-solving thinking feels more comfortable as it deals in certainty rather than uncertainty and comes with recognition and rewards for responding to urgency. Priebe et al. (2025) describe this as the 'tyranny of the urgent over the important'. There are insufficient incentives for thinking long-term (Nestik, 2018; Priebe et al., 2025; Wilkinson, 2017).

- **Avoidance and defensiveness towards negative/uncertain futures** - people find the experience of uncertainty uncomfortable and avoid confronting possible negative outcomes (Priebe et al., 2025; Wilkinson, 2017).
- **Absence of trust or shared purpose** - foresighting, particularly when including negative scenarios, may not be encouraged by the workplace or well received by other staff. Participants may fear reputational risk or being perceived as too speculative and reduce their participation (Priebe et al., 2025).

Environmental barriers:

- **Staffing and time** — foresighting takes dedicated staff resources and time for deliberation, which organisations may not be prepared to commit. This can be compounded by staff turnover causing lack of institutional knowledge (Goodwin & Wright, 2025; Nestik, 2018).
- **Organisational structure** - where organisations are siloed, staff are encouraged to focus on their own narrow terrain. This can lead to foresighting and imagined futures that do not consider many factors in the broader system. This can also constrain the influence of foresighting, when capability is placed in a dedicated team who may have little influence over others (Bartunek et al., 2011; Priebe et al., 2025).

Enablers of participation in foresighting practices include interventions to normalise working with uncertainty, provide better information on the value of foresighting, build specific futures thinking capabilities, provide resources and incentives, integrate foresight into regular practices, and ensure relevance to the user context.

Capability barriers:

- **Lack of knowledge about foresighting by staff and management**, including the terminology, methods and benefits (Poli, 2021; Priebe et al., 2025).

Enablers of participation

The research also identified four types of enabler of participation in foresighting, many of which address specific barriers identified above.

Mindset-shifting interventions

- **Normalising uncertainty** — Use training and workshops to reframe uncertainty as an opportunity for learning and adaptation rather than as a threat.
- **Developing future identity** — Encourage staff to view themselves as stewards of long-term outcome. This designated responsibility increases personal relevance and connection to the future (Goodwin & Wright, 2025).
- **Peer modelling** — Involve respected figures or internal champions who demonstrate curiosity and openness toward foresight practices.
- **Narrative reframing** — Position foresight as a tool for resilience rather than prediction, making it compatible with mainstream planning logics.

Informational interventions

- **Show value of foresighting**, particularly to executives. Proposed points of value for organisations include increased agility, competitive advantage, ability to act early (Demneh et al., 2023; Wilkinson, 2017).
- **Capability building** – provide training for executives and staff in foresighting to increase knowledge, skills and networks (Demneh et al., 2023; Priebe et al., 2025).

Resource and process interventions

- **Dedicated resources** – Encourage organisations to set aside dedicated time and processes for foresighting.
- **Regular practice** – Facilitate regular foresighting engagements, organised in advance.
- **Integration into process** – Build an official requirement for foresighting, by directly linking foresighting with processes related to decision-making, strategic planning and long-term strategies (Dörr et al., 2024).
- **Incentivisation** – Create organisational incentives to undertake foresighting.

Foresighting design

- **Design with relevance** – How foresighting interventions are designed will influence what people do with them. The design process should consider the intended user, success metrics and resources (Wilkinson, 2017). Co-designing the process with some of the participants and stakeholders is one strategy to increase the relevance of the activity.
- **Storytelling and personas** help participants relate emotionally and ethically to futures (Beach, 2021; Dahlgren et al., 2024; Pace et al., 2025). According to Wilkinson (2017): 'Storytelling harnesses imagination and, as such, can be used to support, make explicit and test judgements about things that have not yet happened'.

Reducing bias in foresighting

Without careful design, foresighting activities can perpetuate common biases towards things that are familiar, currently topical, are seen as positive and consolidate group identity. This creates blind spots in our thinking about the future.

The way people think, with inherent heuristics and biases, shapes how they generate and respond to future scenarios. Group foresighting activities can amplify the effects of these biases or reduce them, depending on how they are structured.

Foresighting and future scenario-making reflect current worldviews and are a politically contested area, shaped by values, emotions and biases (Lauer et al., 2025). As Faiella & Corazza (2025) point out: 'Future challenges are imagined by and for individuals with unique needs, biases and perceptions'. Recognising and taking steps to reduce these biases can open up new areas of future-thinking that were previously not available to participants.

Recurrent biases shaping foresighting

Cognitive biases

- **Familiarity bias** — people have a tendency to prefer what is familiar and known over what is uncertain and less well-defined. In foresighting, this can lead participants to over-estimate the probability of current trends continuing. Lauer et al. (2025) found 86% of global environmental scenarios they examined were capitalist, state-centric and anthropocentric, consistent with hegemonic worldviews.

- **Availability heuristic** - current hot topics in the media or organisation are more easily recalled by participants and given disproportionate weight in foresighting. This can lead to a perpetuation of current stereotypes and limit imagination about different futures (Nestik, 2018).

Motivational biases

- **Optimism bias and collective anxiety** — research has found participants in foresighting tend to overestimate the likelihood of preferred outcomes, assigning low probability to scenarios that are less pleasant (Demneh et al., 2023). This can suppress creativity and concentration, increase criticism, and lead to denialism (Demneh et al., 2023; Nestik, 2018).
- **Confirmation bias** — people tend to seek out evidence that fits their current beliefs (Nestik, 2018)
- **Overconfidence effect** — people tend to overestimate the accuracy of their own knowledge and judgments. In foresighting, this can mean experts place too much confidence in their preferred forecasts or narrow areas of expertise, dismissing alternative scenarios or contradictory evidence (Nestik, 2018).

Group biases

- **Normative influence leading to belief polarisation** — as groups discuss information, they have a tendency to focus on the information that appears to be known to most people and disregard information only known to some. This can lead to alignment around particular beliefs and increases impact of expert overconfidence (Nestik, 2018). As Nestik (2018) puts it: 'Over the course of group discussions, initial suppositions about the future tend to turn into absolutes that cannot possibly be doubted'.
- **Group identification** — For some teams, strong group identification and loyalty has been formed through a shared, positive vision of the future. This can disincentivise individual team members from sharing alternative ideas of the future (Nestik, 2018). The result is a paradox — groups need safety and cohesion to work effectively, however these strengths can result in biases limiting the ability of the group to think about the future.

Foresighting practices can be designed to reduce bias by bringing in wild card scenarios to shake up assumptions, creating separate teams to engage in divergent thinking, consciously adopting alternative perspectives and facilitating constructive conflict.

Interventions to reduce bias

Broadening possible futures

- **Mental simulation** — using imagination to test reactions to plausible futures and immerse participants in futures (Oliver, 2023).
- **Pre-mortems** — these activities force people to consider what happens when objectives are not achieved and things go wrong, overcoming biases towards positive futures (Demneh et al., 2023).

- **Inclusion of wild card scenarios** — by deliberately including wild card scenarios, bias towards the status quo and preferred scenarios can be reduced.

Encouraging divergent thinking

- **Red-teaming and devil's advocacy** — creating a safe, authorising environment for participants to challenge consensus (Schirrmeister et al., 2020).
- **Anonymous or written rounds of input** — encourage divergent thinking, e.g. silent, individual brainstorming; microgroup discussions; using 'originality' criterion when ranking ideas (Nestik, 2018).

Overcoming expert bias and groupthink

- **Multi-perspective framing** — asking participants to generate futures from the perspective of different worldviews or cultural logics (Wilkinson, 2017). Using exercises that encourage multiple perspectives.
- **Inclusion of diverse perspectives** - Bringing in external sources of information, diverse perspectives and widening the knowledge base for foresighting (Demneh et al., 2023). A positive spillover effect can be the emergence of long-term networks for idea exchange (Nestik, 2018).
- **Mindset shifting** — including activities before the sessions to encourage people to look at situations from a range of perspectives, encouraging inquisitiveness, open-mindedness and reflection (Goodwin & Wright, 2025).
- **Criteria for assessing scenarios** — using desirability as an explicit criteria when evaluating scenarios, to call attention to this and the influence it might play (Nestik, 2018).

Building common ground

- **Reinforcing shared values** — this can reduce the desire to protect identity during the foresighting activities.
- **Facilitating constructive conflict** — using exercises that create a space for different perspectives and disagreement, with the purpose of building new cooperation (Wilkinson, 2017).

While it can be difficult to motivate individuals and organisations to engage in futures thinking there are ways to overcome these barriers. Building futures literacy in the energy sector should be a key priority to support appropriate action in response to the uncertainty created by the accelerating energy transition.

Summary

This review indicates that it can be difficult to motivate individuals and organisations to engage in futures thinking. When they do engage, common biases related to the way humans think and interact can lead to outcomes that reinscribe the status quote and perpetuate blind spots about possible futures. This was evident in our review of industry visions for the future of the grid.

However, the review also indicates that careful design of foresighting practices can increase motivation for participation and overcome biases, creating space for more imaginative exploration of possible futures. This should lead to better, more resilient actions in the present.

Any foresighting intervention undertaken through the Scenarios for Future Living project will need to build futures literacy for participants so that outcomes genuinely open up new thinking.

A PILOT FORESIGHTING INTERVENTION

At the State of Energy Research Conference 2025, our team collaborated with RACE for 2030 and Energy Catalyst to pilot a futures thinking activity on the future of the grid. The activity is documented here to inform the design of future activities in the next section.

Process

At the State of Energy Research Conference 2025, our team collaborated with RACE for 2030 and Energy Catalyst to **pilot a futures thinking activity on the future of the grid**. The goal was to inform the design of a more comprehensive foresighting practice, described in the next section. The activity was brief (80 minutes) and therefore used a simple design. There were 24 participants, primarily energy researchers.

Participants were asked to self-select into one of three groups based on their interest and expertise. The groups focused on:

- Governance / regulation / market settings
- Customer / social dimensions
- Technology / grid infrastructure.

Participants were asked to respond to the following questions, first individually and then through group discussion:

- **What is your vision for the future of the grid?** Imagine yourself standing in 2035 reflecting on Australia's major power system(s) after a decade of well-integrated, future-oriented transformation: What are the top 3 – 5 things that are now fundamentally different/better (in 2035)?
- **What is standing in the way of your vision?** Returning to 2025, think about the things that act as barriers / handbrakes / speed bumps to the transformation needed to achieve your vision: What are the top 3 – 5 things that are standing in the way of your vision being achieved?

Results

What follows is a summary of the themes identified by participants during the activity and written on sticky notes. The activity did not allow time for participants to build a consensus, so these results represent diverse perspectives that would not be supported by all in the room.

Governance, Regulation & Market Settings

Vision (2035)

- **Fundamental Market Redesign**: A move away from the traditional retailer model (potential for "No Retailers") toward Energy Service Companies (ESCOs) and a clear role for various market players, including active consumers.
- **Gas is Gone**: A complete phase-out of gas for residential and commercial customers.
- **Holistic Pricing**: Carbon is priced appropriately, and "resilience" is valued monetarily. Pricing is localised and co-optimised across energy and networks.

- **Streamlined Governance**: Creation of an "Australian Energy Services Commission" to streamline governance, with clarity between State and Federal roles.
- **Broadened Value**: The definition of "value" has expanded beyond simple economic efficiency to include reliability, security, emissions, equity, and community benefit.
- **Culture of Urgency**: A cultural shift that prioritizes long-term thinking and urgency over short-term economic efficiency.

Barriers (2025)

- **Political Will & Vested Interests**: Are the primary blockers, described as "late-stage capitalism" where markets are treated as ends rather than means.
- **Regulatory Inertia**: The system suffers from complexity and a lack of agility.
- **Siloed Policies**: Disparate State and Federal policies and "non-collaboration" prevent a unified approach.
- **Lack of Accountability & Trust**: People have lost trust in the system; there is a perceived lack of accountability among decision-makers.
- **Data Opacity**: Current reliance on unvalidated data and closed tools rather than open-source data and transparency.

The future grid in 2035 is envisioned not merely as infrastructure, but as a seamless, equitable service where technology works invisibly in the background to support human needs rather than just selling commodities. The consensus is a shift toward a system that values resilience, equity, and social licence over short-term economic efficiency.

Customer & Social Dimensions

Vision (2035)

- **Energy as a Human Right**: Energy is regulated and viewed as an essential, secure service rather than just a consumer good.
- **"Thermal Equity"**: Housing is efficient and affordable for all, including renters (retrofitting is standard).
- **Simplicity for Users**: The household experience is "fake simple"—complex backend technology (automation / aggregators) results in a simple, seamless experience for the user.
- **User-Designed System**: The system is driven and designed by users and communities, not vested interests.
- **Thriving Local Networks**: A decentralized, modular network supports Peer-to-Peer (P2P) trading, local jobs, and community resilience.

Barriers (2025)

- **System Inertia & Resistance**: Resistance to change from incumbents who benefit from the current "broken system."
- **Complexity & Misinformation**: People are confused by "culture wars," misinformation, and a lack of transparent pricing signals.
- **Access & Cost**: High upfront costs for efficiency upgrades and a "split incentive" problem for renters block participation.
- **Physical Constraints**: A shortage of skilled tradespeople and installers to execute the necessary retrofits and upgrades.
- **Trust Deficit**: The "energy poverty" caused by high bills has eroded trust in the sector.

Engineering, Technology & Infrastructure

Vision (2035)

- **100% Renewables & Sovereignty**: The grid operates on 100% renewable energy, with Australia as a net exporter of green energy and possessing a sovereign industrial capability.
- **Automation & Interoperability**: "Homes run themselves energy-wise." There is high visibility of CER, seamless data sharing, and interoperability between systems.
- **Dynamic Grid Management**: The grid has moved from passive to active, with high coordination and control of DER.
- **Diverse Workforce**: The engineering and technology sector is diverse and inclusive, supporting widespread participation.
- **Data Visibility**: Real-time visibility of low-voltage networks allows for better planning and operation.

Barriers (2025)

- **Unclear Responsibilities:** Confusion over "who is taking charge?" regarding the rights and responsibilities for CER.
- **Incentive Misalignment**: Poor incentives for DNSPs to share data or improve power quality; current business models do not support innovation.
- **Regulatory Lag**: Standards and regulations are not keeping pace with technological capabilities.
- **Workforce Shortages**: A lack of "educational uplift" and skilled workers to build and maintain the new infrastructure.
- **Integration Challenges**: Difficulty integrating new technologies into the existing grid infrastructure.

The obstacles are institutional inertia and a deficit of trust. The primary friction is human and structural. Current market design is characterised by misaligned incentives and opaque governance, which is acting as a handbrake on the future vision.

Discussion

Across all three domains, a unified narrative emerges: **the future grid in 2035 is envisioned not merely as infrastructure, but as a seamless, equitable service where technology works invisibly in the background** ("fake simple") to support human needs rather than just selling commodities. Whether through "no retailers," "homes running themselves," or "energy as a human right," the consensus is a shift toward a system that values resilience, equity, and social licence over short-term economic efficiency.

Conversely, the barriers in 2025 are strikingly consistent: the obstacles are rarely described as purely technical impossibilities, but rather as **institutional inertia and a deficit of trust**. "Vested interests," "regulatory lag," and "complexity" appear repeatedly, suggesting that the primary friction is human and structural. The groups collectively identify that the current market design—characterised by misaligned incentives and opaque governance—is the "handbrake" preventing the technological realities of 2035 from taking hold.

While this was a very simple activity that did not use sophisticated futures thinking methods, it nevertheless demonstrated that **participants in the sector are able to explore very different futures for the grid when given a little space to imagine together**. The participants explored futures that are clearly outside the narrow range of plausible futures currently dominating industry visions. For example, the vision for “no retailers”, for an “Australian Energy Services Commission”, for user and community design and a diverse engineering and technology workforce are elements that were missing from industry visions in our earlier review. As a small proof of concept, it confirms the value of designing additional industry foresighting activities.

A PARTICIPATORY FUTURES PROGRAM

This report shows how climate change, geopolitical uncertainty and technological development are contributing to an accelerating transition from a centralised, uni-directional fossil grid to a distributed, multi-directional renewable grid. In the midst of transition, there is much uncertainty about the shape of a future regime and the social, technological, economic, environmental and political innovations that will come to the fore.

Futures thinking can help to guide robust present actions in the face of this uncertainty. However, to date, the industry has engaged with a relatively narrow range of plausible futures and neglected to fully explore possible futures, including wild card futures that can open up more imaginative thinking. The complex governance institutions overseeing the NEM and grid lack suitable spaces for whole-of-system participatory foresighting that could help all affected by energy transition to deliberate together on possible futures and which of those possibilities they would prefer.

Through the Scenarios for Future Living project, there is an opportunity to develop a program of participatory foresighting activities that can boost futures literacy and make progress towards a more holistic vision for grid transition. This final section of the report starts by outlining design principles for such a program, before proposing a series of specific activities for 2026.

Design principles

Drawing on the previous sections of this report and a wider review of participatory futures activities around the world, we propose the following design principles.

Build futures literacy

Given the evidence that futures literacy needs to be improved across the sector, participatory futures activities should aim to build futures literacy as part of their process. This can be achieved through integration of specific capacity building activities and/or through learning by doing approaches.

Increase the focus on exploring low-probability futures

The narrow focus on the most plausible futures within the futures cone is leaving the sector poorly prepared for novel futures that inevitably emerge from the margins. There are countless examples where futures once thought unlikely or even preposterous have become the norm. Participatory futuring activities should engage with wild cards, weak signals and futures that currently seem improbable to identify present-day strategies and actions that are resilient to diverse futures.

Use systems thinking to provide clarity

This report used a systems thinking framework called the multi-level perspective to structure analysis of the current state of grid transition. Systems thinking can provide participants with clarity about the system under consideration, its boundaries and ways to intervene to improve system outcomes. Systems thinking complements futures thinking and helps to navigate the otherwise overwhelming complexity of the grid and supporting institutions.

Empower whole of system participation

Participatory foresighting activities should involve stakeholders representing the whole system, including upstream/generation, grid operators, regulators, customer representatives, academia and NGOs, so that important perspectives that could influence the future are not omitted and blind spots are revealed. Consistent with the principle above, participants from the margins of the system or adjacent systems should be welcomed into the process to introduce new thinking. Diverse, equitable participation also helps processes to gain legitimacy and to contribute to just transition.

Use the full methodological spectrum

Participatory foresighting activities should engage with the full spectrum of foresighting methods. There are various articulations of this spectrum but the UK Futures Toolkit (UK Government Office for Science, 2024) is representative in identifying three stages of foresighting:

1. **What is changing?** Specific methods include horizon scanning, Delphi, driver mapping and Three Horizons.
2. **So what for our futures?** Specific methods include scenarios, visioning and futures wheels.
3. **Now what do we do?** Specific methods include backcasting, roadmapping and policy stress-testing.

It is often too much for a single event or activity to cover this full spectrum but it is important that the sector collectively develops the capacity to address all of these questions in a holistic way. The last stage is particularly important; too many foresighting activities end before identifying the present-day actions that are needed to respond to possible futures. Participatory foresighting should always lead to the articulation of tangible strategies, tools, and pathways that participants can adapt to their reality.

Do not exclude any driver categories

Systematic exclusion of particular categories of drivers, such as customer aspirations, questions of justice or political contestation, leads to narrow scenario sets that constrain thinking. Participatory foresighting activities should not exclude any drivers, which means they need to be convened in spaces outside established political institutions. Tools such as STEEP, PESTLE or other variants can be used as a check on driver coverage.

Create imaginative, deliberative safe spaces for dialogue

Participatory foresighting activities should establish a safe environment for reflective, deep and generative dialogue, for example by using rules like the Chatham House rules. Careful process design and facilitation is needed to encourage listening and deliberation, minimise activation of cognitive biases and ensure 'airtime' is shared equally.

It is important to recognise that imagining alternative futures is not something that is easy to do quickly, or encouraged in the turmoil of daily work. Participatory futuring activities need to provide imagination infrastructure, convening spaces where creativity and imagination is sparked, for example through creative practice, storytelling, role playing, gamification and novel facilitation approaches.

Take a people-centric approach

The grid ultimately exists to provide citizens with energy services, yet citizen perspectives are not at all prominent in energy governance. Participatory foresighting activities should include citizens and focus on their needs. We recognise that this is a more aspirational principle, as the resources and capacity building needed to genuinely include citizens in energy governance are significant. Where resources do not permit direct citizen involvement, we need to rely on customer representatives and the emergence of better data on household practices and aspirations emerging from projects like Scenarios for Future Living.

The 2026 agenda

These principles inform the RACE for 2030 Consumer Grid Summit (https://www.racefor2030.com.au/consumer-grid-summit-2026/). Our team has collaborated with RACE for 2030 and Energy Catalyst on the design of the Consumer Grid Summit.

Consistent with the principle of building futures literacy, the process will start with a series of five online Grid Transition Masterclasses in the second quarter of 2026, on the following topics:

1. The current status of Australia's grid transition
2. The need to collaboratively reimagine Australia's grid
3. Futures thinking for informing Australia's grid transition
4. Change mechanisms for accelerating Australia's grid transition
5. Bringing it together in Three Horizons.

The purpose of the Masterclasses is to help build a cohort of informed and futures literate "transition leaders" who represent a diversity of perspectives yet share a common language and a set of navigational tools. This foundation will not only enrich the Summit discussions but also enable participants to lead transition initiatives within their own organisations and in the wider electricity sector.

The Masterclasses will lead to the 2-day, in-person Consumer Grid Summit in late March 2026. Equipped with the concepts and tools gained through the Masterclasses, participants will work on specific topics in cross-disciplinary teams supported by subject matter experts. These working sessions will be interspersed with plenary discussions, where teams will debate their findings and work toward a shared vision for Australia's power systems in general — and the National Electricity Market (NEM) in particular.

To ensure all possible pathways are considered, the Summit will emphasise open, imaginative exploration beyond the constraints of today's thinking, with all options on the table. Through a dynamic, facilitated process, Summit participants will converge on a robust vision for a transformed grid in 2035 that balances consumer, societal and system priorities and can efficiently scale to meet Australia's 2050 commitments.

After the Summit, we anticipate that Work Package 6 of the Scenarios for Future Living project will design and deliver additional activities to carry forward the recommendations of the Summit and continue to build futures literacy in the sector.

BIBLIOGRAPHY

ACOSS & TEC. (2022). *ourPower: A vision for clean, affordable, dependable energy for all*. Australian Council of Social Services and the Total Environment Centre. https://www.google.com/url?q=https://ourpower.org.au/wp-content/uploads/2022/02/ourPower-Booklet.pdf&sa=D&source=docs&ust=1765502104453634&usg=AOvVaw2mYqB5y3APZHvlGOIXdrhH

AEMC. (2025a). *Residential Electricity Price Trends 2025*. Australian Energy Market Commission.

AEMC. (2025b). *The National Electricity Market Reliability & Security Report FY2024*. Reliability Panel, Australian Energy Market Commission.

AEMO. (2024). *2024 Integrated System Plan for the National Electricity Market: A roadmap for the energy transition*. Australian Energy Market Operator. https://www.aemo.com.au/-/media/files/major-publications/isp/2024/2024-integrated-system-plan-isp.pdf?rev=b811f5d66df24e0a980ce0df8eaa5687&sc_lang=en

AEMO. (2025a). *2025 Inputs, Assumptions and Scenarios Report*. Australian Energy Market Operator. https://www.aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2024/2025-iasr-scenarios/final-docs/2025-inputs-assumptions-and-scenarios-report.pdf

AEMO. (2025b). *Draft 2026 Integrated System Plan for the National Electricity Market: A roadmap for the energy transition*. Australian Energy Market Operator.

AER. (2022). *Towards energy equity: A strategy for an inclusive energy market*. Australian Energy Regulator. https://www.aer.gov.au/industry/registers/resources/reviews/towards-energy-equity-strategy-inclusive-energy-market

AER. (2025a). *Annual retail markets report 2024–25*. Australian Energy Regulator.

AER. (2025b). *State of the energy market*. Australian Energy Regulator. https://www.aer.gov.au/documents/state-energy-market-2025-full-report

Australian Climate Service. (2025). *Australia's National Climate Risk Assessment*. Australian Climate Service, Australian Government.

Bartunek, J. M., Balogun, J., & Do, B. (2011). Considering Planned Change Anew: Stretching Large Group Interventions Strategically, Emotionally, and Meaningfully. *Academy of Management Annals*, *5*(1), 1—52. https://doi.org/10.5465/19416520.2011.567109

Beach, L. R. (2021). Scenarios as narratives. *FUTURES & FORESIGHT SCIENCE*, *3*(1), ffo2.58. https://doi.org/10.1002/ffo2.58

Best, R. (2025, December 8). *Australia's $2.3 billion green energy program is funding oversized batteries and blowing out in cost*. The Conversation. https://doi.org/10.64628/AA.jrcspdrwy

Bice, S. (2024, August 9). *How presumed benevolence will short circuit the energy transition — NextGen Engagement*. https://www.nextgenengagement.org/news/how-presumed-benevolence-will-short-circuit-the-energy-transition/

Bice, S., & Parsons, R. (2025). *Vulnerability and Australia's Energy Transition*. Report for the Australian Council of Learned Academies (ACOLA) Australian Energy Transition Research Plan. https://acola.org/vulnerability-and-australias-energy-transition-report/

Briggs, C., Rutovitz, J., Dominish, E., & Nagrath, K. (2020). *Renewable energy jobs in Australia: Stage one* (p. 80 p. + 6 state summaries) [Report, paper or authored book]. Institute for Sustainable Futures, University of Technology Sydney. VOCEDplus. https://hdl.voced.edu.au/10707/551400

Briggs, C., Tjondro, M., Langdon, R., Niklas, S., Heard, R., Frangos, M., & Gerrard, E. (2025). First Nations people and energy transition: How to increase employment in clean energy. *Cosmopolitan Civil Societies: An Interdisciplinary Journal*, *17*(2), 34—53. https://search.informit.org/doi/abs/10.3316/informit.T2025090100002900522762471

CCA. (2024). *Sector Pathways Review*. Climate Change Authority.

CEC. (2023). *Power Playbook: Accelerating Australia's Clean Energy Transformation*. Clean Energy Council. https://cleanenergycouncil.org.au/Cec/media/Background/Resources/Clean-Energy-Council-Power-Playbook.pdf

CEC. (2025). *Clean Energy Australia*. Clean Energy Council. https://cleanenergycouncil.org.au/news-resources/clean-energy-australia-report-2025

Collingridge, P., & Merhab, A. (2025). *The Consumer Energy Report Card: Household Research Report—Spring 2025*. SEC Newgate for Energy Consumers Australia. https://energyconsumersaustralia.com.au/sites/default/files/2025-12/website-doc-consumer-energy-report-card-dec-2025-topline-report.pdf

Colvin, R. M. (2025). Social Licence for a Net Zero Australia: Grappling with Decarbonisation of the Electricity System. In S. Bice, R. O'Connor, & H. Henderson (Eds.), *Strengthening Australia's Reform "Muscle" via Social Licence to Operate: Case Study Collection*. ANZSOG Research Insights No. 52, ANZSOG. 10.54810/XRIR4287

CSIRO. (2024). *Understanding Australian attitudes toward the renewable energy transition: Snapshot*. CSIRO. https://www.csiro.au/-/media/Environment/Energy-transition/Attitudes-Toward-the-Renewable-Energy-Transition---Snapshot.pdf

Dahlgren, K., Kaviani, F., Strengers, Y., Pink, S., & Korsmeyer, H. (2024). Bringing energy futures to life: Anticipatory household storylines as possible energy futures. *Futures*, *158*, 103347. https://doi.org/10.1016/j.futures.2024.103347

DCCEEW. (2024a). *Australia's emissions projections 2024*. Department of Climate Change, Energy, the Environment and Water, Australian Government. https://www.dcceew.gov.au/sites/default/files/documents/australias-emissions-projections-2024.pdf

DCCEEW. (2024b). *The First Nations Clean Energy Strategy 2024—2030*. Department of Climate Change, Energy, the Environment and Water, Australian Government. https://www.energy.gov.au/energy-and-climate-change-ministerial-council/working-groups/community-engagement-working-group/first-nations-engagement-sub-working-group/first-nations-clean-energy-strategy

DCCEEW. (2025a). *Australia's emissions projections 2025*. Department of Climate Change, Energy, the Environment and Water, Australian Government.

DCCEEW. (2025b). *Australia's Net Zero Plan*. Department of Climate Change, Energy, the Environment and Water, Australian Government.

DCCEEW. (2025c). *Electricity and Energy Sector Plan*. Department of Climate Change, Energy, the Environment and Water, Australian Government.

DCCEEW. (2025d). *National Consumer Energy Resources Roadmap: Implementation Plan Update*. Department of Climate Change, Energy, the Environment and Water, Australian Government. https://www.energy.gov.au/sites/default/files/2025-08/National%20Consumer%20Energy%20Resources%20%28CER%29%20Roadmap%20Implementation%20Plan%20Update%20August%202025.pdf

DCCEEW. (2025e). *National Energy Equity Framework*. Department of Climate Change, Energy, the Environment and Water, Australian Government. https://consult.dcceew.gov.au/national-energy-equity-framework

DCCEEW. (2025f). *Quarterly Update of Australia's National Greenhouse Gas Inventory June 2025*. Department of Climate Change, Energy, the Environment and Water, Australian Government.

Demneh, M. T., Zackery, A., & Nouraei, A. (2023). Using corporate foresight to enhance strategic management practices. *European Journal of Futures Research*, *11*(1), 5. https://doi.org/10.1186/s40309-023-00217-x

Dörr, U.-S., Schönhofer, G., & Schwarz, J. O. (2024). The state of foresight in small and medium enterprises: Literature review and research agenda. *European Journal of Futures Research*, *12*(1), 16. https://doi.org/10.1186/s40309-024-00237-1

Dyer, A. (2023). *Community Engagement Review: Report to the Minister for Climate Change and Energy*. Australian Energy Infrastructure Commissioner on behalf of the Department of Climate Change, Energy, the Environment and Water.

Electric Vehicle Council. (2025). *State of Electric Vehicles 2025*. Electric Vehicle Council. https://drive.google.com/file/d/1_WJD31rHDMDraTI1AnxFrlsQMGUm4qxk/view?usp=sharing&usp=embed_facebook

ENA & LEK. (2024). *The Time is Now: Getting smarter with the grid*. Energy Networks Australian and L.E.K. Consulting. https://www.energynetworks.com.au/assets/uploads/The-Time-is-Now-Report-ENA-LEK-August-2024.pdf

Energy Catalyst. (2025a). *Distribution System Operator (DSO) Models*. AR-PST (Australian Research in Power Systems Transition) Stage 4 Topic 7, prepared for CSIRO.

Energy Catalyst. (2025b). *Emerging Trends Driving Grid Transformation* (Report 2 of 5). Australian Research in Power Systems Transition (Stage 4), prepared for CSIRO.

Energy Catalyst. (2025c). *Future Customer & Societal Objectives*. prepared for CSIRO.

Energy Catalyst. (2025d). *Systemic Issues & Transformation Risks* (Report 3 of 5). Australian Research in Power Systems Transition (Stage 4), prepared for CSIRO.

Energy Consumers Australia. (2025). *Consumer Energy Report Card: Understanding and measuring energy hardship in Australia*. Energy Consumers Australia. https://energyconsumersaustralia.com.au/our-work/surveys/consumer-energy-report-card-understanding-measuring-energy-hardship-australia

Faiella, A., & Corazza, G. E. (2025). Cognitive mechanisms in foresight: A bridge between psychology and futures studies. *Futures*, *166*, 103547. https://www.sciencedirect.com/science/article/pii/S0016328725000102

Ge, M., Friedrich, J., & Vigna, L. (2024, May 12). *Where Do Emissions Come From? 4 Charts Explain Greenhouse Gas Emissions by Sector*. https://www.wri.org/insights/4-charts-explain-greenhouse-gas-emissions-countries-and-sectors

Gerrard, E., & Crofts, K. (2025, September 17). *Battle for the bush? Ignore the noise — most farmers like renewables*. The Conversation. https://doi.org/10.64628/AA.jgshq655q

Goodwin, P., & Wright, G. (2025). Can Narrative-Based Scenarios Support Quantitative Judgmental Forecasting? *FUTURES & FORESIGHT SCIENCE*, *7*(1), e70003. https://doi.org/10.1002/ffo2.70003

Graham, P., Hayward, J., & Foster, J. (2025). *GenCost 2024-25: Final Report*. CSIRO. https://www.csiro.au/en/research/technology-space/energy/Electricity-transition/GenCost

Grudnoff, M. (2020). *The Carbon Pricing Mechanism under the Gillard Government*. The Australia Institute. https://australiainstitute.org.au/report/the-carbon-pricing-mechanism-under-the-gillard-government/

Heffron, R. J. (2022). Applying energy justice into the energy transition. *Renewable and Sustainable Energy Reviews*, *156*, 111936. https://doi.org/10.1016/j.rser.2021.111936

IEA. (2025a). *Energy and AI: World Energy Outlook Special Report*. International Energy Agency. https://www.iea.org/reports/energy-and-ai

IEA. (2025b). *World Energy Outlook 2025*. International Energy Agency.

ILO. (2015). *Guidelines for a just transition towards environmentally sustainable economies and societies for all*. International Labour Organization.

https://www.ilo.org/publications/guidelines-just-transition-towards-environmentally-sustainable-economies

Kaviani, F., Strengers, Y., & Dahlgren, K. (2025). *Household and home business research: Emerging lifestyles preferences and practices*. Emerging Technologies Research Lab (Monash University). https://www.monash.edu/scenarios-for-future-living/releases/household-and-home-business-research-report

Kaviani, F., Strengers, Y., Dahlgren, K., & Korsmeyer, H. (2023). Automated and absent: How people and households are accounted for in industry energy scenarios. *Energy Research & Social Science*, *102*, 103191. https://doi.org/10.1016/j.erss.2023.103191

Lauer, A., Carpintero, Ó., & De Castro, C. (2025). In search of a missing South: An explorative study of biases in global climate and energy scenarios. *Globalizations*, 1–22. https://doi.org/10.1080/14747731.2025.2526295

MacNeil, R., & Beauman, M. (2022). Understanding resistance to just transition ideas in Australian coal communities. *Environmental Innovation and Societal Transitions*, *43*, 118–126. https://doi.org/10.1016/j.eist.2022.03.007

Musil, D., & Gerrard, E. (2024). The transition of the Latrobe Valley, Victoria. In *Regional Energy Transitions in Australia*. Routledge.

Nelson, T., Conboy, P., Hancock, A., & Hirschhorn, P. (2025). *National Electricity Market wholesale market settings review: Draft Report*. Australian Government.

Nestik, T. (2018). The psychological aspects of corporate foresight. *Форсайт*, *12*(2 (eng)), 78–90. https://cyberleninka.ru/article/n/the-psychological-aspects-of-corporate-foresight

NZEA. (n.d.). *Energy Industry Jobs Plan | nzea*. Retrieved December 15, 2025, from https://www.netzero.gov.au/energy-industry-jobs-plan

Oliver, J. J. (2023). Scenario planning: Reflecting on cases of actionable knowledge. *FUTURES & FORESIGHT SCIENCE*, *5*(3–4), e164. https://doi.org/10.1002/ffo2.164

Open Electricity. (2025). Open Electricity. https://openelectricity.org.au/

Pace, L. A., Bruno, C., & Schwarz, J. O. (2025). Personas in scenario building: Integrating human-centred design methods in foresight. *Futures*, *166*, 103539. https://www.sciencedirect.com/science/article/pii/S0016328725000023

Poli, R. (2021). The challenges of futures literacy. *Futures*, *132*, 102800. https://www.sciencedirect.com/science/article/pii/S0016328721001099?casa_token=186viBRbP80AAAAA:u_Rp3ikR7HTpk7ORAH_WsrAJufqUGrxZZfSQYu_oTSR21Z8FmktzKQsx4rpTm_NaQa3fJ27Rh8c

Priebe, M., Veit, S., & Warnke, P. (2025). Understanding Foresight-Policy Interactions: The Role of Institutionalization. *FUTURES & FORESIGHT SCIENCE*, *7*(1), e197. https://doi.org/10.1002/ffo2.197

Rae, M. (2025, December 8). Not happy in the sandbox. *The Energy*. https://theenergy.co/article/not-happy-in-the-sandbox

Reeve, A., Wood, T., Jones, D., & Jefferson, B. (2025). *Bills down, emissions down: A practical path to net-zero electricity*. Grattan Institute. https://grattan.edu.au/report/bills-down-emissions-down-a-practical-path-to-net-zero-electricity/

Riedy, C. (2025). Enhancing anticipatory governance to accelerate just energy transitions in Australia. *Energy Research & Social Science*, *119*, 103839. https://doi.org/10.1016/j.erss.2024.103839

Riedy, C., Economou, D., Koskinen, I., Dargaville, R., Gui, E., Hargroves, C., Newman, P., James, B., Gilmore, N., & Paget, G. (2022). *Smarter planning for the energy transition*.

Riley, B., White, L. V., Wilson, S., Klerck, M., Napaltjari-Davis, V., Quilty, S., Longden, T., Jupurrurla, N. F., & Harrington, M. (2023). Disconnected during disruption: Energy insecurity of Indigenous Australian prepay customers during the COVID-19 pandemic. *Energy Research & Social Science*, *99*, 103049. https://doi.org/10.1016/j.erss.2023.103049

Rosemberg, A. (2010). Building a just transition: The linkages between climate change and employment. *International Journal of Labour Research*, *2*(2), 125. https://search.proquest.com/openview/8c63a878479bc23b643b71ebcdc2a2e9/1?pq-origsite=gscholar&cbl=226543

Ruoso, L. E., Roods, J., Nagrath, K., Niklas, S., Miyake, S., Briggs, C., & Dominish, E. (2024). Building better practice for renewable energy: Six ways to improve ecosystem outcomes. *Prepared for WWF-Australia by the Institute for Sustainable Futures, University of Technology Sydney*. https://www.uts.edu.au/globalassets/sites/default/files/2024-09/2024_building-better-practice-for-renewable-energy.pdf

Schirrmeister, E., Göhring, A., & Warnke, P. (2020). Psychological biases and heuristics in the context of foresight and scenario processes. *FUTURES & FORESIGHT SCIENCE*, *2*(2), e31. https://doi.org/10.1002/ffo2.31

Stevis, D., & Felli, R. (2015). Global labour unions and just transition to a green economy. *International Environmental Agreements: Politics, Law and Economics*, *15*(1), 29–43. https://doi.org/10.1007/s10784-014-9266-1

Strengers, Y. A. A., Kaviani, F., Dahlgren, K., Korsmeyer, H., Pink, S., Nicholls, L., & Martin, R. (2023). *Digital Energy Futures: Scenarios for Future Living 2030/2050*.

Stronge, D. C., Kannemeyer, R. L., & Edwards, P. (2024). Building social licence to operate: A framework for gaining and maintaining meaningful, trustworthy relationships. *Resources Policy*, *89*, 104586. https://doi.org/10.1016/j.resourpol.2023.104586

Sweeney, S. (2024). In Everyone's Backyard? Facing the Challenge of Energy Sprawl. *New Labor Forum*, *33*(1), 90–97. https://doi.org/10.1177/10957960231220683

Taylor, M. (2025). *Examining JUST Energy Metrics: Exploring Australian research priorities*. Report for the Australian Council of Learned Academies (ACOLA) Australian Energy Transition Research Plan. https://acola.org/examining-just-energy-metrics-report/

The Treasury. (2023). *Working Future: The Australian Government's White Paper on Jobs and Opportunities* [Text]. Department of the Treasury. https://treasury.gov.au/employment-whitepaper/final-report

The Treasury. (2025). *Australia's Net Zero Transformation: Treasury Modelling and Analysis*. The Treasury, Australian Government. https://treasury.gov.au/sites/default/files/2025-09/p2025-700922.pdf

UK Government Office for Science. (2024). *The Futures Toolkit HTML*. GOV.UK. https://www.gov.uk/government/publications/futures-toolkit-for-policy-makers-and-analysts/the-futures-toolkit-html

Voros, J. (2017, February 24). The Futures Cone, use and history. *The Voroscope*. https://thevoroscope.com/2017/02/24/the-futures-cone-use-and-history/

Wilkinson, A. (2017). Strategic foresight primer. *European Political Strategy Centre*. https://reevolution.espoch.edu.ec/wp-content/uploads/2021/11/Wilkinson-2017-strategic_foresight_primer.pdf

World Energy Council. (2024). *2024 Scenario Foundations: Rocks and Rivers*. World Energy Council.

Xu, C., Behrens, P., Gasper, P., Smith, K., Hu, M., Tukker, A., & Steubing, B. (2023). Electric vehicle batteries alone could satisfy short-term grid storage demand by as early as 2030. *Nature Communications*, *14*(1), 119. https://doi.org/10.1038/s41467-022-35393-0

APPENDIX A: How foresighting influences thinking and practice

How foresighting influences thinking

Research question: What are the mechanisms by which foresighting changes how people think about the present and the future?

Foresighting influences how participants think through a series of interconnected psychological and social mechanisms. In this review, we propose that immediate cognitive shifts lead to questioning and expanding of views, which leads to shifting beliefs and intentions. Foresighting activities can also generate longer term changes by strengthening skills in futures thinking and changing group dynamics.

The proposed pathway shown in Figure A1 combines existing frameworks about the impact of foresighting to hypothesise how foresighting activities can lead to changes in thought processes.

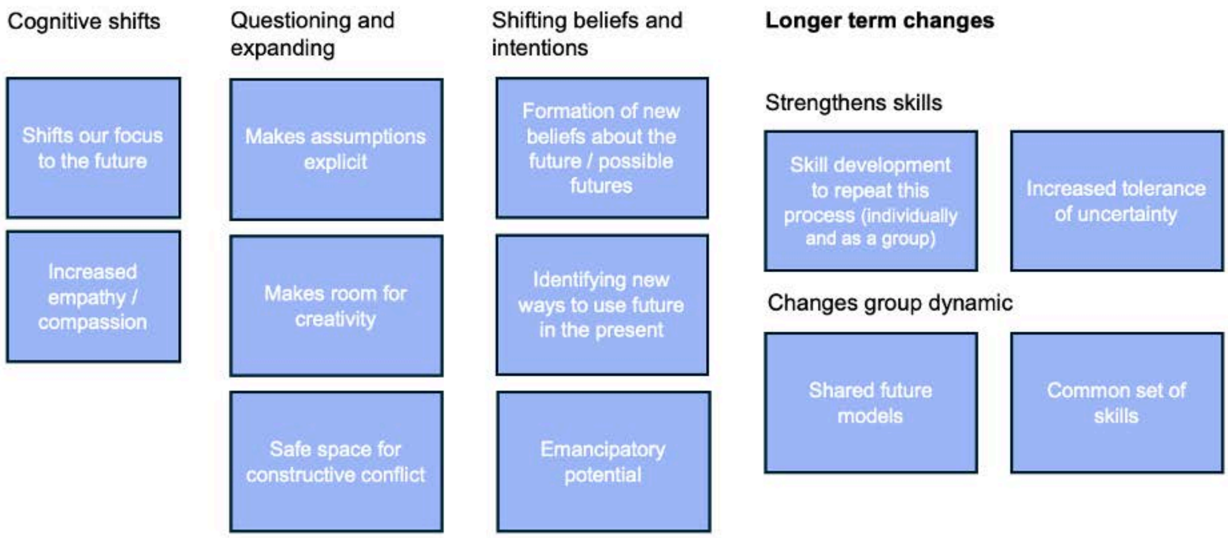

Figure A1: Proposed pathway for impact of foresighting on thought processes

Immediate Cognitive Shifts

Increased focus on the future: Foresighting helps people pay more attention to the future and reduces psychological distance and time discounting (Wilkinson, 2017). It develops the capacity to imagine futures beyond the short-term, broadening decision-making horizons (Lauer et al., 2024).

Questioning and expanding perspectives

Explicit testing of assumptions: By making assumptions about the future explicit, participants can critically reflect on judgments, engage in double-loop learning, and connect present roles with longer-term social goals (Wilkinson, 2017; Goodwin, 2025).

Creativity and idea generation: Foresight creates space for creativity by allowing partial detachment from the past and enabling the development of novel mental simulations (Faiella, 2025).

Changes in How We See Others and the System

Greater compassion and empathy for others: This can arise from expanding beyond narrow focus and considering multiple perspectives (Wilkinson, 2017; Ahvenharju, 2021).

An increased appreciation of difference and alternative viewpoints (Wilkinson, 2017).

Impact on Group Dynamics

Common ground: Foresighting provides a shared language and process for collaboration and open discussion of shared goals, which can result in greater group cohesion (Nestik, 2018).

Constructive conflict: Structured foresighting activities create a safe space for constructive conflict, surfacing diverse perspectives and enabling collective learning (Wilkinson, 2017).

Group future consciousness: Foresight can enhance the development of future consciousness at the group level, by expanding the collective ability to imagine and reflect on long-term futures (Faiella, 2025).

Future as a Tool of Emancipation

Foresighting can strengthen people's **locus of control and sense of agency**, which is particularly impactful for those who have been disempowered and experienced a lack of influence within a system (Poli, 2021). It helps redistribute the "ability to aspire," providing more equitable opportunities for individuals and groups to influence long-term trajectories.

Skill Development

Foresighting and future thinking are often conceptualised as skills that can be strengthened through use, as opposed to one off activities providing fixed answers about the future. Ahvenharju (2021), conceptualises future-conscious behaviour as a flexible ability that can strengthen or weaken depending on context (Ahvenharju, 2021).

Poli (2021) suggests this ability involves:

- Recognising that the future is not simply a continuation of the present.
- Distinguishing among different types of futures.
- Identifying new ways to use the future in the present (Poli, 2021).

Ahvenharju et al (2021) have developed five dimensions of future consciousness that can be strengthened by foresighting practice, as shown in Table A1.

Dimension	Description
Time perspective	How much we orient ourselves towards the future
Agency beliefs	How much we trust in our ability to influence how the future unfolds
Openness to alternatives	How much we critically question established truths and our openness to how different the future can be
Systems perception	How easily we see how human and natural systems are interconnected and recognise the complex consequences of decisions
Concern for others	How much we have broadened our moral and ethical values to include physically or temporally distant people

Table A1: From Ahvenharju et al, 2021

Evidence quality and gaps

High-quality experimental studies support some mechanisms, but more research is needed on how group foresight activities shift future consciousness dimensions over time. Philosophical and dialogical traditions offer rich but under-integrated insights.

How foresighting influences practice

Research question: What influence does foresighting have on how people act and the decisions made by organisations (anticipation)?

Foresighting influences both individual behaviour and collective decision-making. Its impacts can be seen across personal action, organisational shifts, and policy change, but these can be reduced by limiting factors such as institutional siloes.

Types of Action

Personal Actions

- **Intention to act:** After foresighting, some participants report career reorientation, increased engagement in sustainable behaviours, and volunteering for long-term projects (Demneh, Zackery & Nouraei, 2023).
- **Improved decision-making:** Foresighting is associated with reduced risky behaviour and more reflective decision-making (Ahvenharju et al., 2021).
- **Long-term commitment:** Individuals develop a stronger orientation towards sustained, long-term action (Ahvenharju et al., 2021).

Organisational Shifts

- **Strategic and policy changes:** Organisations diversify strategies, reform policies, pilot innovations, and form cross-sector partnerships as a result of foresight processes (Faiella, 2025; Rohrbeck & Kum, 2018; Priebe, Veit & Warnke, 2025).
- **Improved outcomes:** Evidence suggests foresighting contributes to better organisational decision-making and outcomes (Rohrbeck & Kum, 2018).
- **Network strengthening:** Foresighting fosters stronger informal networks and collaborations across organisational boundaries (Priebe, Veit & Warnke, 2025).

Public Policy Impact

Anticipatory governance: Foresighting introduces new governance methods in public planning, regulation, and consultation, embedding longer-term perspectives in policy-making (Uruena, 2021).

Limiting Factors

Siloing: When foresight activities are confined to specialised units without integration across the organisation, their influence and effectiveness are constrained (Priebe, Veit & Warnke, 2025).

Models Measuring Foresighting Maturity

The influence of foresighting on action is partly shaped by the maturity of foresight practices within organisations.

Rohrbeck Model of Corporate Foresighting Maturity

Rohrbeck & Kum (2018) propose a model in which future preparedness depends on balancing an organisation's foresight capabilities (CF skills) with the degree of need for foresight. This model identifies four maturity levels, showing how organisations progress from ad hoc use of foresight to deeply integrated anticipatory capacity.

The model evaluates foresight maturity across six dimensions:

- Information – the organisation's ability to scan, collect and process future-oriented information.
- Networks – the use of internal and external networks to exchange foresight knowledge.
- People – the skills, mindsets, and capacities of staff to engage with foresight.
- Methods – the breadth and sophistication of foresight tools and approaches applied.
- Culture – whether foresight is valued and supported in organisational culture.
- Organisation – the degree to which foresight processes are embedded in governance and decision-making structures.

These dimensions map onto three overarching capacities, the "3Ps" (Rohrbeck & Kum, 2018):

- Perceiving – detecting signals and trends.
- Prospecting – generating and exploring possible futures.
- Probing – experimenting and testing strategies to prepare for different futures.

Evidence Quality and Gaps

There is substantial empirical evidence in both corporate foresight and policy domains. However, practice-oriented studies often lack longitudinal follow-up, making it difficult to assess sustained impact over time. Debate persists over whether foresighting should primarily guide specific decisions or instead cultivate broader adaptive capacity within individuals and organisations.

References

Ahvenharju, S., Lalot, F., Minkkinen, M., & Quiamzade, A. (2021). Individual futures consciousness: Psychology behind the five-dimensional Futures Consciousness scale. Futures, 128, 102708.

Demneh, M. T., Zackery, A., & Nouraei, A. (2023). Using corporate foresight to enhance strategic management practices. European Journal of Futures Research, 11(1), 5.

Faiella, A., & Corazza, G. E. (2025). Cognitive mechanisms in foresight: A bridge between psychology and futures studies. Futures, 166, 103547.

Goodwin, P., & Wright, G. (2025). Can Narrative-Based Scenarios Support Quantitative Judgmental Forecasting?. Futures & Foresight Science, 7(1), e70003.

Lauer, A., Carpintero, Ó., & de Castro, C. (2025). In search of a missing South: an explorative study of biases in global climate and energy scenarios. Globalizations, 1-22.

Nestik, T. (2018). The psychological aspects of corporate foresight. Форсайт, 12(2 (eng)), 78-90.

Poli, R. (2021). The challenges of futures literacy. Futures, 132, 102800.

Priebe, M., Veit, S., & Warnke, P. (2025). Understanding Foresight-Policy Interactions: The Role of Institutionalization. Futures & foresight science, 7(1), e197.

Rohrbeck, R., & Kum, M. E. (2018). Corporate foresight and its impact on firm performance: A longitudinal analysis. Technological Forecasting and social change, 129, 105-116.

Urueña, S., Rodríguez, H., & Ibarra, A. (2021). Foresight and responsible innovation: Openness and closure in anticipatory heuristics. Futures, 134, 102852.

Wilkinson, A. (2017). Strategic foresight primer. European Political Strategy Centre.

Scenarios for Future Living

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