

Energy regulation in transition

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Key points

- For over 200 years NSW has relied on coal to supply the state with power. Over time, this has materially affected the design of regulatory frameworks and key decisions about investments and infrastructure within the electricity sector.
- Both NSW and Australia have now legislated emissions reduction targets to rapidly decarbonise the economy. To meet these targets, the electricity sector will need to transition away from fossil fuels to renewable generation sources.
- The current regulatory approach used in the National Electricity Market (NEM) is the competitive market model that was designed for the supply of large fossil-fuel generation within the NEM.
- Today, more than one third of electricity supplied via the NEM is generated from renewable energy sources. This has led to specific regulatory challenges such as the rise of prosumers (consumers who both consume and produce energy), digitisation and the introduction of smart technologies, energy storage, and new forms of distributed energy resources.
- Despite the significant changes associated with the energy transition, the cooperative energy laws that underpin the NEM have only been subject to piecemeal changes. This has resulted in a complex legal, institutional and governance structure that is increasingly unworkable and not fit for purpose.
- State and territory governments are now frequently derogating from the cooperative energy laws or enacting their own policy solutions. This increases fragmentation and undermines efforts to harmonise the NEM jurisdictions.
- While many of the competitive market regulatory principles have been retained to address current challenges, new regulatory principles are emerging that reflect evolving energy needs, technological advancements, energy security concerns, and social priorities.
- Five modern energy principles may have particular significance for the NSW electricity sector. These principles seek to:
 1. Rapidly decarbonise the electricity sector by replacing fossil fuel generation with generation from renewable energy sources
 2. Improve energy and supply chain security
 3. Support a just energy transition
 4. Move towards a more sustainable and circular economy
 5. Enable the sector to become more resilient to the changing climate and the increased risk of natural disasters such as bushfires and floods.
- A reformed legal framework that integrates these principles would enable the electricity sector to remain efficient and reliable while meeting consumer and industry needs in the face of rapid transformation.

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1. Introduction

Electric power is critical to almost every aspect of modern life. Yet few consumers appreciate the direct impact of energy regulation every time they turn on an electrical device. Energy regulation has traditionally determined the market structure, the fuel sources used to generate electric power, the products and services available to energy consumers, and even how much their power costs.

For more than 2 centuries, the energy system in NSW has slowly evolved under different regulatory models from the earliest colonial model to the competitive market model used today. Each model has had an impact, with features of previous models evident in the design of our current energy regulatory framework.

The competitive market model that forms the basis of our current regulatory framework was designed in the late 1990s to create a single energy market servicing the east coast of Australia: the National Electricity Market (NEM). The NEM was premised on the idea that the introduction of competition into the energy market would provide better outcomes that were in the long-term interests of consumers. When the NEM commenced operations in 1998, more than 99% of electricity traded within the NEM was generated by large fossil-fuelled generators, predominantly using Australia's rich domestic endowment of coal.¹ The electricity generated was then transmitted and distributed in one direction to end-consumers.

Today, due to efforts to rapidly decarbonise the electricity sector and transition away from fossil fuels, our energy system looks quite different. More than one third of all electricity supplied via the NEM is now generated from renewable energy sources.² Australia has the highest uptake per capita of residential rooftop solar in the world.³ Consumers can now become 'prosumers,' and sell their excess solar generation into the grid, creating bi-directional flows on the distribution networks. New technologies such as energy storage, electric vehicles, and energy products such as peer-to-peer energy trading, and virtual power plants are emerging. International developments in the energy sector have also had an impact, with Australia having to decarbonise its electricity sector as part of its Nationally Determined Contribution under the Paris Agreement,⁴ as well as growing concerns about energy justice closely linked to the Sustainable Development Goals.⁵ These changes have meant that the competitive market regulatory model is increasingly no longer fit for purpose.

As a result, a range of modern energy regulatory principles has been developed by lawmakers, policymakers, and energy consumer advocates. These regulatory principles aim to send the correct market signals to the electricity sector to support the transition from fossil fuels to renewable generation and to better adapt to Australia's changing climate. Many of these principles, such as the

¹ OpenNEM, [Energy: NEM](#), December 1998-September 2024, accessed 19 September 2024.

² Department of Climate Change, Energy, the Environment and Water, [Australian Energy Update 2023](#), Australian Government, September 2023, p 34.

³ Australian Energy Market Operator, [2022 Integrated System Plan](#), Australian Government, June 2022, p 38.

⁴ Department of Industry, Science, Energy and Resources, [Australia's Nationally Determined Contribution](#), Communication 2022, Australian Government, p 3.

⁵ United Nations, [Transforming our world: the 2030 Agenda for Sustainable Development](#), GA Res 70/1, A/Res/70/1, 21 October 2015 (adopted 25 September 2015), Goal 7.

need for greater energy efficiency, technology neutrality, and more consumer empowerment, are largely uncontroversial. The 5 modern energy regulatory principles most likely to affect the NSW electricity sector are:

1. The electricity sector should rapidly decarbonise by replacing fossil fuel generation with generation from renewable energy sources
2. With the changing generation mix, the electricity sector should consider both energy and supply chain security
3. The energy transition should be a just transition and should not disproportionately affect vulnerable consumers or communities
4. The electricity sector should adopt circular economy principles
5. The electricity sector should become more resilient to the changing climate and the increased risk of natural disasters.

Despite the significant changes associated with the energy transition, there has not been a wholesale adoption of the modern energy regulatory principles into the regulatory framework underpinning the NEM. Rather, there have only been piecemeal changes within the competitive market model to accommodate changes within the electricity sector. This approach has resulted in ever-increasing length and complexity in the national energy laws and regulations. At the same time, state governments are increasingly formulating their own regulatory responses to the challenges emerging in the electricity sector, often drawing heavily on the modern energy regulatory principles as they seek to 'gap-fill' or address urgent state-based priorities.

The purpose of this paper is to explore how the energy transition, emerging energy technologies, products, and services, and changing societal expectations are challenging the market structures and competitive market model of regulation for the NSW electricity sector operating within the NEM. The rise of the modern energy regulatory principles most likely to affect the NSW electricity sector is critically examined to understand the role they may play in resolving the looming challenges facing the sector.

2. The evolution of energy regulation

2.1 Legislative competence for energy

The power to make laws and regulations governing the Australian electricity sector is shared in a complex constitutional arrangement between the Australian Government and the states and territories. The Australian Government can legislate on all energy matters relating to interstate or international trade or commerce, corporations, the territories, external affairs, or matters referred by the states.⁶ All other energy related matters are within the exclusive legislative competence of the states.

This division of legislative competence meant that Australia lacked a nationally coherent regulatory approach to energy for much of the 20th century. This had little impact when electricity generation, transmission and distribution were operated first on a municipal basis, and then later on a state-basis. However, over the latter half of the 20th century, there was a growing recognition that the challenges and opportunities within the electricity sector often transcended state boundaries.⁷ As highlighted in [section 3](#), this led to the development of the cooperative federalist governance structure used today, through which the Australian Government, states and territories work together to support a more harmonised approach to the electricity sector.⁸ Balancing the interests and priorities of different jurisdictions, each with its own energy resources, infrastructure, and policy goals, requires ongoing negotiation and compromise.

2.2 Regulatory models in NSW from 1788 to the present

For more than 2 centuries our energy systems evolved under different regulatory models to take advantage of our rich endowment of coal as the primary fuel source for Australia's electricity generation (Figure 1). When the state-owned electricity monopolies were first established in the late 1940s and early 1950s, almost all Australian electricity was derived from large coal-fired generators. Over many decades, this heavy reliance on coal-fired generation influenced key investment and infrastructure decisions and critically shaped the regulatory approach within the electricity sector.⁹ This historical path dependence continues to affect the dynamics of the electricity market today and explains why transitioning the electricity sector away from coal is particularly challenging for Australia.

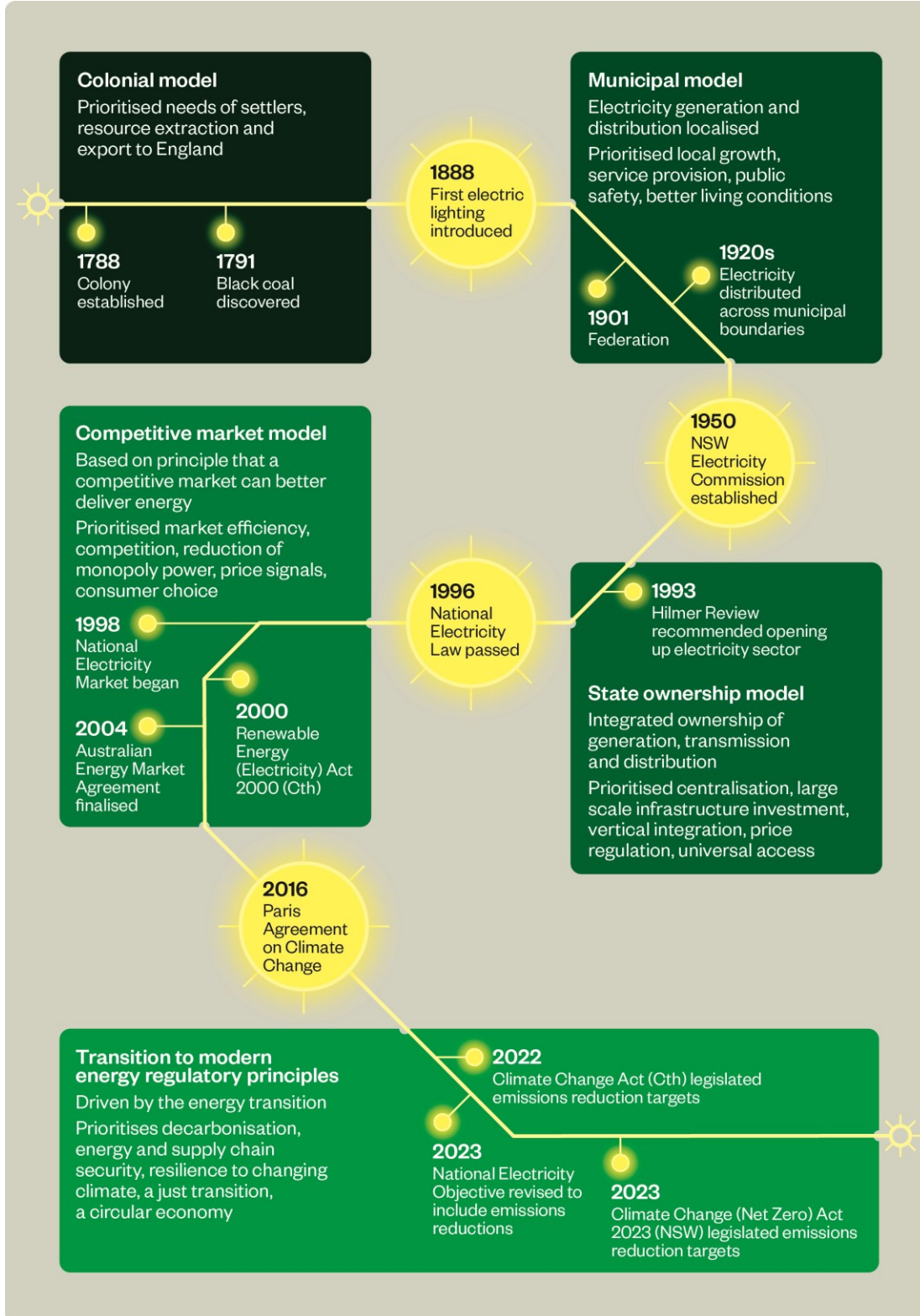
⁶ [Australian Constitution](#) s.51(i), (xx), (xxxvii), s.61, and s.122.

⁷ D Clarke and P Graham, [Australian Electricity Transitions 1900 to 2050: What will it take for Australia to transition to a net-zero electricity system by 2050?](#), CSIRO, December 2022, p 7.

⁸ A Kallies, [The Australian Energy Transition as a Federalism Challenge: \(Un\)cooperative Energy Federalism?](#), *Transnational Environmental Law*, 2021, 10(2), p 211, p 215, doi: 10.1017/S204710252000045X.

⁹ For example, the 1981 decision of the NSW government to expand the remit of the state's Electricity Commission to include the operation of coal mines to support coal-fired generation.

Figure 1: The history and regulatory evolution of the NSW electricity sector



Source: Author provided

Despite recent efforts to diversify the electricity generation mix, over the 12 months to 18 September 2024, 63.7% of NSW's electricity was still generated from coal.¹⁰ However, associated with Australia's international commitment under the Paris Agreement on climate change¹¹ to phase out coal-fired generation and reduce our greenhouse gas emissions, as well as the legislated NSW¹² and Commonwealth¹³ emissions reduction targets for 2030 and 2050, the underlying assumption of large coal-fired generators in our market design is now being challenged. As Australia transitions to a more diversified energy mix, modern energy regulatory principles provide options for reforming the system to better accommodate renewable energy sources, distributed generation and new market participants.

[Appendix 1](#) provides more details of the historical evolution of the NSW electricity sector and energy regulation.

¹⁰ OpenNEM, [New South Wales](#), 2024, accessed 19 September 2024. The NEM average was 56.4%, with 41.5% from black coal and 14.9% from brown coal.

¹¹ United Nations, [Paris Agreement](#), 2016 (adopted 12 December 2015; entered into force 4 November 2016).

¹² [Climate Change \(Net Zero Future\) Act 2023 \(NSW\)](#) s.9.

¹³ [Climate Change Act 2022 \(Cth\)](#) s.10.

3. The National Electricity Market

By the early 1990s Australia was going through a period of significant economic reform under the Hilmer Review of National Competition Policy, which sought to enhance efficiency, competition, and investment throughout the economy.¹⁴ The electricity sector was targeted for reform due to the fragmented nature of national energy policy and the inefficiencies in the state-based system, which were viewed as hindering cross-border electricity trade.¹⁵ Hilmer proposed that the sector be opened up to market competition and liberalisation to support improved efficiency and reliability, and the development of a nationally integrated electricity market.¹⁶

The National Grid Management Committee, comprising the Commonwealth, states, and the ACT, negotiated the formation of the NEM, a cross-border wholesale electricity market through which electricity would be generated, traded, and then transported. The National Electricity Law (NEL)¹⁷ was enacted as a schedule of the *National Electricity (South Australia) Act 1996* to provide the legal framework for the NEM. Under this cooperative legislative framework, South Australia serves as the 'host jurisdiction' for the NEL,¹⁸ with other participating jurisdictions incorporating the South Australian law into their own laws through corresponding legislation or regulations to ensure a harmonised legal approach.¹⁹ The NEM commenced operations on 13 December 1998.²⁰

Today, the NEM spans Queensland, NSW, the ACT, Victoria, South Australia, and Tasmania.²¹ It is made up of approximately 350 large generators, 5 state-based transmission networks linked by 6 cross-border interconnectors, and 13 major distribution networks that supply electricity to end use consumers.²² The NEM provides electricity to approximately 80% of all electricity consumers nationally, including all grid-connected NSW electricity consumers.²³

3.1 The NEM has a complex institutional and governance structure

The current structure of the NEM reflects the cooperative federalist arrangements negotiated between the Commonwealth, the states, and territories under the Australian Energy Market Agreement (AEMA).²⁴ The NEM's governance is often criticised for being overly complex and opaque (Figure 2), making it difficult for consumers and stakeholders to understand how decisions are made.²⁵ This complexity impedes effective participation and oversight and has been a source of

¹⁴ F G Hilmer et al., *National Competition Policy Review*, Australian Government, 25 August 1993.

¹⁵ F G Hilmer et al., *National Competition Policy Review*, Australian Government, 25 August 1993, p 249.

¹⁶ F G Hilmer et al., *National Competition Policy Review*, Australian Government, 25 August 1993.

¹⁷ *National Electricity (South Australia) Act 1996 (SA)* sch National Electricity Law.

¹⁸ *National Electricity (South Australia) Act 1996 (SA)* s.5; sch National Electricity Law, s 6(1)(a).

¹⁹ *National Electricity (South Australia) Act 1996 (SA)* sch National Electricity Law, s 6(1)(b).

²⁰ D Clarke and P Graham, *Australian Electricity Transitions 1900 to 2050: What will it take for Australia to transition to a net-zero electricity system by 2050?*, CSIRO, December 2022, p 8.

²¹ Despite being called the National Electricity Market, neither Western Australia nor the Northern Territory are connected to the NEM due to the remoteness of their population centres.

²² Australian Energy Regulator, *State of the Energy Market 2023*, Australian Government, 2023, p 37.

²³ Department of Climate Change, Energy, the Environment and Water, *National Electricity Market*, accessed February 2024.

²⁴ *Australian Energy Market Agreement* (entered into agreement 30 June 2004).

²⁵ R Ben-David, *Rethinking markets, regulation and governance for the energy transition*, Conference Paper prepared for AER/ACCC Regulatory Conference, Monash Energy Institute, Monash Business School, August 2023, p 17-18.

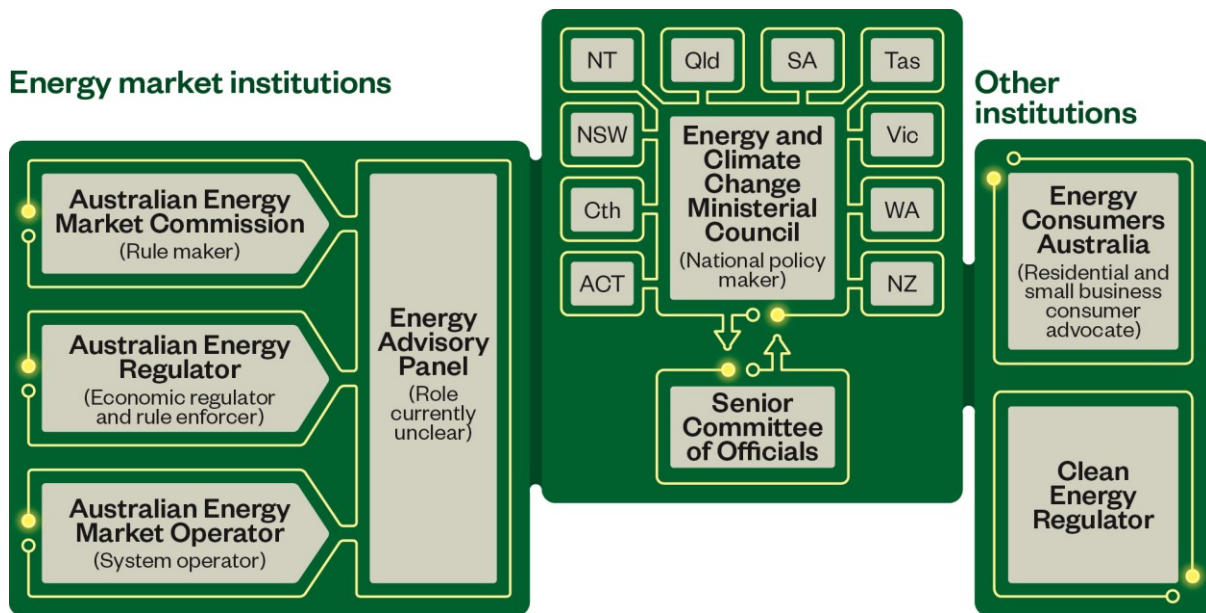
distrust in the system. The International Energy Agency (IEA) in its Australia Energy Policy Review (2023) stated that:

...the NEM governance framework is complex, with a large number of institutions and relatively unwieldy reform processes... NEM entities struggle to efficiently integrate new technologies and business models and take decisions and approvals in a timely way. Roles, functional responsibilities and related accountabilities of ministers (federal, state and territory) and the NEM market institutions can overlap and be overly complex, while there appears to be some significant gaps.²⁶

3.2 Market institutions and governance bodies

Figure 2 sets out the key energy market institutions and governance bodies for the NEM, and summaries of their roles are provided in this section.

Figure 2: Energy market institutions and governance bodies for the National Electricity Market



Source: Author provided

The **Energy and Climate Change Ministerial Council (ECMC)** is a Committee of National Cabinet comprising the relevant ministers from the Commonwealth, states and territories, and New Zealand. It is tasked with formulating national energy policy.²⁷ It also has oversight of the energy market institutions.²⁸

²⁶ International Energy Agency (IEA), *Australia 2023 Energy Policy Review*, April 2023, p 134.

²⁷ Department of Climate Change, Energy, the Environment and Water, *Energy and Climate Change Ministerial Council*, n.d., accessed September 2024.

²⁸ Department of Climate Change, Energy, the Environment and Water, *Energy and Climate Change Ministerial Council*, n.d., accessed September 2024.

The **Australian Energy Market Commission (AEMC)** is the rule-maker for electricity and gas markets in Australia. It develops and maintains the energy sector's delegated legislation²⁹ in the form of the National Electricity Rules (NER), the National Gas Rules (NGR), and the National Energy Retail Rules (NERR). The AEMC also conducts reviews and provides advice on energy market operations and the strategic direction of the sector.³⁰

The **Australian Energy Regulator (AER)** oversees the regulation of energy markets and networks across Australia. It monitors, investigates, and enforces compliance with the energy market rules and regulations, sets network tariffs, and publishes energy market data to promote transparency.³¹

The **Australian Energy Market Operator (AEMO)** handles the operation of Australia's electricity and gas markets and systems. It ensures the reliability and security of energy supply, plans the development of the energy system, and facilitates the energy markets where electricity and gas products are bought and sold. There is significant variance in AEMO's functions by state and territory, including with respect to their role in developing and implementing plans for the energy transition.³²

The **Energy Advisory Panel (EAP)** comprises the heads of the AEMC, the AER, and AEMO, with the Energy Commissioner of the Australian Competition and Consumer Commission (ACCC) as an observer.³³ Its role is to coordinate the market bodies' advice to governments under the National Energy Transformation Partnership on issues relating to the security, reliability, and affordability of Australia's east coast energy system.³⁴ It is envisaged that the EAP will also deal with issues relating to gas supply, retail markets and consumer protections. However, given the lack of transparency about the execution of these functions, it remains to be seen what role the EAP will play.

Energy Consumers Australia (ECA) represents residential and small business energy consumers' interests within the NEM. It advocates for policies and regulations that reflect consumers' values and expectations, focusing on affordability, reliability, and sustainability.³⁵

3.3 The cooperative legal framework

The NEM institutional structure is facilitated by laws and regulations enacted by the South Australian Parliament and then incorporated cooperatively within the other NEM jurisdictions. These laws are often operationalised through detailed delegated legislation made by the AEMC in the form of the national rules (although the South Australian Minister does have delegated authority to make some limited rules under the NEL). There is a similar cooperative legislative regime for gas, which is outside the scope of this paper.

²⁹ Delegated legislation is not made directly by Parliament, but instead, is created by a body or individual who is authorised to do so under an Act of Parliament.

³⁰ Australian Energy Market Commission (AEMC), *About Us*, n.d., accessed September 2024.

³¹ Australian Energy Regulator (AER), *Our Role*, n.d., accessed September 2024.

³² Australian Energy Market Operator (AEMO), *Annual Report FY23*, 3 October 2023, p 4.

³³ Energy and Climate Change Ministerial Council – Energy Ministers Sub-Group, *Meeting Communiqué 19 May 2023*, p 2-3.

³⁴ Department of Climate Change, Energy, the Environment and Water, *National Energy Transformation Partnership*, 12 August 2022, accessed August 2024.

³⁵ Energy Consumers Agency (ECA), *Who we are*, n.d., accessed September 2024.

There are two overarching laws that govern the NEM, the National Electricity Law (NEL)³⁶ and the National Electricity Retail Law (NERL).³⁷ These laws contain the National Electricity Objective (NEO) and the National Energy Retail Objective (NERO), respectively, which set out the guiding regulatory principles for the NEM.³⁸

The NEL and the NERL are supported by the National Electricity (South Australia) Regulations (NE Regs),³⁹ and the National Energy Retail Regulations (South Australia) (NE Retail Regs),⁴⁰ as well as the National Electricity Rules (NER),⁴¹ and the National Electricity Retail Rules (NERR).⁴² Some parts of these laws, regulations and rules collectively form the National Energy Customer Framework (NECF), which provides additional energy-specific customer protections and facilitates retail competition in most NEM jurisdictions (Box 1).

³⁶ [National Electricity \(South Australia\) Act 1996 \(SA\)](#) sch National Electricity Law

³⁷ [National Energy Retail Law \(South Australia\) Act 2011 \(SA\)](#) sch National Energy Retail Law.

³⁸ The National Electricity Objective (NEO) ([National Electricity \(South Australia\) Act 1996](#) sch - National Electricity Law s7); the National Energy Retail Objective (NERO) ([National Energy Retail Law \(South Australia\) Act 2011](#) sch - National Energy Retail Law s13).

³⁹ [National Electricity \(South Australia\) Regulations](#).

⁴⁰ [National Energy Retail Regulations \(South Australia\)](#).

⁴¹ [National Electricity Rules](#).

⁴² [National Electricity Retail Rules](#).

Box 1: The National Energy Customer Framework

The National Energy Customer Framework (NECF) regulates the sale and supply of electricity to retail customers. The NECF provides consumer protections beyond those found in Australia's general consumer protections that are set out in the Australian Consumer Law (ACL),⁴³ retailer obligation and dispute resolution processes. The NECF applies in all NEM jurisdictions, although all jurisdictions have modified its application to suit the needs of their state or territory,⁴⁴ and Victoria has only adopted the NECF to a very limited extent.

The NECF highlights the complexity of the legal frameworks involved in the operation of the NEM. It is not consolidated into a single document but rather spread across four different legal instruments (the NERL, NE Retail Regs, the NERR, and parts of the NER), which combined come to almost 2,400 pages. Moreover, the NECF applies to some new energy technologies and circumstances but not others, and it is applied differently in each jurisdiction.⁴⁵ For example, when a grid-connected customer buys a solar PV and battery system from a third party, the applicable consumer protections are the NECF for the electricity purchased from the grid and the ACL for the solar PV and battery system.⁴⁶ This makes the NECF difficult for energy consumers to navigate. There are also different dispute resolution and enforcement processes and remedies available depending on whether the issue falls within the ACL or the NECF. [Appendix 2](#) illustrates the interaction between the NECF, national laws and regulations and NSW law.

3.3.1 The delegated rulemaking function lacks parliamentary oversight

The normal system of checks and balances for delegated legislation includes parliamentary scrutiny through the committee system and disallowance procedures. However, disallowance procedures are not available to any parliament with respect to the AEMC's rulemaking, such as the NER and the NERR.⁴⁷ This was an intentional feature in the design of the rulemaking process:

Both the NER and Regulations are not subject to parliamentary disallowance because it is not considered appropriate for the Parliament of one jurisdiction to disallow a legislative instrument that applies to all jurisdictions.⁴⁸

This means that there is no effective check that the AEMC is exercising its rule-making powers within the scope and intent of the *National Electricity (South Australia) Act 1996*. While judicial review is available to affected parties if they can show that the AEMC made a legal error in their rulemaking,

⁴³ AEMC, [How energy consumers are protected under the NECF and the ACL](#), n.d., accessed September 2024.

⁴⁴ AEMC, [Jurisdictional differences within the NECF](#), n.d., accessed September 2024.

⁴⁵ AEMC, [How energy consumers are protected under the NECF and the ACL](#), n.d., accessed September 2024; AEMC, [Jurisdictional differences within the NECF](#), n.d., accessed September 2024.

⁴⁶ AEMC, [How energy consumers are protected under the NECF and the ACL](#), n.d., accessed September 2024; AEMC [2019 Retail Energy Competition Review](#), June 2019, p 200.

⁴⁷ [National Electricity \(South Australia\) Act 1996 \(SA\)](#) s 13. Note also 11(5) in relation to the Regulations made under the Act.

⁴⁸ P Nicholas, [Administrative Law in the Energy Sector: Accountability, Complexity and Current Developments](#), AIAL Forum No. 59, 2008, p 77.

this process is time-consuming, legalistic, and expensive,⁴⁹ meaning that no one has ever brought a judicial review of an AEMC decision.

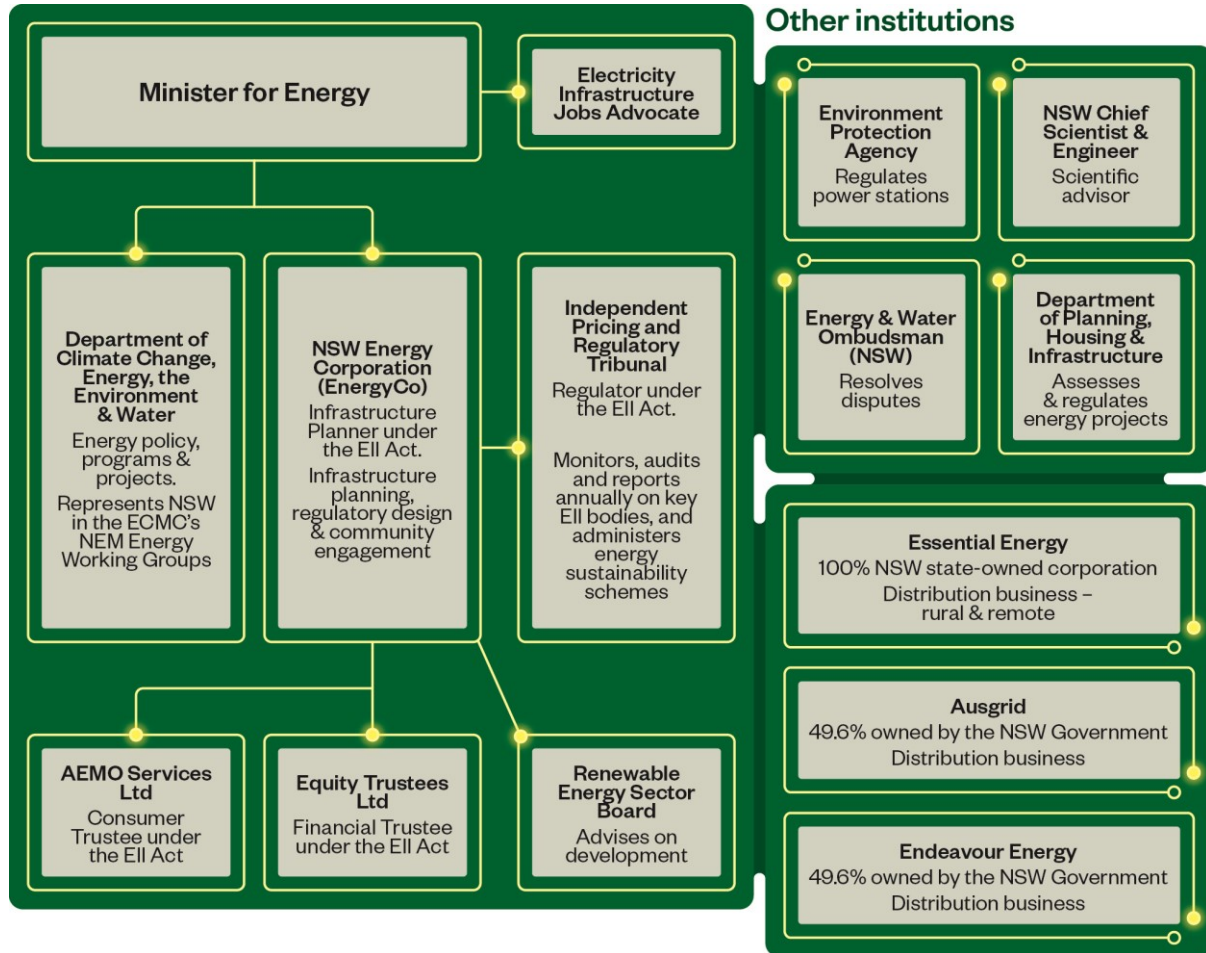
Several strategies could be adopted to improve oversight of the impacts of this delegated legislation on NSW energy consumers. One option may be to establish a new Standing Committee or task the existing Joint Net Zero Standing Committee with ensuring that the delegated legislation aligns with the state's social, economic, and environmental objectives. This committee could monitor how rule changes affect NSW energy consumers, assess the accuracy of modelling and predicted benefits, and evaluate the need for, and effectiveness of, NSW derogations. Additionally, a legislative requirement could be introduced for the NSW Department of Climate Change, Energy, the Environment and Water to publicly report on significant AEMC rule changes and their expected impacts on the state.

3.4 The role of the NSW Government within the NEM

Due to the shared legislative competence for energy, NSW has its own separate ministries and governance bodies responsible for aspects of the electricity sector (Figure 3). These entities each have their own remit and strategic priorities, which reflect the additional layer of NSW legislation governing the NSW sector, the policy agenda of the NSW government, and the needs of NSW energy consumers. The NSW Parliament has passed laws relating to energy efficiency, electrical safety, environmental protection, climate change, consumer protections, and planning. These laws materially affect how energy projects in NSW are approved, developed, and managed. Key pieces of state legislation include the *Electricity Supply Act 1995*, the *Electricity Infrastructure Investment Act 2020* ('EII Act'), and the *Climate Change (Net Zero Future) Act 2023*.

⁴⁹ G Appleby, [Accountability in the National Energy Market](#), Report prepared for the Public Interest Advocacy Centre, 6 May 2015, p 26.

Figure 3: The institutional and governance structure of the NSW electricity sector



Source: Author provided

For the NSW entities to successfully achieve their remits, they need to work collaboratively with the other NEM jurisdictions to represent the interests of NSW and influence the development of the laws, policies and institutions that govern the NEM. However, the formal opportunities for state government representation and influence within the cooperative federalist governance structure that governs the NEM are limited, with only:

- A seat on the ECMC, which typically only meets 4 times per year
- Representation via the ECMC's working groups of senior public servants.⁵⁰ The extent of influence able to be exerted via these working groups is unclear due to a lack of public information around them
- A role as a government member of AEMO

⁵⁰ Australian Government Department of Climate Change, Energy, the Environment and Water, [Energy and Climate Change Ministerial Council: Working groups](#), Australian Government, 2024, accessed 19 September 2024.

- The presence of 3 formal state and territory (collectively) representative board members on the AER Board.

There is no state or territory representation on the boards of either the AEMC, the Energy Advisory Panel or Energy Consumers Australia.

3.5 State and territory ownership of assets in the NEM

When the NEM and its supporting regulatory frameworks were being negotiated, it was done on the basis that the states were transitioning their power sectors from being dominated by large vertically integrated state-owned monopolies to privatised corporations. An essential part of this process was ‘unbundling,’ or the separation of the monopolies by their function into distinct business units, namely generation, transmission, distribution, and retail businesses. Despite this, there continues to be significant public ownership of the essential assets and infrastructure that make up the NEM (Table 1). In addition, 3 interconnectors (Queensland–NSW, Heywood, and Victoria to NSW) are owned by state governments and 3 interconnectors (Directlink, Murraylink and Basslink) are privately owned.⁵¹

Table 1: Public and private ownership structures in NEM jurisdictions⁵²

Jurisdiction	Generation ⁵³	Storage	Transmission	Distribution	Retail	Renewables ⁵⁴
ACT	Private	Private	Private	Public/Private	Private	Private
NSW	Private	Private	Private	Public/Private	Private	Private
QLD	Public/Private	Public	Public	Public	Public/Private	Public/Private
SA	Private	Private	Private	Private	Private	Private
TAS	Public/Private	Private	Public	Public	Public/Private	Public/Private
VIC	Public/Private	Private	Private	Private	Private	Private

Source: [Australian Energy Regulator](#)

The differences in the degree of public ownership in electricity assets reflects the different historical policy decisions, ideological positions, and economic strategies adopted by the states and territories. Jurisdictions that have retained public ownership argue it allows for greater control over energy security, price stability, and the ability to direct investment towards policy goals such as renewable energy.⁵⁵ Jurisdictions that have pursued privatisation point to increased efficiency, reduced public debt, and the benefits of competition.⁵⁶

⁵¹ AER, [State of the Energy Market 2023](#), Australian Government, October 2023, p 81.

⁵² AER, [State of the Energy Market 2023](#), Australian Government, October 2023, p 81-4.

⁵³ Note that some generation businesses own both fossil fuel and renewable generation assets.

⁵⁴ While most renewable generation in Australia is privately owned, this category reflects that some states now have explicit public ownership mandates for renewable generation projects.

⁵⁵ D Montoya, [The energy transition: Decarbonisation, decentralisation and digitalisation](#), NSW Parliamentary Research Service, August 2023, p 27; R Nepal and J Foster, [Electricity Networks Privatization in Australia: An Overview of the Debate](#), *Economic Analysis and Policy* 2015, p 48, doi:10.1016/j.eap.2015.10.001, p 22; Queensland Government, [Miles Labor Government locks in 100,000 jobs for the future](#) [media release], Queensland Government, 18 April 2024.

⁵⁶ R Nepal and J Foster, [Electricity Networks Privatization in Australia: An Overview of the Debate](#), *Economic Analysis and Policy* 2015, 48, doi: 10.1016/j.eap.2015.10.001, p 21-22; Productivity Commission, [The Electricity Industry in South Australia](#), Industry Commission research report, 29 April 1995, p 89.

The level of state ownership matters because it has been shown to materially influence market dynamics, pricing, investment in infrastructure, and the pace of transition towards renewable energy (see section 5.2).⁵⁷ It also represents a potential conflict of interest in the context of the states voting on contentious matters in the key policymaking and oversight body in the NEM, the ECMC.

The ECMC largely adopts a consensus-based model of decision-making resulting in a 'lowest common denominator' approach to policymaking.⁵⁸ Where one of the participating jurisdictions in the NEM holds out on accepting a decision, they may be able to exercise a disproportionate level of power. This issue is important given that some states currently have a conflict of interest regarding their public ownership of assets, which may lead to their decision-making at the ECMC favouring the interests of their investments to the detriment of the long-term consumer interests of the broader market. The implications of the consensus-based decision-making model used by the ECMC are difficult to assess, because the frequency, the subject-matter and the individual votes of each participating jurisdiction are not publicly available through meeting communiqués or any other document.

Contrary to the stated intent at the time of the formation of the NEM, public ownership/involvement is likely to continue to grow within the energy sector over the coming decade. This reflects the strategies adopted by the Queensland and Victorian governments to take significant stakes in their renewable generation portfolios and projects (see section 5.2).⁵⁹

3.6 Is the NEM 'fit for purpose' in the context of the energy transition?

The NEM has made progress over its lifetime. Competition has been introduced into sections of the energy market, leading to efficiency gains and innovation in the sector, as well as new investment, especially in renewable energy sources. The NEM has also facilitated consumer choice and the entry of new market participants, including renewable energy providers. This has led to more diverse options for consumers and opportunities for cost savings, especially for those able to leverage new technologies like rooftop solar.

However, the governance of the NEM has long been a topic of debate and criticism, particularly in the context of Australia's energy transition and the evolving demands on the electricity system.⁶⁰ It has been argued that both the governance structure and the regulatory framework are no longer fit for purpose.⁶¹ The energy transition has been marked by the introduction of novel products and services, leading to regulatory challenge, including issues involving prosumers (consumers who both consume

⁵⁷ B Steffen et al., [State Ownership and Technology Adoption: The Case of Electricity Utilities and Renewable Energy](#), *Research Policy*, 2022, 51(6) 104534, doi: 10.1016/j.respol.2022.104534, p 3, p 6.

⁵⁸ P Crossley, [Review of the institutional governance arrangements of the national electricity market](#), Report for the Public Interest Advocacy Centre to inform the Governance Review of the Council of Australia Governments (COAG) Energy Council, May 2015.

⁵⁹ [Energy \(Renewable Transformation and Jobs\) Bill 2023 \(Qld\)](#) s 13; Premier of Victoria, [The SEC Is Back: Accelerating Victoria's Renewable Future](#), [media release], Victorian Government, 26 October 2023.

⁶⁰ International Energy Agency (IEA), [Australia 2023 Energy Policy Review](#), April 2023, p 134.; R Ben-David, [Rethinking markets, regulation and governance for the energy transition](#), Conference Paper prepared for AER/ACCC Regulatory Conference, Monash Energy Institute, Monash Business School, August 2023, p 18.

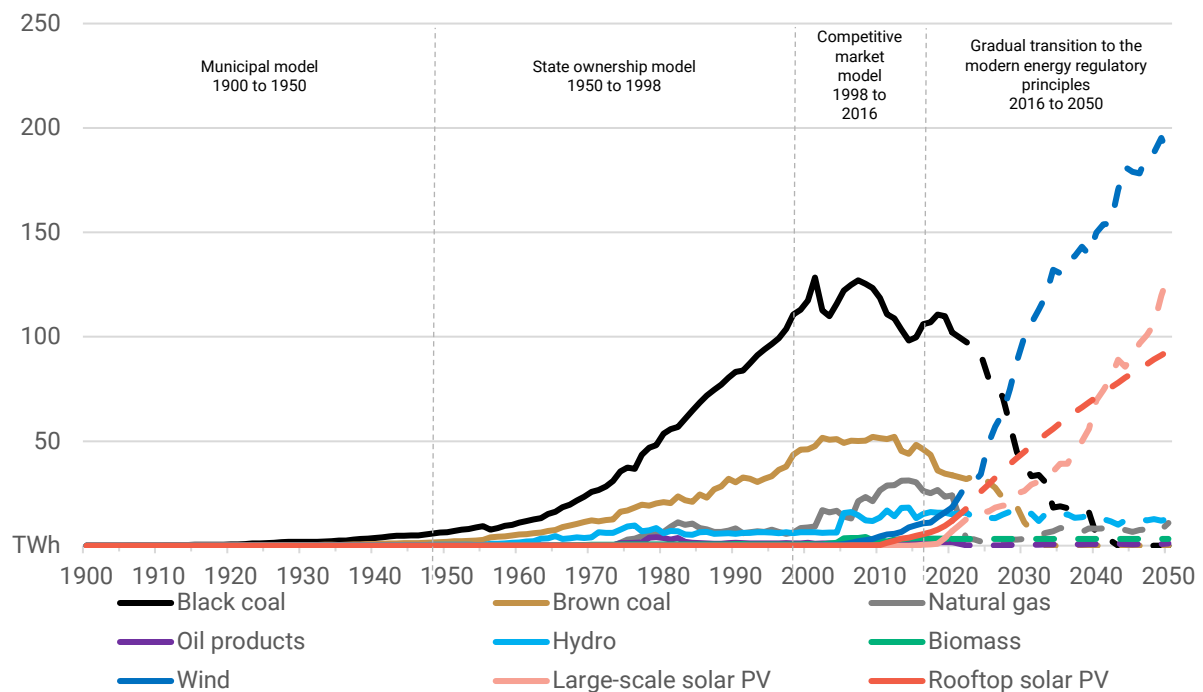
⁶¹ R Ben-David, [Rethinking markets, regulation and governance for the energy transition](#), Conference Paper prepared for AER/ACCC Regulatory Conference, Monash Energy Institute, Monash Business School, August 2023, p 18.

and produce energy), digitisation and the introduction of smart technologies and grids, energy storage, and new forms of distributed energy resources.

3.6.1 The NEM was designed for large fossil-fuelled generation not distributed renewable energy generation

Although the NEL and the NER are stated to be technology-neutral, they were clearly designed with a large-scale model of fossil-fuelled generation in mind. As highlighted in Figure 4, in the first full year of operation of the NEM in 1999, almost all electricity traded within the NEM was a result of large-scale generation from coal (95.9%), gas (3.2%) or hydropower (0.9%).⁶²

Figure 4: Electricity generation by fuel and technology in NEM jurisdictions: 1990 to 2050



Source: P Graham and G Wilkenfeld, *Australian energy transition data*, v1, CSIRO, 2022. The figure shows electricity generation data for all NEM jurisdictions except Tasmania before 2004. Tasmania joined the NEM in 2005.

In the 12 months to 18 September 2024, renewable generation accounted for 38.4% of electricity generated within the NEM. The largest contributors to renewable generation were solar (rooftop 11.5%, utility-scale 7.3%), wind (12.9%) and hydropower (6.2%), with smaller contributions made by discharging batteries and forms of bioenergy.⁶³ As a result, several aspects of the cooperative NEM laws no longer fit the current context. Examples include:

⁶² OpenNEM, *Energy: NEM*, 2024, accessed 19 September 2024.

⁶³ OpenNEM, *Energy: NEM*, 2024, accessed 19 September 2024.

- The laws and regulations governing the distribution networks were designed for a one-way flow of electricity from the generator to the end consumer, not the bi-directional flows seen today as 'prosumers' export their excess solar generation to the grid
- The rules were drafted on the principle that electricity could not be stored. This is no longer the case given the advent of battery and pumped hydro storage, with battery storage alone now exceeding 6 GW of capacity on the NEM⁶⁴
- There was an assumption that generation capacity would be fairly constant and not have the intermittent or highly variable capacity profile that solar energy and wind power have.

Over time, the initial design of the regulatory frameworks governing the NEM has been increasingly challenged. This has been further compounded by emerging developments within the NSW energy market that represent fundamental shifts from the traditional large-scale generation model including:

- The significant growth in distributed energy resources (DER),⁶⁵ which are small-scale generation and energy storage systems such as rooftop solar panels and batteries. For example, there are over 3.8 million rooftop solar systems in Australia located 'behind the meter'⁶⁶ which has historically been less visible to AEMO. These solar systems are now capable of providing 48% of the NEM's power demand in the middle of a sunny day.⁶⁷ Renewable energy tends to be variable and intermittent in its generation output, which makes centralised market planning and operations more important to ensure reliability, stability, security, and system balancing between demand and supply
- The growth in the provision of bundled services, such as energy and water, energy and new technology systems, and new technologies and management and control systems⁶⁸
- The advent of solar leasing and solar power purchase agreements⁶⁹
- Increased collective action and community schemes such as micro-grids and peer-to-peer trading⁷⁰
- The development of virtual power plants by existing market participants⁷¹

⁶⁴ A Colthorpe, [Australia installed 2.5GWh of battery storage in record-breaking 'Year of the Big Battery'](#), Energy Storage News, 10 April 2024.

⁶⁵ DER assets are sometimes also referred to as Consumer Energy Resources (CER) to connote that these systems are often owned by individual energy consumers. However, given the advent of leasing and third-party ownership models, this report will use the broader (and internationally recognised) term, DER, for these assets.

⁶⁶ Australian PV Institute, [Australian PV Market Since April 2001](#), 30 June 2024.

⁶⁷ AEMO, [Draft 2024 Integrated System Plan for the National Electricity Market](#), Draft Report, January 2024, p 30.

⁶⁸ P Crossley et al., [What will energy consumers expect of an energy and water ombudsman scheme in 2020, 2025 and 2030?](#), Final Report, 15 October 2019, p 19; AER, [Review of consumer protections for future energy services](#), Final Report, November 2023, p 20; See for example, AGL, [Bundle and Save](#), n.d., accessed September 2024; Origin, [Origin Essentials Bundle](#), n.d., accessed September 2024.

⁶⁹ P Crossley et al., [What will energy consumers expect of an energy and water ombudsman scheme in 2020, 2025 and 2030?](#), Final Report, 15 October 2019, p 19; ; AER, [Review of consumer protections for future energy services](#), Final Report, November 2023, p 8; NSW Office of Environment & Heritage, [What Are Solar Power Purchase Agreements](#), Fact Sheet, December 2015.

⁷⁰ P Crossley et al., [What will energy consumers expect of an energy and water ombudsman scheme in 2020, 2025 and 2030?](#), Final Report, 15 October 2019, p 19; Wen Wu et al., [The Future of Peer-to-Peer Trading of Distributed Renewable Energy](#), CSIRO Report, 2019, p 9.

⁷¹ Australian Renewable Energy Agency, [What Are Virtual Power Plants and Why Do They Matter?](#), 8 February 2021, accessed September 2024.

- The increased use of intermediaries such as commercially operated price comparison sites, demand aggregators and resellers⁷²
- The growth in standalone power systems and the islanding of remote communities⁷³
- The growth in electric vehicles, which are predicted to be able to be used as backup household battery systems within 3–4 years (this would currently breach the warranty of many electric vehicles on the Australian market).⁷⁴

Responding to these developments has resulted in a substantial number of piecemeal changes to the laws and regulations, which have multiplied the length of the NEL by 5, and more than doubled the length of the NER. However, the pace of technological change and innovation in the electricity sector has outstripped the NEM's regulatory adaptation. This has created a situation where new technologies, business models, and consumer demands have not been fully accommodated within the market's operational and regulatory frameworks (Box 2).⁷⁵

⁷² Australian Competition and Consumer Commission (ACCC), *The Comparator Website Industry in Australia*, ACCC Report, November 2014, p 4-5.

⁷³ Islanding involves removing any direct grid connection to the NEM for very remote communities when it does not make economic sense to support extensive grid infrastructure to service a small population. Instead, energy services for the 'islanded' community are provided through a combination of local energy generation and community battery storage. Ausgrid, *What Is a Stand Alone Power System?*, n.d., accessed September 2024.

⁷⁴ P Graham, *Electric Vehicle Projections 2023: Update to the 2022 Projections Report*, CSIRO, December 2023.

⁷⁵ A Finkel et al., *Independent Review into the Future Security of the National Electricity Market*, Department of the Environment and Energy, June 2017.

Box 2: Incorporating multifunctional battery storage into the NEM

One of the many examples of regulatory lag relates to the issues associated with the introduction of battery storage assets in the NEM. Battery storage is a multifunctional asset that can provide services across several of the functions that were unbundled as part of the introduction of competition into the NEM, including generation, frequency support and ancillary services.⁷⁶ As a result, battery storage assets did not fit neatly into a NEM registration category,⁷⁷ leading to them being treated as a 'registered market generator' rather than having their own separate asset class in the NEL and the NER.⁷⁸ This subsequently led to problems in how grid-connected battery storage could be used, and how the services batteries could provide were remunerated (or not), which were not addressed for almost 5 years.⁷⁹ Even now, these assets must hold 2 separate market registrations depending on which functions they are carrying out.⁸⁰ This highlights the inflexibility in the current regulatory framework and market design, with many new technologies capable of performing more than the one functional role that the competitive market model supports.

3.6.2 The historic failure to incorporate climate change considerations

The changing generation mix is often celebrated as a triumph of various government support schemes. These include the Australian Government's renewable energy target and subsidy schemes under the *Renewable Energy (Electricity) Act 2001* (Cth) and state efforts such as the NSW Solar Bonus Scheme, which sought to rapidly decarbonise the electricity sector.

One significant criticism of the NEM, however, relates to the failure to adequately incorporate climate change considerations into its operational and investment frameworks.⁸¹ The National Energy Objectives⁸² (NEO) only incorporated a climate objective in September 2023. Prior to this there was a lack of policy coherence between Australia's energy and climate laws and policies.⁸³ In particular, the AEMC's rule change process could only consider the impacts of a proposed rule change in the NEM against economic, security, safety and reliability criteria that were contained in the NEO, rather than

⁷⁶ See for example, P Crossley, [Defining the Greatest Legal and Policy Challenge to Energy Storage](#), *Renewable Energy Law and Policy Review*, 2013, No 4., p 268-281; AEMC, [Integrating energy storage systems into the NEM](#), Rule determination, 2 December 2021, p 2.

⁷⁷ See for example, P Crossley, [Defining the Greatest Legal and Policy Challenge to Energy Storage](#), *Renewable Energy Law and Policy Review*, 2013, No 4., p 268-281; AEMC, [Integrating energy storage systems into the NEM](#), Rule determination, 2 December 2021, p 2.

⁷⁸ AEMC, [Integrating energy storage systems into the NEM](#), Rule determination, 2 December 2021, p 2-4.

⁷⁹ AEMC, [Integrating energy storage systems into the NEM](#), Rule determination, 2 December 2021, p 2-4.

⁸⁰ AEMO, [Registering a Battery System in the NEM](#), Fact Sheet, 2021.

⁸¹ J Quiggin, [Energy Security: Responding to the Failure of the National Electricity](#), Submission to NSW Energy Security Taskforce, 2017, p 5.

⁸² Specifically, the National Electricity Objective (NEO) ([National Electricity \(South Australia\) Act 1996](#) sch - National Electricity Law s7); the National Energy Retail Objective (NERO) ([National Energy Retail Law \(South Australia\) Act 2011](#) sch - National Energy Retail Law s13); and the National Gas Objective (NGO) ([National Gas \(South Australia\) Act 2008 \(SA\)](#) sch - National Gas Law s 23).

⁸³ [Statutes Amendment \(National Energy Laws\) \(Emissions Reduction Objectives\) Act 2023 \(South Australia\)](#).

also considering what impact a rule may have on the climate.⁸⁴ The 2023 change recognised that addressing climate change and Australia meeting its national and international commitments to reduce greenhouse gas emissions are also in the long-term interests of consumers. The impact of the amendment was to require the AEMC to consider the impact of public commitments to reduce greenhouse gas emissions when making a determination on a rule change request, in addition to the existing criteria contained in the NEO.

3.6.3 Growing concerns about the fitness of the regulatory framework have seen the states derogating from it

The cooperative NEM legislative framework was designed to provide a cohesive and uniform approach to energy regulation across the Commonwealth and participating states and territories. However, states are increasingly choosing to derogate, or diverge, from these cooperative legislative schemes to better suit their specific circumstances, policy objectives, and local conditions.⁸⁵ Research published by the AEMC in 2023 highlighted the extent of the issue, with over 400 derogations identified to the suite of regulations that make up the NERL, the NERR, the NER and the National Gas Rules.⁸⁶ While some derogations are minor, some are significant. These include the decision of the Victorian Government not to adopt the NECF⁸⁷ or commence the NERL or NERR, and to retain the Victorian Energy Retail Code which is administered by the Victorian Essential Services Commission.⁸⁸ Thus, the flexibility claimed by the states associated with derogations comes with significant challenges, including the increased complexity and inconsistency in the regulatory landscape across Australia.

The NEM was designed for an energy market which was very different to the energy market that exists today. This has required the cooperative legal framework to change with it. However, as highlighted in this section, the changes to the law have been piecemeal and only served to add to the complexity of the laws. Over time this has made it more difficult for industry, regulators, and energy consumers to navigate the laws and the NEM. Sometimes, states have sought to address this issue through derogations, and while this may address an issue at the level of the individual jurisdiction, it again creates complexity for what is meant to be a cooperative harmonised legal regime. The constant adding of complexity without doing more systemic wholesale reform of the competitive market model and its large fossil-fuelled generation underpinnings simply cannot be sustained over the longer term.

⁸⁴ [National Electricity \(South Australia\) Act 1996 \(SA\)](#) sch – National Electricity Law s 32; [National Energy Retail Law \(South Australia\) Act 2011 \(SA\)](#) sch – National Energy Retail Law s 244; [National Gas \(South Australia\) Act 2008 \(SA\)](#) sch – National Gas Law s 72. Note recent amendments that now include an emissions reduction objective.

⁸⁵ AEMC, [How energy consumers are protected under the NECF and the ACL: 2019 Retail Energy Competition Review](#), 28 June 2019, p 24.

⁸⁶ AEMC, [Guide to the application of the NECF](#), n.d., accessed September 2024.

⁸⁷ Victorian State Government, [Our regulatory framework](#), 10 April 2024, accessed September 2024.

⁸⁸ Essential Services Commission, [Energy Retail Code of Practice](#), 1 October 2022.

4. Modern energy regulatory principles

It has been almost 30 years since the enactment of the main regulatory framework governing the NEM, that is, the NEL and NER. Under the competitive market model that was foundational to the design of the NEM and this regulatory framework, economic rationalism was prioritised. This was evident in the NEO that applied between 1996 and 21 September 2023 to all rulemaking and review processes within the NEM:

“to **promote efficient investment** in, and **efficient operation and use of**, electricity services for the long term interests of consumers of electricity with respect to:

- a. price, quality, safety, reliability and security of supply of electricity; and
- b. the reliability, safety and security of the national electricity system.⁸⁹ [emphasis added]

In recent years, both in Australia and internationally, modern energy regulatory principles have begun to evolve to provide the market signals needed to support investment and planning decisions to decarbonise and transition the electricity sector away from fossil fuels.⁹⁰ These modern regulatory principles are a shift from the economic rationalist approach that underpinned the competitive market model of the NEM. They also reflect the changing societal expectations about the treatment of vulnerable energy consumers and the communities most affected by the energy transition. The principles further address the challenge of the geopolitics of renewable energy technology manufacturing being heavily concentrated in China, as well as how new threats to security and stability, such as those posed by natural disasters and climate change, are affecting the domestic electricity sector.

The key modern energy regulatory principles for NSW are:

1. The electricity sector should rapidly decarbonise by replacing fossil fuel generation with generation from renewable energy sources
2. With the changing generation mix, the electricity sector should consider both energy and supply chain security
3. The energy transition should be a just transition and should not disproportionately impact vulnerable consumers or communities
4. The electricity sector should adopt circular economy principles
5. The electricity sector should become more resilient to the changing climate and the increased risk of natural disasters.

At times, these modern regulatory principles sit in stark contrast to the economic rationalism of the competitive market model, yet they are increasingly being incorporated into regulatory decision-

⁸⁹ [National Electricity \(South Australia\) Act 1996 \(SA\)](#) sch s 7 (*National Electricity Law*).

⁹⁰ See for example, R Ben-David, [Rethinking markets, regulation and governance for the energy transition](#), Conference Paper prepared for AER/ACCC Regulatory Conference, Monash Energy Institute, Monash Business School, August 2023, p 17-18; T Wood et al., [Keeping the lights on: How Australia should navigate the era of coal closures and prepare for what comes next](#), Research Report, Grattan Institute, 28 April 2024.

making affecting the sector. This process involves balancing the competitive market and modern regulatory principles, or at the very least showing that the modern regulatory principles have been considered as part of the decision-making process.⁹¹

The origin of these principles varies. The decarbonisation principle arose out of Australia's international commitments and the legislated national and state targets to reduce greenhouse gas emissions.⁹² The energy and supply chain security principle came about due to increasing concerns about Australia's vulnerability to the highly concentrated technology manufacturing and critical minerals supply chain, and supply constraints that arose during the COVID-19 pandemic.⁹³ The need for resilience from natural disasters and climate risks arose as a response to the significant infrastructure damage caused by the 2019–2020 bushfires and the floods in northern NSW and south east Queensland in 2022.⁹⁴ While the concepts of a just energy transition and the circular economy were developed through academic research, they have subsequently been adopted by various intergovernmental agencies such as the IEA and the International Renewable Energy Agency, as well as the Australian, state and territory governments.⁹⁵

This section discusses each modern energy regulatory principle and provides some examples of how the principle is being incorporated into the law or implemented via policies and programs.

4.1 Principle 1: The electricity sector should rapidly decarbonise by replacing fossil fuel generation with generation from renewable energy sources

The electricity sector is the largest source of greenhouse gas emissions within the Australian economy, accounting for more than 34% of Australia's net emissions in 2023.⁹⁶ As a result, the electricity sector has become a focal point for national efforts to decarbonise (Box 3).

Australia has made international commitments under the Paris Agreement to reduce greenhouse gas emissions to 43% of 2005 levels⁹⁷ and this commitment has been enacted into legislation in the *Climate Change Act (2022)* (Cth).⁹⁸ To achieve this target by 2030, the share of renewable electricity in the national energy mix will need increase markedly from 38.4% in 2024⁹⁹ to 82% in 2030.¹⁰⁰

⁹¹ AEMC, [How the national energy objectives shape our decisions](#), Report, September 2023, p 16.

⁹² AEMC, [How the national energy objectives shape our decisions](#), Report, September 2023, p 9.

⁹³ Department of Industry, Science and Resources, [Critical Minerals Strategy 2023–2030](#), Report, June 2023.

⁹⁴ M Binskin et al., [Royal Commission into National Natural Disaster Arrangements](#), Report, 28 October 2020, p 236-244.

⁹⁵ See, e.g., IRENA, [Circular Economy](#), n.d., accessed September 2024; Department of Climate Change, Energy, the Environment and Water, [Circular Economy Ministerial Advisory Group](#), 29 August 2024, accessed September 2024.

⁹⁶ Department of Climate Change, Energy, the Environment and Water, [Australia's emissions projections 2023](#), 28 May 2024, accessed September 2024.

⁹⁷ Department of Industry, Science, Energy and Resources, [Australia's Nationally Determined Contribution](#), Communication 2022, Australian Government, p 3.

⁹⁸ [Climate Change Act 2022 \(Cth\)](#) s 10.

⁹⁹ OpenNEM, [Energy: NEM](#), accessed 19 September 2024.

¹⁰⁰ Department of Climate Change, Energy, the Environment and Water, [Australia's emissions projections 2023](#), 28 May 2024, accessed September 2024.

Box 3: Emissions reductions being incorporated into the National Electricity Objective

The clearest example of the decarbonisation regulatory principle being incorporated into law-making in the electricity sector comes from the changes to the NEO that occurred in September 2023.¹⁰¹ The NEO now has an additional section which reads:

s.7 To promote the efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to--

[...]

c. the achievement of targets set by a participating jurisdiction--

- i. for reducing Australia's greenhouse gas emissions; or
- ii. that are likely to contribute to reducing Australia's greenhouse gas emissions.

Note--

The AEMC must publish targets in a targets statement.

In addition to the existing criteria within the NEO of price, quality, safety, reliability and security of supply, the AEMC now has the additional criterion of the impact on emissions reductions when they consider, weight appropriately, and then balance the criteria in the long-term interests of consumers as part of each rule change and review process.

The AEMC has stated that it will incorporate consideration of emissions reductions within their regulatory impact analysis for proposed rule changes in the following way:

1. At the outset of each project, it will consider how to determine whether the proposed reform will contribute to the long-term interests of energy consumers. This involves consideration of all the relevant criteria, including whether the proposed reform is likely to impact emission reduction targets.¹⁰²
2. Where the proposed reform is likely to have an impact on emissions, then the extent of the impact on emissions reductions will be adopted as one of the assessment criteria used in the assessment of the rule throughout the project.¹⁰³
3. To assess whether the proposed reforms are likely to efficiently contribute to efforts to reduce emissions, the AEMC will use a variety of assessment techniques ranging from qualitative assessment to quantitative cost benefit analysis. The AEMC has stated that the assessment techniques will be selected depending 'on the likely impacts, complexity and nature of the proposed change.'¹⁰⁴ Previous research has shown that the AEMC tends to place greater reliance on quantitative evidence.¹⁰⁵ This will require putting an economic

¹⁰¹ [Statutes Amendment \(National Energy Laws\) \(Emissions Reduction Objectives\) Act 2023 \(South Australia\)](#).

¹⁰² AEMC, [How the national energy objectives shape our decisions](#), September 2023.

¹⁰³ AEMC, [How the national energy objectives shape our decisions](#), September 2023.

¹⁰⁴ AEMC, [How the national energy objectives shape our decisions](#), September 2023, p 16.

¹⁰⁵ See for example, P Crossley and T Matthews, [The impact of consultations with energy consumer advocates in the AEMC rule change process: A study of the outcomes of energy consumer advocates](#), Report for the Public Interest Advocacy Centre, 2015.

value on emissions reductions in light of current targets, and then ‘estimat[ing] the impact of the rule change in question [on the ability to meet emission reduction targets], in terms of the number of tonnes of greenhouse gas emissions likely to be avoided or emitted as a result of the rule change.’¹⁰⁶

4. This assessment will then guide the decision-making about whether the proposed rule change is in the long-term interests of consumers.

The Climate Change Authority has stated that the electricity sector will do much of the heavy lifting in the earlier phases of decarbonising the Australian economy.¹⁰⁷ There are 3 key reasons for this:

1. Australia’s existing fleet of coal-fired generators are now reaching retirement and need to be replaced.¹⁰⁸ This is an opportune time to transition to renewable generation sources and technologies.
2. Renewable technologies are both sufficiently technologically advanced and cost competitive to make them a viable alternative, especially given the advent of battery storage and pumped hydro storage.¹⁰⁹ The 2023–2024 CSIRO GenCost Report found that the lowest cost new build generation technologies were renewables (solar and wind + firming).¹¹⁰
3. The electricity sector has been identified as an enabler for emissions-intensive sectors that are comparatively more difficult to decarbonise such as agriculture, resources and transportation.¹¹¹

Examples of other regulatory and energy market governance developments which have incorporated decarbonisation into energy regulation include:

- The inclusion of the Climate Ministers in the Energy and Climate Change Ministerial Council to enable integrated energy and climate policies to be developed across Australia¹¹²
- The formation of the National Energy Transformation Partnership (NETP) between the Australian, state and territory governments. The NETP is designed to foster a collaborative approach across the jurisdictions to achieve the necessary reform work to transform Australia’s energy system, with the goal of it reaching net zero by 2050¹¹³

¹⁰⁶ AEMC, [How the national energy objectives shape our decisions](#), September 2023, p 16.

¹⁰⁷ Climate Change Authority, [2023 Annual Progress Report](#), October 2023, p 66.

¹⁰⁸ NEMOpen, [Energy: NEM](#), accessed March 2024

¹⁰⁹ Lazard, [Lazard’s Levelized Cost of Energy \(17th Edition\)](#), June 2024.

¹¹⁰ P Graham et al., [GenCost 2023-24](#), Final report, CSIRO, May 2024.

¹¹¹ Department of Climate Change, Energy, the Environment and Water, [Net Zero](#), 29 July 2024, accessed September 2024.

¹¹² Department of Climate Change, Energy, the Environment and Water, [Membership, Energy and Climate Change Ministerial Council](#), n.d., accessed September 2024.

¹¹³ Department of Climate Change, Energy, the Environment and Water, [National Energy Transformation Partnership](#), 12 August 2022, accessed August 2024.

- The establishment of the National Net Zero Authority¹¹⁴ and the NSW Net Zero Commission¹¹⁵
- The adoption of emissions reduction targets for NSW under the *Climate Change (Net Zero Future) Act 2023*¹¹⁶
- The adoption of 2 competitive tender schemes: the NSW Long-Term Energy Service Agreements (LTESA) Scheme, and the Australian Government's Capacity Investment Scheme (CIS). The LTESA is designed to provide revenue certainty and de-risk private investment in selected new renewable energy generation, firming, and long-duration storage projects.¹¹⁷ The CIS seeks to provide an additional 32GW of renewable and clean dispatchable capacity through the government providing revenue underwriting via an agreed floor and ceiling price, thereby lessening the risk of investment.¹¹⁸ The states have also agreed to participate in this scheme with NSW participating in the pilot project with the Australian Government in partnership with the NSW Electricity Infrastructure Roadmap.¹¹⁹

Despite the adoption of international commitments, legislated national and state-based targets, and the changes to the NEO, there remains broad concern in the energy industry that the 2030 target will not be achieved.¹²⁰ Indeed in 2023 investments in renewable energy projects declined, with the Grattan Institute reporting that financial approvals for new solar farms dropped by a third, while no new wind farm projects were financed.¹²¹ The difficulties in meeting the 2030 target have been attributed to a range of factors such as the slow transmission rollout, the cost of capital for large projects, delays in planning and environmental processes, supply chain and skills constraints, and social licence issues.¹²² These issues will need to be urgently addressed if the electricity sector is to succeed in its critical role of leading the decarbonisation of the Australian economy.

4.2 Principle 2: With the changing generation mix, the electricity sector should consider both energy and supply chain security

During the fossil-fuelled generation era the electricity sector experienced high levels of energy self-sufficiency due to Australia's rich natural endowments of black and brown coal, and natural gas. However, with the advent of the energy transition, Australia's electricity sector will no longer be self-sufficient. This is due to the reliance on the highly concentrated international markets for the

¹¹⁴ [Net Zero Economy Authority Bill 2024 \(Cth\)](#); [Net Zero Economy Authority \(Transitional Provisions\) Bill 2024 \(Cth\)](#).

¹¹⁵ NSW Climate and Energy Action, [Net Zero Commission](#), n.d., accessed September 2024.

¹¹⁶ [Climate Change \(Net Zero Future\) Act 2023 \(NSW\)](#) s.9.

¹¹⁷ EnergyCo, [Long-Term Energy Service Agreements](#), n.d., accessed September 2024.

¹¹⁸ Department of Climate Change, Energy, the Environment and Water, [Capacity Investment Scheme](#), 4 September 2024, accessed September 2024.

¹¹⁹ Department of Climate Change, Energy, the Environment and Water, [Capacity Investment Scheme](#), 4 September 2024, accessed September 2024.

¹²⁰ See for example, A Reeve, [The renewables revolution is running late](#), Grattan Institute, 17 May 2024, accessed September 2024; S Vorrath, [States need to do a lot more in the race to 82% renewables because the capacity scheme is not enough](#), *RenewEconomy*, 11 March 2024, accessed September 2024; D Mercer, [Australia will fall well short of 82 per cent renewable energy by 2030, analysts predict, as problems mount](#), *ABC News*, 6 August 2023; Clean Energy Council and Green Energy Markets, [Bridging the Gap to 82% Renewable Electricity Generation by 2030](#), August 2023.

¹²¹ A Reeve, [The renewables revolution is running late](#), Grattan Institute, 17 May 2024, accessed September 2024.

¹²² See for example, R Thomas, [The 82 per cent national renewable energy target – where did it come from and how can we get there?](#), Australian Energy Council, 17 August 2023, accessed September 2024.

manufacture of renewable technologies and the supply of critical minerals used for domestic renewable technology manufacturing. The IEA has stated that these 'high levels of market concentration, compounded by complex supply chains, increase the risks that could arise from physical disruption, trade restrictions or other developments in major producing countries.'¹²³ Indeed, this supply chain disruption manifested during the COVID-19 pandemic.¹²⁴ It also has implications for the development of future industries, with over 42% of the world's 12.7 million clean energy manufacturing jobs currently located in China.¹²⁵

There is significant market concentration found in the markets for lithium, cobalt, and the rare earth elements necessary for renewable technology and battery manufacture. Only 3 countries control more than 75% of global output of these commodities, and a recent IEA report found that in 2019 the Democratic Republic of the Congo and China accounted for 70% and 60% of global production of cobalt and rare earth elements, respectively.¹²⁶ The processing business is even more concentrated, with China refining 35% of nickel globally, 50-70% of lithium and cobalt, and nearly 90% of rare earth elements.¹²⁷ This concentration of the market flows through to manufacturing of renewable technologies, with China currently manufacturing almost 90% the world's polysilicon, which is used to make PV solar cells.¹²⁸

Recent efforts to address these concerns include agreements with strategic allies and partners to secure access to critical minerals,¹²⁹ moves to diversify raw materials and technology suppliers internationally,¹³⁰ and funding to develop domestic processing and manufacturing capabilities.¹³¹ These efforts are designed to help the sector withstand and adapt to rapidly changing conditions, including geopolitical and market disruptions.

This challenge is not unique to Australia, with many countries legislating green industrial policies to support domestic renewable energy technology manufacturing and seeking to diversify their supply chains. For example, between 2022 and 2023, the United States passed the \$USD 6 billion *Inflation Reduction Act* to develop its clean energy industry, Japan adopted its Green Transformation Strategy, India supported domestic solar manufacturing through the Indian Solar PV Incentive II and the European Union adopted their REPowerEU Plan.¹³² Given the rapid policy development in this area

¹²³ IEA, [The Role of Critical Minerals in Clean Energy Transition](#), World Energy Outlook Special Report, May 2021, p 12.

¹²⁴ John Hopkins School of Advanced International Studies, [How COVID-19 Disrupted the Renewable Energy Transition – and How the World Can Get Back on Track](#), 12 December 2022, accessed September 2024.

¹²⁵ International Labour Organization, [Renewable energy jobs hit 12.7 million globally](#), [media release], 22 September 2022, accessed September 2024.

¹²⁶ IEA, [The Role of Critical Minerals in Clean Energy Transition](#), World Energy Outlook Special Report, May 2021, p 12.

¹²⁷ IEA, [The Role of Critical Minerals in Clean Energy Transition](#), World Energy Outlook Special Report, May 2021, p 12.

¹²⁸ IEA, [Special Report on PV Global Supply Chains](#), July 2022, p 18.

¹²⁹ The White House, [Australia-United States Climate, Critical Minerals and Clean Energy Transformation Compact](#), 20 May 2023, accessed September 2024.

¹³⁰ N Moore, *Invested: Australia's Southeast Asia Economic Strategy to 2040*, Report for the Australian Government, September 2023, p 60-71.

¹³¹ NSW Government, [\\$275 million investment sparks net zero manufacturing and jobs](#), [media release], NSW Government, 26 February 2024, accessed September 2024.

¹³² See for example, [Inflation Reduction Act of 2022](#), Pub.L. No.117-169, 136 Stat. 1818 (2022); [Japan GX \(Green Transformation\) Policy 2022](#) (in Japanese); R Creemers et al., [Translation: 14th Five-Year Plan for National Informatization –](#)

internationally, the Australian clean energy industry has advocated strongly for the Australian Government to implement similar policies. The industry argued that this was needed to attract investment and domestic technology manufacturing, which was becoming harder to do in the context of the fierce international competition within the sector.¹³³

In 2024 a range of initiatives were announced in Australia. These include:

- The Australian Government's \$1 billion Solar Sunshot Program, which is designed 'to help Australia capture more of the global solar manufacturing supply chain through support, including production subsidies and grants.'¹³⁴ This program seeks to build domestic strategic manufacturing capability in clean energy technologies to take advantage of Australia's critical mineral resources. Solar Sunshot will support the parts of the supply chain that Australia can be most competitive in, relying on existing and potential comparative advantages such as access to raw materials and low-cost clean electricity supply. It will support manufacturing facilities across the PV supply chain, as well as complementary aspects of the supply chain such as solar glass.¹³⁵
- The NSW Net Zero Manufacturing Initiative. The NSW Government announced that \$275 million would be available in the first round 'to support workers, small businesses, manufacturers and innovators to take advantage of the transformation of our energy grid.'¹³⁶ In the planned second round of this initiative, government procurement will be leveraged 'to offer offtake agreements to local manufacturers of renewable products and low carbon materials.'¹³⁷ The goal of the Net Zero Manufacturing Initiative is to encourage new low emission technologies to enter the market and to build the manufacturing capabilities needed for these products.¹³⁸

4.3 Principle 3: The energy transition should be a just transition and should not disproportionately impact vulnerable consumers or communities

Energy justice is a broad concept that is used to address equity issues associated with the energy transition. It is commonly invoked in Australia to justify interventions to support vulnerable customers such as low-income energy consumers and renters, particularly around energy affordability issues; and the communities residing near, and working in, coal-based industries as they transition away from fossil fuels.

[Dec. 2021](#), DigiChina Stanford Policy Institute, January 24, 2022; Ministry of New and Renewable Energy, [Production Linked Incentive \(PLI\) Scheme: National Programme on High Efficiency Solar PV Modules](#), Government of India, n.d., accessed 20 September 2024. European Commission, [REPowerEU Plan](#), COM (2020) 230 final, 18 May 2022.

¹³³ Clean Energy Council, [Clean Energy Australia 2024](#), Report, 2024, p 22.

¹³⁴ Prime Minister of Australia, Minister for Domestic Manufacturing and Government Procurement, Minister for Energy and Climate Change, [Solar SunShot for our regions and industries to deliver a future made in Australia](#), [media release], 28 March 2024, accessed September 2024.

¹³⁵ Australian Renewable Energy Agency, [Solar Sunshot](#), n.d., accessed September 2024.

¹³⁶ NSW Government, [Net Zero Manufacturing Initiative](#), 4 September 2024, accessed September 2024.

¹³⁷ Prime Minister of Australia, Minister for Climate Change and Energy, NSW Minister for Climate Change and Energy, NSW Minister for Domestic Manufacturing and Government Procurement, [Solar Sunshot for our region](#), [media release], 28 March 2024, accessed September 2024.

¹³⁸ NSW Government, [Net Zero Manufacturing Initiative: Frequently Asked Questions](#), 12 April 2024, accessed September 2024.

Compared to Australia, energy justice has received greater prominence in energy regulation in Europe, the United States and developing nations. This is likely to be due to Australia's high levels of energy self-sufficiency within the electricity sector and historically lower electricity prices. However, the concept has been gaining increased prominence due to its close links to United Nations Sustainable Development Goal 7 'Ensure access to affordable, reliable, sustainable and modern energy for all',¹³⁹ the interrelated concept of climate justice¹⁴⁰ and the idea of a 'just' energy transition.¹⁴¹

When used in energy regulation, energy justice is used to address equity issues in energy systems, ensuring fairness in energy access, affordability, and sustainability.¹⁴² It encompasses several key tenets, primarily distributional (allocation of costs and benefits), procedural (who participates in decision-making), and recognition justice (respect for, engagement with and fair consideration of diverse cultures and perspectives),¹⁴³ and aims to ensure that energy's benefits and burdens are shared equitably across all segments of society, regardless of income, race, or other socioeconomic factors.¹⁴⁴ This concept extends to ensuring that all community members can influence energy decision-making processes that affect them, fostering inclusivity and preventing discrimination or exploitation.¹⁴⁵ In the United States, the concept of energy justice extends even further, being increasingly used by advocates and policymakers to redress historical disadvantage in racial and ethnic minority groups and other disadvantaged communities. One example is the work done by the Department of Energy's dedicated Office of Energy Justice Policy and Analysis (Box 6).¹⁴⁶

Incorporating energy justice into energy regulation involves embedding fairness and equity into policy decisions and energy governance frameworks. This can be achieved by:

- Ensuring fair distribution of energy resources so that all communities have reliable and affordable access
- Promoting procedural justice by involving diverse stakeholders and community representatives in energy planning and decision-making processes, ensuring transparency and accountability

¹³⁹ United Nations, *Transforming our world: the 2030 Agenda for Sustainable Development*, GA Res 70/1, A/Res/70/1, 21 October 2015 (adopted 25 September 2015), p 14.

¹⁴⁰ K Jenkins, *Setting energy justice apart from the crowd: Lessons from environmental and climate justice*, *Energy Research and Social Science* 2018: 39, p 117, doi: 10.1016/j.erss.2017.11.015.

¹⁴¹ Legislative Assembly Committee on Environment and Planning, *Sustainability of energy supply and resources in New South Wales*, Parliament of NSW, August 2021, p v; P Adey et al., *Just Transitions in Australia Moving Towards Low Carbon Lives Across Policy, Industry and Practice*, March 2022, p 9.

¹⁴² J Lewis et al., *Energy Efficiency as Energy Justice: Addressing Racial Inequities through Investments in People and Places*, *Energy Efficiency*, 2019:13, doi: 10.1007/s12053-019-09820-z, p 419, p 421.

¹⁴³ D McCauley et al., *Advancing energy justice: the triumvirate of tenets and systems thinking*, *International Energy Law Review*, 32(3), p 107; European Environment Agency, *Delivering Justice in Sustainability Transitions*, Briefing Note, 28 February 2024, accessed September 2024.

¹⁴⁴ D McCauley et al., *Advancing energy justice: the triumvirate of tenets and systems thinking*, *International Energy Law Review*, 32(3), 107-110.

¹⁴⁵ D McCauley et al., *Advancing energy justice: the triumvirate of tenets and systems thinking*, *International Energy Law Review*, 32(3), 107-110.; K Jenkins et al., *Energy Justice: A conceptual review*, *Energy Research and Social Science*, 2016(11), p 174-182, doi: 10.1016/j.erss.2015.10.004.

¹⁴⁶ Office of Energy Justice and Equity, United States Department of Energy, *Energy Justice Dashboard (BETA)*, 20 June 2024, accessed September 2024.

- Recognising the needs and rights of all stakeholders, particularly marginalised and vulnerable groups, to protect them from the negative impacts of energy production and consumption
- Integrating restorative measures to address past injustices by reassessing policies and systems that have perpetuated inequality.¹⁴⁷

Since 2023, there has been significant policy development aligned with the principle of energy justice in Australia (Box 4). These policies tend to target energy affordability because it directly affects economic stability, social welfare, and quality of life. Given the essential nature of electricity, regulatory frameworks aim to make energy both accessible and affordable while maintaining the sustainability and reliability of the supply.¹⁴⁸ Rising energy costs give rise to the issue of vulnerable consumers and energy poverty. This was a significant concern highlighted by the ACCC Retail Pricing Inquiry.¹⁴⁹ The AER's 2022–2023 Retail Markets Report found that energy affordability in the NEM had declined,¹⁵⁰ with NSW households spending a higher proportion of their income on electricity for the third year in a row.¹⁵¹ This problem is particularly acute for low-income households, who are now paying more than double the proportion of their annual income than average-income households.¹⁵² This has led governments at all levels to provide targeted interventions to enhance energy efficiency measures, increase support for low-income households, promote competitive energy markets, and encourage the adoption of cost-effective renewable energy technologies, particularly by disadvantaged communities.

¹⁴⁷ K Jenkins et al., [Energy Justice: A conceptual review](#), *Energy Research and Social Science*, 2016(11), p 174-182, doi: 10.1016/j.erss.2015.10.004; R J. Heffron, [Energy justice – the triumvirate of tenets revisited and revised](#), *Journal of Energy & Natural Resources Law*, 2023, 42(2), doi: 10.1080/02646811.2023.2256593, p 1.

¹⁴⁸ IEA, [Australia 2023 Energy Policy Review](#), April 2023, p 12.

¹⁴⁹ ACCC, [Restoring electricity affordability and Australia's competitive advantage: Retail Electricity Pricing Inquiry](#), Final Report, June 2018.

¹⁵⁰ AER, [Annual retail markets report 2022-2023](#), November 2023, p 46.

¹⁵¹ AER, [Annual retail markets report 2022-2023](#), November 2023, p 47.

¹⁵² AER, [Annual retail markets report 2022-2023](#), November 2023, p 47.

Box 4: Selected examples of recent Australian energy justice policy initiatives

Many of these initiatives have arisen out of partnerships between the Australian Government and states and territories under the \$100 million Community Solar Banks Program. This program seeks to develop shared community solar banks to provide solar energy to households who would otherwise struggle to install their own solar energy systems due to their status as renters, apartment dwellers and/or low-income households.¹⁵³

- The NSW and Australian Government's \$175 million scheme to provide energy saving upgrades to social housing (including both state- and community housing-managed dwellings). Many older social housing properties were built prior to minimum construction standards and as a result lack basic insulation and modern appliances. Under this scheme, 24,000 eligible homes will be able to access a range of upgrades including heat pump hot water systems, ceiling fans, reverse-cycle air conditioners, solar systems, insulation and draught proofing.¹⁵⁴ This should reduce the residents' domestic energy consumption and the associated power bills.
- The Victorian and Australian Government's \$16 million partnership to improve access to solar energy for 5,000 apartments. This program aims to provide greater access to cheap solar energy to the 65% of apartment dwellers who are renters and low-income households who may otherwise struggle to access solar. It will do this by addressing the barriers to 'installing solar panels on shared roof spaces, with multiple owners and tenants, and complex approval processes, including owners' corporation approvals.'¹⁵⁵ In recognition of the difficulties that owner's corporations of apartment complexes have in installing solar, the rebates for each apartment are double those available to freestanding homes.
- The development of the Australian Government's First Nations Clean Energy Strategy to ensure that First Nations communities can also participate in the energy transition and benefit from it.¹⁵⁶
- In NSW, the Minister for Energy has issued First Nations Consultation Guidelines¹⁵⁷ to ensure the NSW Government consults and engages closely with First Nations people and communities in implementing the Electricity Infrastructure Roadmap. The purpose of these consultations is to identify 'matters of interest and concern,'¹⁵⁸ as well as to help

¹⁵³ Australian Government, Department of Climate Change, Energy, the Environment and Water, [Community Solar Banks](#), 7 May 2024, accessed September 2024.

¹⁵⁴ Prime Minister of Australia, Premier of New South Wales, Minister for Climate Change and Energy, New South Wales Minister for Climate Change and Energy, [Over \\$200m in cost-of-living energy upgrades for over 30,000 NSW households](#), [media release], 16 January 2024, accessed September 2024.

¹⁵⁵ Solar Victoria, [Improving access to solar for apartment buildings](#), 16 February 2024, accessed September 2024.

¹⁵⁶ Department of Climate Change, Energy, the Environment and Water, [First Nations Clean Energy Strategy](#), Energy and Climate Change Ministerial Council, n.d., accessed September 2024.

¹⁵⁷ [Electricity Infrastructure Investment Act 2020 \(NSW\)](#) s4(1); NSW Climate and Energy Action, [First Nations Guidelines](#), 17 May 2024, accessed September 2024.

¹⁵⁸ EnergyCo, [First Nations Consultation Guidelines](#), n.d., accessed September 2024.

First Nations communities 'secure the economic, community and environmental opportunities'¹⁵⁹ enabled by the roadmap.

- The NSW Government provides support to disadvantaged households through the Energy Savings Scheme,¹⁶⁰ as well as other concessions, rebates, and direct bill assistance that are available to eligible households, including seniors, those with disabilities, and low-income families.¹⁶¹ These examples illustrate efforts to integrate energy justice into regulatory practices, aiming to make energy systems more equitable and inclusive.

This regulatory principle is likely to attract greater attention in the future, with nations such as Norway and the United States explicitly incorporating the regulatory principle of energy justice into their energy laws (Boxes 5 and 6).

¹⁵⁹ EnergyCo, [First Nations Consultation Guidelines](#), n.d., accessed September 2024.

¹⁶⁰ [Electricity Supply Act 1995 \(NSW\)](#) sch 4A pt 1.

¹⁶¹ NSW Climate and Energy Action, [Rebates, grants and schemes](#), n.d., accessed September 2024.

Box 5: The 'socially rational' approach in the Norwegian Energy Act 1990

The purpose of the Norwegian *Energy Act 1990* is described as:

§ 1-2. (Purpose): The Act must ensure that the production, transformation, transfer, sale, distribution and use of energy takes place in a **socially rational way**, including that consideration must be given to public and private interests that are affected. [emphasis added]

The Norwegian Energy Regulatory Authority has released guidance on how it assesses whether the power system is being carried out in a socially rational way. This means consideration of whether the development, operation, and use of electricity infrastructure and resources maximises the social welfare for Norwegian society as a whole. This guidance states that elements of a 'socially rational' power system include:

- Creating an efficient power market by counteracting cross-subsidisation between monopoly-based and competitive businesses
- Ensuring cost-effective and neutral network monopolies
- Limiting negative environmental and climate impacts
- Ensuring security of supply and delivery quality
- Ensuring connection to the grid and to the power market for all customers
- That customers must pay their share of the costs of the transmission of electrical energy.¹⁶²

Importantly, these elements must be carefully balanced to achieve market efficiency while still delivering on their key environmental and social goals. Norway's long history of significant public ownership, and the resulting very high penetration of affordable hydropower in its energy mix, has meant it has not experienced the same difficulties in transitioning its domestic electricity sector in the way that Australia is experiencing. However, the decision to keep Norway's renewable generation assets in public control also reflects a difference in approach about how to maximise social welfare. Only 1% of the Norwegian population describe themselves as experiencing energy poverty,¹⁶³ and Norwegian electricity consumption per capita has declined at double the rate of Australia since 2000.¹⁶⁴ In contrast to Norway's approach, Australia's NEL still adopts an economic rationalist approach and until recently has used a narrow interpretation of how to promote efficient investment, and what was in the long-term interests of consumers under the NEO.

¹⁶² This means that customers are required to contribute to the expenses associated with maintaining and operating the grid and other infrastructure that transmit electricity from generation facilities to their home or business, without cross-subsidisation.

¹⁶³ T Bredvold et al., [Shockingly cold and electricity-dependent in a rich context: Energy poor households in Norway](#), *Energy Research & Social Science*, Volume 91, 2022, 102745, doi:10.1016/j.erss.2022.102745.

¹⁶⁴ IEA/OECD, [Norway: Electricity Consumption per capita 2000-2022](#), n.d, accessed September 2024; IEA/OECD, [Australia: Electricity Consumption per capita 2000-2022](#), 1 April 2023, accessed September 2024.

Box 6: The Energy Justice Dashboard in the US

The Office of Energy Justice and Equity in the United States Department of Energy has developed an Energy Justice Dashboard. This pilot data visualisation tool is being used by the department to better understand whether its funding and investments are being distributed to the 'communities across the country experiencing disproportionately high and adverse economic, human health, climate-related, environmental, and other cumulative impacts.'¹⁶⁵ The department reports that these 'lower-income, Black, Brown and Indigenous communities are disproportionately impacted by polluted air and water, and vulnerable to extreme weather events,'¹⁶⁶ while also shouldering a heavier energy burden, with the 'poorest families... paying upwards of 30% of their income on energy costs.'¹⁶⁷ This tool relies on environmental indicators such as air pollution data and public health data, which are then overlaid with the energy burden indicator—a measure of how much households spend on energy bills as a proportion of their income as a key indicator of energy justice. These equity layers are being developed as data indicators to enable, over time, the department to identify targeted investments with an energy justice focus in areas such as clean energy, energy efficiency, sustainable housing, clean transportation, training and workforce development, and the remediation of pollution.

¹⁶⁵ Office of Energy Justice and Equity, United States Department of Energy, [Energy Justice Dashboard \(BETA\)](#), 20 June 2024, accessed September 2024.

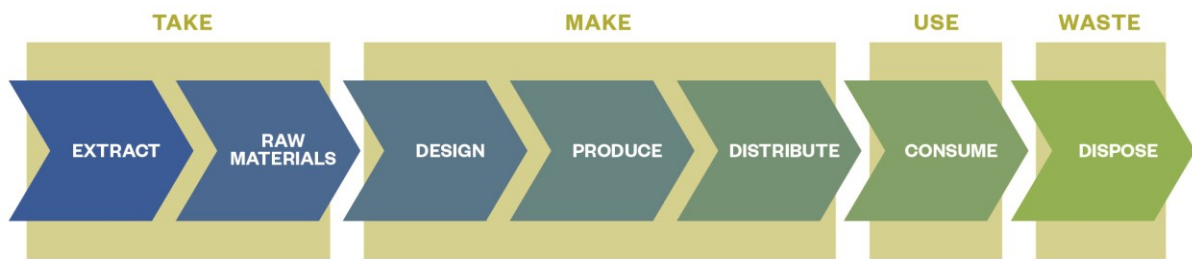
¹⁶⁶ Office of Energy Justice and Equity, United States Department of Energy, [Energy Justice Dashboard \(BETA\)](#), 20 June 2024, accessed September 2024.

¹⁶⁷ Office of Energy Justice and Equity, United States Department of Energy, [Energy Justice Dashboard \(BETA\)](#), 20 June 2024, accessed September 2024.

4.4 Principle 4: The electricity sector should increasingly adapt to the circular economy

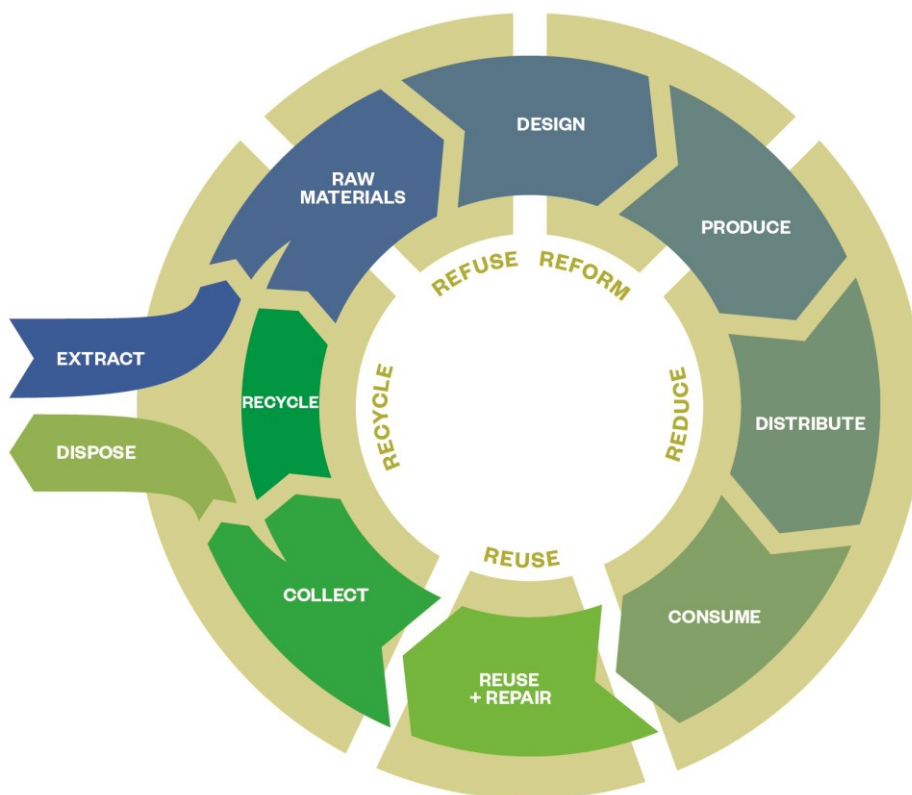
In contrast to the conventional linear economy approach of ‘take, make, use, and waste’ adopted during the first industrial revolution in developed economies (Figure 5), in a circular economy (Figure 6) products are reused, repurposed and then recycled at the end of their operational life.

Figure 5: The linear economy



Source: Author provided

Figure 6: A circular economy



Source: Author provided

While similar concepts have existed in the literature since the late 1960s,¹⁶⁸ the definition of what constitutes a circular economy remains contested in the public policy and academic literature.¹⁶⁹ This reflects the diversity of perspectives from engineering, business, public policy, and regulation grappling with the challenge that the circular economy seeks to address—how to decouple economic growth from its environmental impact. Figure 6 highlights the common areas of conceptual agreement.

While the development of a circular economy in Australia is still in its infancy, government efforts to foster a circular economy have prioritised the clean energy sector. In particular, the high market concentration in clean energy technology manufacturing and the associated supply chain risks highlight the need for a more sustainable approach to managing the critical minerals used in these technologies. Most reuse and repurposing initiatives are currently focused on old EV lithium-ion batteries and solar panels. However, there remain concerns about assurance of product quality, electrical safety, as well as consumer guarantees for these second-hand products. Where a technology cannot be reused or repurposed into a secondary product, such as an EV battery becoming a stationary battery storage system, some jurisdictions have begun to include minimum recycled content requirements (Box 7). For these initiatives to be successful, financial incentives need to be properly structured to avoid creating an incentive for a consumer to retire an operational energy technology prematurely, thereby creating more waste to be managed.

¹⁶⁸ A Alexander, Introduction, in A Alexander et al. (eds), *Handbook of the Circular Economy – Transitions and Transformations*, De Gruyter, 2023, p 19.

¹⁶⁹ See for example, A Alexander, Introduction, in A Alexander et al. (eds), *Handbook of the Circular Economy – Transitions and Transformations*, De Gruyter, 2023, p 20-21.

Box 7: The new European Batteries Regulation

In March 2020, the European Commission adopted its second Circular Economy Action Plan as a cornerstone of the European Green Deal.¹⁷⁰ The European Green Deal is a region-wide growth strategy that seeks to transform the ‘...Union into a fair and prosperous society, with a modern, resource-efficient and competitive economy where there are no net greenhouse gas emissions in 2050 and where economic growth is decoupled from resource use.’¹⁷¹

The plan identifies 35 actions which are being implemented by the European Commission. These actions include a new regulation on green claims, common rules on the right to repair, a new circular economy monitoring framework, and new rules on eco-design. The first initiative adopted was to create a harmonised regulatory framework to make batteries more sustainable, circular, and safe throughout their lifecycle. Batteries were selected due to predictions that global demand for batteries would increase 14-fold over the decade to 2030 to support the energy transition, and that the EU would account for more than 17% of that demand.¹⁷²

The Batteries Regulation was adopted by the European Parliament and Council on 12 July 2023 and applies to all batteries which enter Europe. The Batteries Regulation sets out rules and clear targets on ‘...the sustainability, performance, safety, collection, recycling and second life of batteries as well as on information about batteries for end-users and economic operators.’¹⁷³ Some of the measures adopted include:

- Extended producer responsibility, with all waste batteries to be collected free of charge regardless of the nature, chemical composition, condition, brand, or origin of the battery in question
- A ban on battery waste going to landfill
- Compulsory resource recovery requirements for raw materials undergoing recycling
- Compulsory minimum recycled content requirements for all new industrial batteries larger than 2kWh of 6% per cent for lithium and nickel, 16% for cobalt and 85% for lead.

This strategy means that batteries are less likely to be dumped at the end of their life and that critical minerals contained within them are more likely to be recovered. This program is

¹⁷⁰ European Commission, [Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and The Committee of the Regions: A new Circular Economy Action Plan For a cleaner and more competitive Europe \(2020\)](#), COM/2020/98 final.

¹⁷¹ European Parliament resolution of 15 January 2020 on [the European Green Deal](#), (2019/2956(RSP)). See also, European Commission, [Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and The Committee of the Regions: The European Green Deal, Brussels, \(11December 2019\)](#), COM(2019) 640 final.

¹⁷² [Regulation \(EU\) 2023/1542](#) of the European Parliament and of the Council of 12 July 2023 concerning batteries and waste batteries.

¹⁷³ [Regulation \(EU\) 2023/1542](#) of the European Parliament and of the Council of 12 July 2023 concerning batteries and waste batteries.

designed to both address the EU's supply chain issues and to help scale the battery recycling and solar recycling markets into viable companies.

Proponents of the transition to a circular economy claim that incorporating circular economy principles into energy regulation not only enhances the sustainability of the energy sector but also helps create an economic system that is restorative and regenerative by design.¹⁷⁴ This approach can reduce environmental impacts such as carbon dioxide emissions, lower costs in the long-term, and drive economic growth, job creation and technological innovation.¹⁷⁵ A 2020 report commissioned by the CSIRO estimated that introducing a circular economy to the food, transportation and built environment sectors would bring benefits to Australia to the value of \$210 billion with an additional 17,000 full time equivalent jobs by 2047–48.¹⁷⁶

However, other analyses have critiqued the claimed benefits of a circular economy citing challenges with practical implementation, system governance, environmental labelling and greenwashing, and a poor understanding of the system boundary limits.¹⁷⁷ An example of the implementation challenges was highlighted by a recent study of more than 10,000 European small and medium-sized firms.¹⁷⁸ This study found that conflicting and complex regulations, and the associated administrative and financial burdens imposed on businesses posed the most significant barrier to the eco-innovations required across the product lifecycle to support a circular economy.¹⁷⁹ Other research has argued that due to the disproportionate research and policy emphasis on the production side of circular business models, it is poorly understood how consumption and consumers would affect or be affected by the circular economy.¹⁸⁰

Despite these concerns, the requirement that industry and society transition to a circular economy has been widely adopted in legislation and policy internationally, including by the European Union,¹⁸¹

¹⁷⁴ M den Hollander et al., [Product Design in a Circular Economy: Development of a Typology of Key Concepts and Terms](#), *Journal of Industrial Ecology*, 2017, Vol 21, 517-8, doi: [10.1111/jiec.12610](#)

¹⁷⁵ Ellen MacArthur Foundation, [Towards the circular economy: an economic and business rationale for an accelerated transition](#), 2013, Vol 1, 1-98.

¹⁷⁶ KPMG Economics, [Potential economic pay-off of a circular economy](#), Report commissioned by the CSIRO, 28 April 2020, p 2.

¹⁷⁷ See for example, H Corvellac, [Critiques of the circular economy](#), *Journal of Industrial Ecology*, 2022, Vol 26, p 421, p 424. Doi: [10.1111/jiec.13187](#).

¹⁷⁸ J García-Quevedo, et al., [Barriers to the circular economy in European small and medium-sized firms](#), *Business Strategy and the Environment*, 2020, Vol 29, 2453-4.

¹⁷⁹ J García-Quevedo, et al., [Barriers to the circular economy in European small and medium-sized firms](#), *Business Strategy and the Environment*, 2020, Vol 29, 2453-4.

¹⁸⁰ J Camacho-Otero, et al., [Consumption in the Circular Economy: A Literature Review](#), *Sustainability*, 2018, Vol 10, 2758, 1. Doi: [10.3390/su10082758](#).

¹⁸¹ European Commission, [Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and The Committee of the Regions: A new Circular Economy Action Plan For a cleaner and more competitive Europe \(2020\)](#), COM/2020/98 final.

China,¹⁸² the United States,¹⁸³ Japan,¹⁸⁴ the G7¹⁸⁵ and the World Economic Forum.¹⁸⁶ Equally, Environment Ministers in all Australian jurisdictions have 'agreed to work with the private sector to design out waste and pollution, keep materials in use and foster markets to achieve a circular economy by 2030.'¹⁸⁷ This has led to the establishment of a national Circular Economy Ministerial Advisory Group,¹⁸⁸ the development of state-based circular economy strategies,¹⁸⁹ and circular economy laws in the ACT,¹⁹⁰ Victoria¹⁹¹ and NSW.¹⁹² These developments underscore the strong legislative commitment, both internationally and across Australia, to the adoption of economy-wide circular economy principles.

Examples of regulatory and policy interventions within the energy sector to support a circular economy include:

- Encouraging the transition from fossil fuel to renewable sources of power generation to decarbonise production and enhance sustainability. For example, in 2008 the Chinese Government established a whole of government approach to the strategic design, adoption and reporting on the implementation of a circular economy when it enacted the Circular Economy Promotion Law. Article 17 of the law includes a mandate '...to establish and improve a standard system for circular economy, and improve standards on energy, water and material conservation, waste recycling and resource recovery.'¹⁹³ Article 23 states that where possible all new buildings and structures 'shall make full use of renewable energy resources such as solar energy, geothermal energy and wind energy'¹⁹⁴
- The development of biomass/biogas production from landfill¹⁹⁵
- Extended producer responsibility or mandatory product stewardship being imposed on manufacturers to encourage eco-design, extended product lifespans, and enhanced recyclability¹⁹⁶

¹⁸² [Circular Economy Promotion Law of the People's Republic of China](#), 2008, Art 23.

¹⁸³ President Biden, [Executive Order on Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability](#), 8 December 2021, accessed September 2024.

¹⁸⁴ Ministry of Economy, Trade and Industry, Japan, [Growth-Oriented, Resource-Autonomous Circular Economy Strategy](#), March 2023, (in Japanese).

¹⁸⁵ G7 Ministers, Circular Economy and Resource Efficiency Principles (CEREP), [A Communiqué Annex, G7 Minister's Meeting on Climate, Energy and Environment](#), April 2023.

¹⁸⁶ See for example, World Economic Forum, [Circular Economy](#), n.d., accessed September 2024.

¹⁸⁷ Department of Climate Change, Energy, the Environment and Water, [Transitioning to a more circular economy](#), 29 August 2024, accessed September 2024.

¹⁸⁸ Department of Climate Change, Energy, the Environment and Water, [Circular Economy Ministerial Advisory Group](#), 29 August 2024, accessed September 2024.

¹⁸⁹ See for example, NSW Government, [NSW Circular Economy Policy Statement: Too Good to Waste](#), February 2019.

¹⁹⁰ [Circular Economy Act 2023 \(ACT\)](#).

¹⁹¹ [Circular Economy \(Waste Reduction and Recycling\) Act 2021 \(Victoria\)](#).

¹⁹² [Plastic Reduction and Circular Economy Act 2021 \(NSW\)](#).

¹⁹³ [Circular Economy Promotion Law of the People's Republic of China](#), 2008, Art 17.

¹⁹⁴ [Circular Economy Promotion Law of the People's Republic of China](#), 2008, Art 23.

¹⁹⁵ Department of Planning, Industry and Environment, [NSW Waste and Sustainable Materials Strategy 2041, Stage 1: 2021–2027](#), June 2021.

¹⁹⁶ [Regulation \(EU\) 2023/1542](#) of the European Parliament and of the Council of 12 July 2023 concerning batteries and waste batteries.

- Adopting a minimum recycled content requirement for batteries and PV solar panels¹⁹⁷
- E-waste bans which capture renewable technologies¹⁹⁸
- Older energy infrastructure, such as decommissioned power plants or underutilised grid components, can be also repurposed for new energy technologies. For instance, the sites of former coal-fired plants can be converted into green hydrogen or renewable energy hubs or storage facilities. Regulation could support this through streamlined permitting processes and financial incentives that lower the cost and complexity of converting existing sites.

4.5 Principle 5: The electricity sector should become more resilient to the changing climate and the increased risk of natural disasters

Australia is one of the most vulnerable countries in the world to the impacts of global warming and climate change.¹⁹⁹ From increased frequency and severity of bushfires and droughts to repeated instances of catastrophic flooding, extreme weather events and emergencies are materially affecting the organisation and provision of electricity both during their occurrence, and throughout recovery processes.

In 1998, when the NEM was first established, emergency system planning consisted of AEMO preparing a Summer Readiness Plan. This process saw AEMO collaborate with generation and transmission network providers, and the Australian, state and territory governments to actively manage heightened risks to power system operations of distinct, individual emergencies.²⁰⁰ Historically, when a bushfire affected the electricity sector, the focus was on ensuring supply and frequency support. The ability to turn off or isolate the power networks quickly was also important. These decisions were often difficult, as a source of power was needed to operate water pumps and emergency communication networks.

However, following the Black Saturday bushfires in 2009, evidence was tendered before the Bushfire Royal Commission that a third of the fires and 159 of the 173 deaths were associated with aged electricity infrastructure and not shutting down the network fast enough.²⁰¹ Several class action lawsuits eventuated, and many, including the Kilmore East Kinglake and Murrindindi class action lawsuits, were against SPI Electricity, trading as SP AusNet, and its contractor, Utility Services Corporation Limited.²⁰² These lawsuits, which were subsequently settled for almost \$700 million, directly sought to attribute fault to these companies for breaching their duty of care by failing to appropriately maintain the power line which caused the fires.²⁰³ These lawsuits fundamentally shifted the understanding within the sector that the electricity sector may be a significant contributing factor to the damage caused by bushfires, rather than a mere injured party.

¹⁹⁷ [Directive 2012/19/EU](#) of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE) (recast).

¹⁹⁸ See for example, [Circular Economy \(Waste Reduction and Recycling\) Act 2021 \(Victoria\)](#).

¹⁹⁹ Climate Change Authority, [2023 Annual Progress Report](#), Australian Government, October 2023, p 2.

²⁰⁰ See for example, AEMO, [Summer 2021-22 Readiness Plan](#), Report, December 2021.

²⁰¹ B Teague, et al., [2009 Victorian Bushfires Royal Commission](#), Final Report, July 2010.

²⁰² *Matthews v Ausnet Electricity Services & Ors* [2014] VSC 663; *Rowe v AusNet Electricity Services* [2015] VSC 232.

²⁰³ Supreme Court of Victoria, [Court approves distribution of almost \\$700 million to victims of the 2009 Black Saturday disaster](#), 7 December 2016, accessed September 2024.

Three of Australia's hottest summers on record have occurred since 2018.²⁰⁴ With climate change, El Nino/La Nina and Southern Oscillation events have become more prominent across Australia bringing with them associated climate characteristics (drought/bushfire or torrential rain/floods).²⁰⁵ These events are becoming more frequent, more significant in scale and more severe. The 2019–2020 bushfires involved 11,744 fires in NSW alone,²⁰⁶ with more than 24 million hectares of land burnt across Australia resulting in more than \$10 billion of damage (Box 8).²⁰⁷ It is also growing increasingly difficult to isolate individual events, with a shift towards longer series of cascading events, which blur into each other temporally, geographically, and causally.²⁰⁸ Transmission and distribution infrastructure losses have grown significantly, with Essential Energy alone losing 3,200 poles during the 2019–2020 bushfires, up eightfold from the previous record of only 400 poles lost.²⁰⁹ In addition to the transmission and distribution infrastructure losses, this also creates forecasting challenges as fire, ash, smoke and haze impact transmission networks and solar output.²¹⁰

²⁰⁴ Bureau of Meteorology, [Bureau of Meteorology's 2024 Autumn Long-Range Forecast](#), 29 February 2024, accessed 20 June 2024.

²⁰⁵ W Cai and A Santoso, [New study helps solve a 30-year-old puzzle: how is climate change affecting El Nino and La Nina?](#), CSIRO, 19 May 2023, accessed September 2024.

²⁰⁶ NSW Environment Protection Authority, [NSW State of Environment: Fire](#), 2021, accessed September 2024.

²⁰⁷ M Binskin et al., [Royal Commission into National Natural Disaster Arrangements](#), Report, 28 October 2020, p 5.

²⁰⁸ F Vahedifard and A AghaKouchak, [The risk of "cascading" natural disasters is on the rise](#), *The Conversation*, 22 October 2018, accessed September 2024.

²⁰⁹ Essential Energy, [Essential Energy response to the NSW Independent Bushfire Inquiry](#), April 2020, p 10.

²¹⁰ AEMO, [2019-20 summer highlights need for enhanced energy system resilience](#), 22 June 2020, accessed September 2024.

Box 8: Lessons learnt from the 2019–2020 bushfire season

To ensure a reliable and continuous energy supply that can survive a changing climate, the increased risk of bushfires and other natural disasters, the Energy Ministers amended the NER to introduce a category of 'indistinct events' to help manage risk and strengthen operational resilience. Indistinct events are 'events on the power system for which it is not possible or reasonable to identify the associated threats to the specific power system elements because the threat is so broad or extreme and/or the specific assets likely to be affected because the broad nature of the threats means there are a large number of possible outcomes.'²¹¹ This rule change has impacted revenue forecasting, revenue determinations, revenue recovery on an actual cost basis, and governance and provided the market operator with greater flexibility.²¹²

New rules were also introduced for assessing resilience funding, with the AER stating:

We will have regard to the following factors when assessing any funding for network resilience:

- future network needs may not be the same as they are today
- there is uncertainty as to what the future network needs are
- there is also uncertainty from other related areas like changes in demand and energy mix as well as technological advances
- consumer and community preferences will be very important in our consideration.²¹³

The AER also explicitly recognised that the assessment of the benefits and future costs could be subject to greater margins for error (up and down) than normal because the impact of climate change is not static, and it is expected to grow over time. This may increase the value of flexibility and scaling in the responses to resilience.

Reforms were also made to support the deployment of standalone power systems. The rationale behind this package of rule changes was to enable the distribution networks to supply customers using standalone power systems when it is cheaper than maintaining a connection to the grid. It also meant that eligible customers, who tended to be in more remote areas, could unlock the benefits of solar and storage technologies, receive their electricity services at lower cost, and also benefit from improved reliability and reduced bushfire risks. Importantly for these customers, this package of rule changes also enabled them to access off-grid energy from their distribution network, without losing their consumer protections, retail deals, and reliability standard.²¹⁴

²¹¹ AEMC, [National Electricity Amendment \(Enhancing Operational Resilience in Relation to Indistinct Events\) Rule](#), Final Rule Determination, 2022, p 1; AEMC, [National Electricity Rules, Version 209](#), 2024, ch 10.

²¹² AER, [Network resilience - A note on key issues](#), April 2022, p 9.

²¹³ AER, [Network resilience - A note on key issues](#), April 2022, p 9.

²¹⁴ AEMC, [National Electricity Amendment \(Stand Alone Power Systems\) Rule 2022](#); AEMC, [National Electricity Rules, Version 209, 2024](#), Rule 11.147.

5. Applying the modern energy regulatory principles to current energy issues

This section applies the guiding principles for modern energy regulation to 2 case studies that examine potential mandates for recycling of all end of life solar panels and direct state government investment in renewable energy generation. This section explores how the principles could be used to guide the development of optimal regulatory responses to these challenges.

5.1 Should NSW mandate that solar panels be recycled?

Renewable energy laws such as the *Renewable Energy (Electricity) Act 2000* (Cth) and the *Electricity Supply Amendment (Solar Bonus Scheme) Act 2009* (NSW) have accelerated the adoption of clean energy technologies. Australia is now world-leading in its uptake of rooftop solar, installing new solar panels at 10 times the global average rate.²¹⁵ Over the last 20 years, this has resulted in almost a million small-scale solar systems being installed on homes and small businesses across NSW.²¹⁶ In the same period, the average size of the installations increased almost 10-fold from under 1kW in the early 2000s to 9.7kW in December 2023.²¹⁷ It is now estimated that one in 3 NSW homes and small businesses has a rooftop solar system.²¹⁸

The average life span of an Australian solar system ranges between 10–15 years for the earliest models, to up to an anticipated 25–30 years for newer systems. However, research suggests that many households are retiring their systems before their predicted end of life to install a larger system to better meet their energy needs, install a battery storage system, or to replace damaged or defective panels.²¹⁹

Currently, more than 90% of small-scale solar systems go to landfill when they are retired or reach end of life.²²⁰ Figure 7 shows the scale of the predicted solar waste problem in NSW through to 2035.

²¹⁵ A Blakers, et al. [Pathway to 100% Renewable Electricity](#), *IEEE Journal of Photovoltaics*, 2019, 9(6), doi: 10.1109/JPHOTOV.2019.2938882.

²¹⁶ Clean Energy Regulator, [Small-scale installation postcode data](#), 16 May 2024, accessed May 2024.

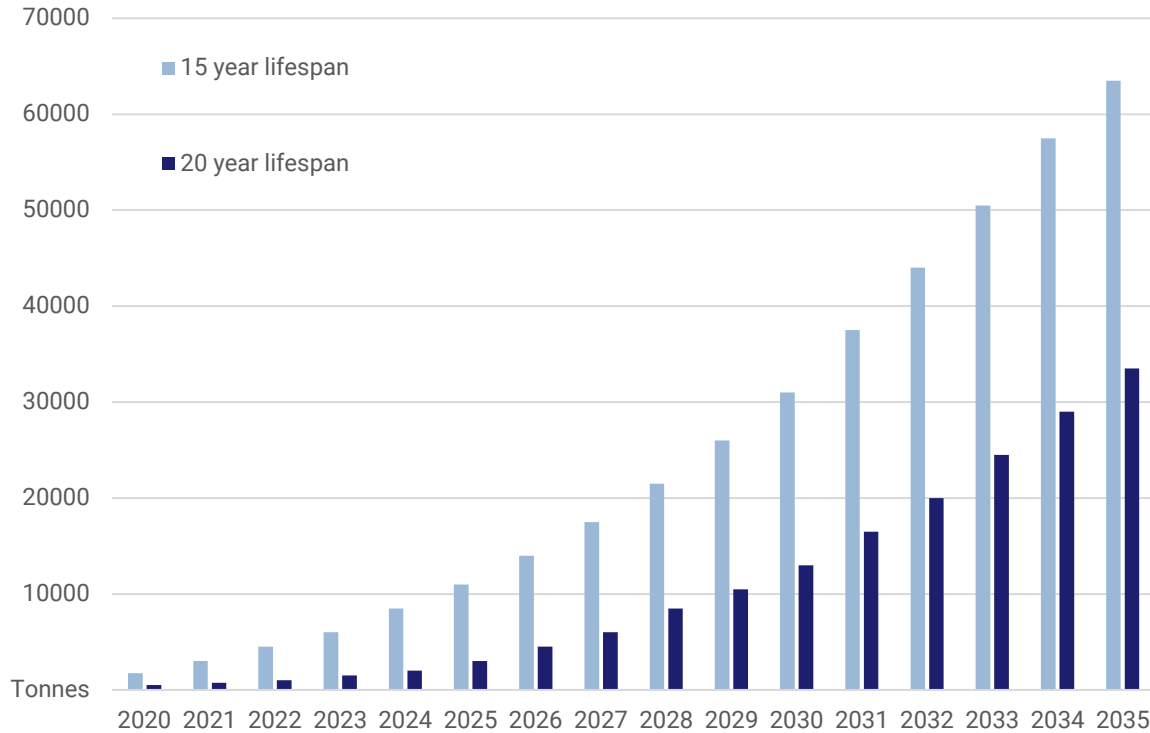
²¹⁷ Australian Photovoltaic Institute, [Monthly Installations by Size](#), n.d., accessed May 2024.

²¹⁸ NSW Climate and Energy Action, [Second Life Solar](#), 28 March 2024, accessed September 2024.

²¹⁹ R Deng et al. [Scoping Study: Solar Panel End-of-life Management in Australia](#), *Australian Centre for Advanced Photovoltaics*, March 2024, p 4.

²²⁰ E Terzon. [Australia's solar industry is booming, but so is the amount of valuable waste going to landfill](#), *ABC News*, 23 July 2019, accessed September 2024. Note the this is unlikely to occur in the context of commercial solar farms which are required to have a decommissioning plan from the outset as part of their Environmental Impact Assessment.

Figure 7: Estimated waste volumes for all end-of-life PV panels (tonnes)



Source: N Florin, et al., [Scoping study for solar panels and battery system reuse and recycling in NSW](#), Commissioned report for the NSW Department of Planning, Industry and Environment, February 2020, p 12.

Improperly handled solar waste poses a serious risk to the environment and human health, with older panels containing cadmium and lead which cause cancer and neurological and cardiovascular problems.²²¹ Solar waste also contains critical minerals such as indium, gallium, germanium, ruthenium, and tellurium that are essential to the manufacture of advanced technologies. These critical minerals, which are predominantly found in China, have been identified by the Australian Government as creating future security of supply issues.²²²

Addressing the challenge of solar waste has been listed as a key environmental priority for the Australian Government for the past 9 years.²²³ There are several reasons for this:

- The focus of Australian renewable energy laws and regulations has been on accelerating solar deployment. To date these laws have not incorporated circular economy principles. This means that while the sources of renewable energy sources have to be ecologically

²²¹ D Cloughton, [Solar panel farms growth raises more questions over potential for heavy metals to leak into soil](#), ABC News, 17 Jan 2022, accessed September 2024.

²²² J Wilson, [Strategies for Securing Critical Material Value Chains](#), Perth USAsia Centre, University of Western Australia, 2020.

²²³ Australian Government, Department of Climate Change, Energy, the Environment and Water, [Minister's Priority List 2022-23](#), 24 November 2023, accessed September 2024.

sustainable, there is no equivalent requirement imposed on the associated technologies used throughout their lifecycle.

- Due to this being an emerging problem, there is a lack of facilities to support the second life of retired solar panels at scale (whether it be reuse, refurbish/repair, repurpose, recycle),²²⁴ and unknown levels of consumer acceptance for the associated secondary products.
- The costs associated with recycling a solar panel are higher than those for sending it to landfill.²²⁵
- There is a historical failure of voluntary product stewardship schemes within the solar sector.²²⁶

Recently, there have been several efforts to address this challenge. Victoria,²²⁷ and South Australia²²⁸ have banned the disposal of solar panels in landfill. The Queensland Government has announced plans to ban solar waste in the next 5–10 years and is currently trialling a voluntary product stewardship scheme.²²⁹ Western Australia has also signalled that solar panels are likely to be banned from landfill in future iterations of their waste regulations.²³⁰ These landfill bans have typically taken the form of bans on all e-waste (often described as ‘anything with a plug, battery or power cord that is no longer wanted or useful’).²³¹ The rationale behind these bans is that e-waste is a major source of hazardous waste entering landfill, e-waste such as battery storage systems often contain valuable critical minerals, and when improperly handled, e-waste has been linked to a growing number of safety incidents.

Many of the modern energy regulatory principles, such as supporting the creation of a circular economy and improving the sustainability of solar panels throughout their lifecycle, support the development of solar recycling. In addition to these justifications, there are further concerns that almost 99% of Australia’s solar panels come from China,²³² as does over 80% of the world’s high grade polysilicon supply.²³³ Mandatory solar recycling could provide diversified sources of raw material inputs for domestic solar manufacturing through recycled content to reduce the risk of supply chain constraints.

²²⁴ The NSW government has sought to address this issue by supporting the development of technical and economic opportunities for a circular solar economy, for example through the [NSW Environment Protection Authority’s Circular Solar Grants Program](#).

²²⁵ Author calculation based on data from Ecogeneration, [Save our solar ... the narrow road to economic PV recycling](#), 21 July 2020.

²²⁶ S Vorrath, [Industry “frustrated” as Ley sets deadline for national solar recycling scheme](#), *RenewEconomy*, 23 June 2021, accessed September 2024.

²²⁷ Victorian Government, [Waste Management Policy \(E-waste\)](#), Victorian Government Gazette, No. G26, 28 June 2018.

²²⁸ South Australian Government, [Environment Protection \(Waste to Resources\) Policy 2010](#), under the Environment Protection Act 1993.

²²⁹ L Korycki, [QLD plan to ban solar panels from landfill](#), *Waste Management Review*, 6 May 2023, accessed September 2024.

²³⁰ Government of Western Australia, [E-waste to landfill ban in Western Australia – Decision regulatory impact statement](#), October 2023, p 25.

²³¹ Clean Energy Council, [What You Need To Know For The Victoria E-Waste Ban](#), 28 June 2019, accessed September 2024.

²³² M Foley, [Australia invented solar panels. Now 99 per cent of ours come from China](#), *The Sydney Morning Herald*, 29 March 2024, accessed September 2024.

²³³ IEA, [Solar PV Global Supply Chains: An IEA Special Report](#), June 2022.

The problem of solar waste highlights some of the challenges associated with the modern regulatory principles (Box 9). For example, for the circular economy to work, someone must want to use the recycled outputs recovered from solar panels. Equally, consumers must pay more for greater supply chain security and improved sustainability over the product life cycle.

The European Union has mitigated the issues associated with the lack of market scale for recycled outputs through their actions as a 'market maker.' It has done this by mandating content requirements of a specified percentage of recycled raw materials in some new electronic products such as batteries.²³⁴ This approach, together with the significantly larger European market, has helped to address many of the challenges being faced within the Australian solar recycling sector.

While the NSW Government has funded some technical and economic feasibility studies to support the development of a circular solar economy, to date solar waste is not banned from landfill. With the Australian Environment Ministers agreeing to introduce a circular economy by 2030,²³⁵ and the continued national focus on the ever-increasing problem of solar waste, the NSW Government is likely to come under growing pressure to stimulate the development of a circular economy within the solar sector in the form of mandated solar recycling.

²³⁴ [Regulation \(EU\) 2023/1542](#) of the European Parliament and of the Council of 12 July 2023 concerning batteries and waste batteries, Art 8(2).

²³⁵ Department of Climate Change, Energy, the Environment and Water, [Transitioning to a more circular economy](#), 2 June 2023.

Box 9: The Victorian approach to solar waste

In 2019, the Victorian e-waste landfill ban came into force.²³⁶ It was hoped that this ban would provide sufficient scale to the Victorian solar recycling market to make it commercially viable. The financial viability of solar recycling is closely linked to the size of the market, the quality of the outputs of the recycling process, and having a willing purchaser for those recycled outputs. Due to the low levels of solar panels recycled to date and the difficulties associated with producing high grade recycled outputs, financial viability remains problematic. In 2023, one of the largest Victorian solar recycling businesses, Reclaim PV, went into insolvency citing ‘the pressure of years spent developing a recycling methodology in-house on a low budget, coupled with initiating manufacturer networks, establishing collection channels, and pitching for investors.’²³⁷ Further, there have been reports that most of the Australian solar recyclers are yet to move into processing, leading to retired solar panels being stockpiled.²³⁸

While some Australian solar recyclers claim that they can now technically recycle almost 100% of a PV solar panel,²³⁹ currently only about 17% of the materials by weight in a solar panel (largely the aluminium frame and the plastic junction box) are typically recycled by most Australian recyclers.²⁴⁰ The significant proportion of high-grade polysilicon in the glass is particularly labour intensive, technology intensive and costly to recycle, with no Australian recycler currently recovering this product.²⁴¹ In 2022, in an attempt to address stockpiling and support enhanced recovery from solar recycling, the Victorian Government announced a \$10 million ‘solar waste challenge’ via the state startup fund, Breakthrough Victoria, to invest in innovative solutions to reduce solar waste.²⁴² However, despite several applications from solar recyclers to date no funding had been approved by April 2024.²⁴³

5.2 Should the NSW Government own a majority stake in renewable generation?

The initial design of the NEM was premised on the privatisation of formerly state-owned electricity assets to open up the electricity sector to competition, improve the efficiency of the sector and support cross-border trade. However, as highlighted earlier (see [section 3.5](#)), significant public

²³⁶ Victorian Government, [Waste Management Policy \(E-waste\)](#), Victorian Government Gazette, No. G26, 28 June 2018.

²³⁷ B Peacock, [Australia’s most recognisable solar recycler handed windup notice by Victorian court](#), *PV Magazine Australia*, 15 September 2023, accessed September 2024.

²³⁸ B Peacock, [Australia’s most recognisable solar recycler handed windup notice by Victorian court](#), *PV Magazine Australia*, 15 September 2023, accessed September 2024. See also J Millbank, [Recycling Solar](#), *Renew Magazine*, 19 November 2019, accessed September 2024.

²³⁹ K Rooney, [Tonnes and tonnes of old solar panels with nowhere to go](#), *The Sydney Morning Herald*, 14 April 2024, accessed September 2024.

²⁴⁰ Sustainability Victoria, [National approach to manage solar panel, inverter and battery life cycles](#), 1 August 2023, accessed September 2024.

²⁴¹ Sustainability Victoria, [National approach to manage solar panel, inverter and battery life cycles](#), 1 August 2023, accessed September 2024.

²⁴² K Rooney, [Tonnes and tonnes of old solar panels with nowhere to go](#), *The Sydney Morning Herald*, 14 April 2024, accessed September 2024.

²⁴³ K Rooney, [Tonnes and tonnes of old solar panels with nowhere to go](#), *The Sydney Morning Herald*, 14 April 2024, accessed September 2024.

ownership remains within some NEM jurisdictions. In recent years, this trend has become particularly evident when it comes to the ownership of the renewable generation assets and energy storage assets that will be critical for the energy transition. For example:

- The Tasmanian Government has always held a significant stake in the state's renewable generation and energy storage capacity by virtue of its 100% ownership of Hydro Tasmania.²⁴⁴ Indeed in 2022 Tasmania met its target of 100% self-sufficiency in renewable electricity generation.²⁴⁵
- In 2024 the Queensland Parliament passed the *Energy (Renewable Transformation and Jobs) Act 2024* which mandated that more than 54% of all new generation assets, and all transmission and distribution assets, and 'deep storage assets,' are to be publicly owned by 2035.²⁴⁶ Importantly, public ownership is defined to include Australian, state and local government ownership.²⁴⁷
- In 2023 the Victorian Government announced plans to amend the state constitution to enshrine the State Electricity Commission into the Constitution and enable it to own and operate renewable generation assets.²⁴⁸ The Victorian Government has publicly stated that it plans for the State Electricity Commission to hold a portfolio of renewable generation assets in Victoria for the long term.²⁴⁹ As at 1 October 2024 this Bill had passed the Victorian Legislative Assembly, was amended by the Victorian Legislative Council, and the Assembly will consider the amendments made by the Council.²⁵⁰

NSW has investments in critical electricity infrastructure but does not currently have a significant stake in renewable generation assets.²⁵¹

5.2.1 Benefits of the public ownership of renewable generation assets

Proponents of public ownership of renewable generation assets argue that such an approach is necessary to enable the state to provide a strategic and coordinated approach to the energy transition.²⁵² This was a central argument run in Queensland during their debates on the *Energy (Renewable Transformation and Jobs) Act 2024*, with the Queensland Energy Minister stating that public ownership would give the state 'unprecedented control to guide the transformation'²⁵³ of the

²⁴⁴ Hydro Tasmania, [Our Governance](#), n.d., accessed September 2024.

²⁴⁵ Tasmanian Government Department of State Growth, [Renewable Energy Action Plan](#), December 2020.

²⁴⁶ [Energy \(Renewable Transformation and Jobs\) Act 2024 \(Qld\)](#) pt 3.

²⁴⁷ [Energy \(Renewable Transformation and Jobs\) Act 2024 \(Qld\)](#) cl 13(3).

²⁴⁸ [Constitution Amendment \(SEC\) Bill 2023 \(Vic\)](#) cl 1.

²⁴⁹ D Caroll, [Victoria to target 95% renewable energy by 2035](#), *PV Magazine Australia*, 20 October 2022.

²⁵⁰ [Victorian Government, Constitution Amendment \(SEC\) Bill 2023](#), (Current status, 1 October 2024).

²⁵¹ See Figure 3 for NSW government ownership of transmission assets. Note that NSW also plays a significant role in underwriting other infrastructure investments under the *Electricity Infrastructure Investment Act 2020* including through the provision of Long-Term Energy Service Agreements.

²⁵² B Steffen et al., [State Ownership and Technology Adoption: The Case of Electricity Utilities and Renewable Energy](#), *Research Policy*, 2022, 51(6), 104534, doi: 10.1016/j.respol.2022.104534.

²⁵³ P Hannam, [Public Ownership of power assets key to smooth shift to renewables, Queensland energy minister says](#), *The Guardian*, 17 October 2022.

energy system and make the system more secure and reliable.²⁵⁴ The Victorian Government has argued that public ownership would ensure faster investment within the renewable energy sector,²⁵⁵ allowing new large-scale generation, transmission and storage infrastructure to be built, potentially ahead of ordinary market signals.²⁵⁶ This could mean that the state climate and decarbonisation targets are met more rapidly than they would be with a purely market-driven approach, as well as providing the investment signals and security to encourage private sector investment.²⁵⁷ This could ease coordination issues and allow for the orderly phase-out of fossil fuel generation, while also ensuring a more just, transparent and democratic process.²⁵⁸

There is also evidence that public ownership of renewable generation will make power more affordable²⁵⁹ because under a public ownership model 'any financial surplus is either reinvested to improve the service or used to reduce energy prices.'²⁶⁰ In contrast, under a private ownership model, some analysts have argued that investment in renewables is impeded as investors are concerned 'by low and volatile financial returns.'²⁶¹ Another benefit of public ownership is that it can be used to provide targeted support for those coal regions transitioning their local economies and skills, with the Queensland Minister arguing that a publicly owned energy system will protect 'tens of thousands of jobs in existing industries already vulnerable to carbon emissions.'²⁶²

When considered in the context of national policies such as the *Future Made in Australia Bill 2024* (Cth),²⁶³ state government ownership of renewable generation assets could also be used to strengthen the security of supply chains by supporting domestic manufacturing of critical renewable technologies.

²⁵⁴ P Hannam, [Public Ownership of power assets key to smooth shift to renewables, Queensland energy minister says](#), *The Guardian*, 17 October 2022.

²⁵⁵ Premier of Victoria, [Bringing Back Public Power with Leading Energy Experts](#), [media release], 7 February 2023, accessed September 2024.

²⁵⁶ P Hannam, [Public Ownership of power assets key to smooth shift to renewables, Queensland energy minister says](#), *The Guardian*, 17 October 2022.

²⁵⁷ B Steffen et al., [State Ownership and Technology Adoption: The Case of Electricity Utilities and Renewable Energy](#), *Research Policy*, 2022, 51(6), 104534, doi: 10.1016/j.respol.2022.104534; Premier of Victoria, [Bringing Back Public Power with Leading Energy Experts](#), [media release], 7 February 2023, accessed September 2024.

²⁵⁸ V Wegmann and D Hall, [A publicly owned energy industry could help tackle energy poverty and increase renewables](#), *The Conversation*, 12 October 2021, accessed September 2024.

²⁵⁹ [Energy \(Renewable Transformation and Jobs\) Act 2024 \(Qld\)](#) cl 13(1)(a); Energy Research Acceleration, [Assessing the Case for Public Ownership in the Energy Sector](#), Report, January 2024, p 14; Premier of Victoria, [Bringing Back Public Power with Leading Energy Experts](#), [media release], 7 February 2023, accessed September 2024.

²⁶⁰ V Wegmann and D Hall, [A publicly owned energy industry could help tackle energy poverty and increase renewables](#), *The Conversation*, 12 October 2021, accessed September 2024.

²⁶¹ The Australia Institute, [Submission No 24 to Senate Standing Committees on Finance and Public Administration](#), Parliament of Australia *Net Zero Economy Authority Bill 2024 and the Net Zero Economy Authority (Transitional Provisions) Bill 2024*, April 2024, p 26, citing Brett Christophers, [Fossilised Capital: Price and Profit in the Energy Transition](#), *New Political Economy*, 2021 27(1), doi:10.1080/13563467.2021.1926957, p 146,

²⁶² M de Brenni, [Landmark legislation protects Queensland energy workers and public ownership](#), [media statement] 24 October 2023, accessed September 2024.

²⁶³ This proposed law provides the statutory basis for the Australian Government's \$1 billion SolarSunshot program, which seeks to develop domestic manufacturing capability for solar technologies.

5.2.2 Costs associated with the public ownership of renewable generation assets

Public ownership of renewable generation assets would also have significant implications for how the NSW state budget is allocated, and the amount of financial risk that the state is willing to bear. Some investor groups argue that private ownership and operation of renewable assets could lead to more efficient, cost-effective, and innovative outcomes than state-run entities, which may not face the same competitive pressures.²⁶⁴ State ownership may also negatively distort competition within the market and make the NSW energy sector less agile in responding to rapid changes in technology and market conditions.²⁶⁵ For example, in response to the Queensland Bill, the Clean Energy Investor Group raised concerns that public ownership in the energy sector would ‘adversely affect investor sentiment’;²⁶⁶ incentivise more ‘develop and flip’ projects, at the expense of good social licence practices;²⁶⁷ and potentially create conflicts of interest (perceived or real) given the increasing powers allocated to Powerlink in Queensland.²⁶⁸ Moreover, this group raised concerns that some private asset owners may not be able or want to sit alongside a public owner, meaning private capital can be ‘inelastic’.²⁶⁹ Similarly, the Global Infrastructure Investor Association suggested that public control of energy assets would ‘encourage capital flight, reduce overall levels of FDI [Foreign Direct Investment] and reduce business investment to even lower levels than is currently the case’²⁷⁰ while also ‘reducing the productivity and value creation of these sectors for consumers and dampening the incentives to invest private capital.’²⁷¹

The decision for NSW to own a majority stake in renewable generation must consider the long-term vision for the state’s energy system, the role of government in facilitating the energy transition, and the mechanisms best suited to ensure that the transition benefits society as a whole. While state ownership offers certain advantages, especially in terms of strategic control and prioritising the rapid decarbonisation of the NSW energy sector, it also presents challenges related to market dynamics, innovation, and financial risk. A balanced approach might involve strategic public investments in renewable energy, coupled with policies and regulatory frameworks that encourage private sector participation and investment. This could include public-private partnerships, incentives for private investment in renewables, and state-owned enterprises that operate in the market on a commercial basis.

²⁶⁴ See for example, Clean Energy Investor Group, [Response to Energy \(Renewable transformation and jobs\) Bill 2023 – Exposure draft Consultation](#), 30 June 2023, p 2.

²⁶⁵ Clean Energy Investor Group, [Response to Energy \(Renewable transformation and jobs\) Bill 2023 – Exposure draft Consultation](#), 30 June 2023, p 2.

²⁶⁶ Clean Energy Investor Group, [Response to Energy \(Renewable transformation and jobs\) Bill 2023 – Exposure draft Consultation](#), 30 June 2023, p 2. See also Global Infrastructure Investor Association, [Submission No IFD0015 to House of Commons International Trade Select Committee](#), *Inward Foreign Direct Investment Inquiry*, 26 February 2021.

²⁶⁷ Clean Energy Investor Group, [Response to Energy \(Renewable transformation and jobs\) Bill 2023 – Exposure draft Consultation](#), 30 June 2023, p 2.

²⁶⁸ Clean Energy Investor Group, [Response to Energy \(Renewable transformation and jobs\) Bill 2023 – Exposure draft Consultation](#), 30 June 2023, p 2.

²⁶⁹ Clean Energy Investor Group, [Response to Energy \(Renewable transformation and jobs\) Bill 2023 – Exposure draft Consultation](#), 30 June 2023, p 2.

²⁷⁰ Global Infrastructure Investor Association, [Submission No IFD0015 to House of Commons International Trade Select Committee](#), *Inward Foreign Direct Investment Inquiry*, 26 February 2021, 6.3.

²⁷¹ Global Infrastructure Investor Association, [Submission No IFD0015 to House of Commons International Trade Select Committee](#), *Inward Foreign Direct Investment Inquiry*, 26 February 2021, 8.3.

6. Conclusions

The energy transition away from large fossil-fuel fired generation to distributed renewable energy sources has introduced new energy sources and technologies, modes of participation, and challenges to the NEM. Despite these significant changes, the piecemeal adjustments made to the existing legislative and regulatory structures that govern the NEM have been largely incremental and reactive, leading to an unsustainable level of complexity. This complexity is burdensome for energy consumers and industry participants and undermines the efficiency and adaptability of the regulatory system. This has resulted in a convoluted set of cooperative energy laws that are no longer fit for purpose, particularly as they struggle to keep pace with rapid technological advancements and evolving market dynamics.

At the same time, there is increasing divergence in state-level regulatory responses to emerging challenges, through derogations from the NEL and state-based solutions to issues such as consumer protections, retail markets, and public ownership of energy assets. This fragmentation exacerbates the inconsistencies within the NEM's regulatory landscape. This not only creates barriers to achieving a harmonised and coherent national energy policy but also threatens the resilience and effectiveness of using the cooperative federalist approach via the NEM to facilitate a just and sustainable energy transition. The changes to the energy sector are so fundamental that they demand a more coherent and forward-thinking regulatory approach beyond the competitive market model that was designed for the supply of large fossil-fuel generation in the NEM.

Five modern energy principles were identified in this paper as likely to have particular significance for the reform of the competitive market model used to regulate the NSW electricity sector. These principles seek to:

1. Rapidly decarbonise the electricity sector by replacing fossil fuel generation with generation from renewable energy sources
2. Improve energy and supply chain security
3. Support a just energy transition
4. Move towards a more sustainable and circular economy
5. Enable the sector to become more resilient to the changing climate and the increased risk of natural disasters, such as bushfires and floods.

These principles are designed to address the market failures that have emerged during the energy transition resulting from unpriced externalities within the electricity sector. They should guide the reform of the regulatory framework, moving away from the existing patchwork of rules towards a more streamlined and adaptive system that can effectively support the energy sector's transformation. Without substantial reform, the NEM's ability to meet the needs of government, industry, and society will continue to be compromised, leaving NSW and the other NEM jurisdictions ill-prepared to navigate the complexities of the energy transition.

Moving forward, policymakers should consider how these modern regulatory principles can be integrated into a reformed legal framework that is capable of addressing the multifaceted challenges

ahead. By doing so, the regulatory system can be realigned to meet the evolving demands of the electricity sector, ensuring that it remains both efficient and reliable, and meets consumer and industry needs in the face of rapid change.

Glossary of acronyms

Acronym	
ACCC	Australian Competition and Consumer Commission
ACL	Australian Consumer Law
AEMA	Australian Energy Market Agreement
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
CER	Consumer energy resources
CIS	Capacity investment scheme
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DER	Distributed Energy Resources
EAP	Energy Advisory Panel
ECA	Energy Consumers Australia
ECMC	Energy and Climate Change Ministerial Council
EII Act	Electricity Infrastructure Investment Act 2020
EnergyCo	Energy Corporation of NSW
EPA	Environment Protection Authority
IEA	International Energy Agency
IRENA	International Renewable Energy Agency
LTESA	Long-Term Energy Service Agreements
NECF	National Energy Customer Framework
NEL	National Electricity Law
NEM	National electricity market
NEO	National Electricity Objective
NERL	National Energy Retail Law
NERO	National Energy Retail Objective
NERR	National Electricity Retail Rules
NETP	National Energy Transformation Partnership
SDG	Sustainable Development Goal

Appendix 1: History of the NSW electricity sector and evolution of energy regulation

Year	Event	Regulatory model and principles
1791	Black coal discovered in NSW ²⁷²	Colonial model Prioritised the basic needs of the settlers, then resource extraction and export to England and the other colonies
1820s	Introduction of municipal street lighting, initially using whale oil and then gas ²⁷³	Municipal model Before Federation in NSW, electricity generation assets and networks were nascent and primarily localised. The municipal model prioritised basic service provision to improve public safety, enhance living conditions, and foster local economic growth through industrial development and commercial expansion
1888	Tamworth introduced electric lighting supply ²⁷⁴	
1896	Municipal Council of Sydney Lighting Act passed ²⁷⁵	
1900	Commonwealth of Australia Constitution Act established shared legislative competence for energy between the Commonwealth and the states ²⁷⁶	
1901	Federation	
1904	Sydney introduced electric lighting supply ²⁷⁷	Gradual transition from municipal model to state ownership model
1920s	Use of electricity spread beyond lighting, with electricity generated being distributed across municipal boundaries ²⁷⁸	
1949	Snowy Mountains Hydro-Electric Scheme established ²⁷⁹	
1950	Electricity Commission of NSW established ²⁸⁰	State ownership model This model supported a vertically integrated model of state ownership of energy assets that operated to supply end-customers with electricity generated by large fossil-fuelled generators. Each state owned and operated its
1952	Electricity Commission began acquiring and operating power generation and supply assets	
1981	The Electricity Commission's remit expanded to include coal mining to support coal fired generation	

²⁷² Geoscience Australia, [Australian energy facts, Coal](#), 1 September 2023, accessed September 2024.

²⁷³ S Smith, [Electricity and Privatisation](#), NSW Parliamentary Library Research Service, September 1997, p 1.

²⁷⁴ NSW Government, [Tamworth Powerstation Museum](#), n.d., accessed September 2024.

²⁷⁵ [Municipal Council of Sydney Electric Lighting Act 1896](#) (NSW); S Smith, [Electricity and Privatisation](#), NSW Parliamentary Library Research Service, September 1997, p 2.

²⁷⁶ [Australian Constitution](#).

²⁷⁷ J Egan, [On this day: Sydney gets electricity](#), *Australian Geographic*, 7 November 2013, accessed September 2024.

²⁷⁸ [Local Government Act 1919](#) cited in S Smith, [Electricity and Privatisation](#), NSW Parliamentary Library Research Service, September 1997, p 2.

²⁷⁹ D Clarke and P Graham, [Australian Electricity Transitions 1900 to 2050: What will it take for Australia to transition to a net-zero electricity system by 2050?](#), CSIRO, December 2022, p 7-8.

²⁸⁰ S Smith, [Electricity and Privatisation](#), NSW Parliamentary Library Research Service, September 1997, p 1.

Year	Event	Regulatory model and principles
1987	The Energy Corporation of NSW established to oversee the long-term development of the electricity sector and fuel sourcing	own electricity generation, transmission, and distribution networks. This public utility model reflected the strategic importance of energy to economic development, especially in the post-World War II nation building period ²⁸¹ Regulatory principles prioritised: <ul style="list-style-type: none"> • Centralised planning and development • Supporting large-scale investment in grid and generation infrastructure • Economies of scale and scope achieved through vertical integration • Price regulation • Universal access to energy²⁸²
1992	NSW Electricity Commission began trading as Pacific Power, with the electricity generation, transmission and mining businesses spun into separate subsidiaries over time	
1993	Hilmer Review of National Competition Policy recommended the electricity sector be opened to market competition and liberalisation to support improved efficiency and reliability, and a nationally integrated electricity market ²⁸³	Transition towards a more cooperative federalist approach between the Commonwealth, states and territories to energy governance and policymaking
1995	NSW Parliament passed the Electricity Supply Act for the areas outside the scope of the future NEM including distribution ²⁸⁴ and retail licensing requirements, ²⁸⁵ and electrical safety standards	
1996	National Electricity Market Legislation Agreement between NSW, Victoria, Queensland, South Australia, the Australian Capital Territory, and the Commonwealth ²⁸⁶ South Australian Parliament passed the National Electricity Law ²⁸⁷	
1998	The National Electricity Market began operations ²⁸⁸	Competitive market model ²⁸⁹ The competitive market model reflected the position that market forces, guided by appropriate regulatory frameworks, could deliver energy more efficiently, foster innovation, and better meet consumer needs, than the former
2000	Renewable Energy (Electricity) Act 2000 (Cth) ²⁹²	
2001	Ministerial Council on Energy formed body through which the Ministers from the	

²⁸¹ D Clarke and P Graham, *Australian Electricity Transitions 1900 to 2050: What will it take for Australia to transition to a net-zero electricity system by 2050?*, CSIRO, December 2022, p 7.

²⁸² Australian National Committee of CIGRE, *A Dictionary of Electricity – Australia*, A Joint project of CIGRE (The International Conference on Large High Voltage Electrical Systems) and AHEF (The Association for the History of Electricity in France, 1996.

²⁸³ F G Hilmer et al., *National Competition Policy Review*, Australian Government, 25 August 1993.

²⁸⁴ *Electricity Supply Act 1995 (NSW)* s 14.

²⁸⁵ *Electricity Supply Act 1995 (NSW)* s 14, pt 4.

²⁸⁶ *National Electricity Market Legislation Agreement (May 1996) between The State of NSW, The State of Victoria, The State of Queensland, The State of South Australia, The Australian Capital Territory.*

²⁸⁷ *National Electricity (South Australia) Act 1996 (SA)* sch National Electricity Law.

²⁸⁸ AEMO, *About the National Electricity Market (NEM)*, n.d., accessed September 2024.

²⁸⁹ D Montoya, *The energy transition: Decarbonisation, decentralisation and digitalisation*, NSW Parliamentary Research Service, August 2023, p 7.

²⁹² *Renewable Energy (Electricity) Act 2000 (Cth)*.

Year	Event	Regulatory model and principles
2004	Commonwealth, states and territories, as well as New Zealand, having primary responsibility for energy matters could meet to formulate national energy policy ²⁹³ Australian Energy Market Agreement between the Commonwealth, NSW, Victoria, Queensland, Western Australia, South Australia, Tasmania, the Australian Capital Territory, and the Northern Territory ²⁹⁴	vertically integrated state-owned energy monopolies ²⁹⁰ The key regulatory principles included: <ul style="list-style-type: none"> • Market efficiency and the reduction of monopoly power through the unbundling and privatisation of the generation, transmission, distribution, and retail segments of the state-owned utilities • Cost reflective prices to facilitate price signals and consumer choice • Regulatory support of competition while ensuring economically efficient, reliable, and safe energy supply • Establishing consumer protections, independent regulators, and external dispute resolution bodies to safeguard consumer interests, including vulnerable consumers²⁹¹
2011	Clean Energy Act introduced a price on carbon ²⁹⁵	
2014	Repeal of the carbon price ²⁹⁶	
2015	Energy Consumers Australia established ²⁹⁷	
2016	Sustainable Development Goals (SDG), including SDG 7: Affordable and Clean Energy and SDG 13: Climate Action launched ²⁹⁸ Paris Agreement on Climate Change – international agreement on climate change adopted by 196 signatories ²⁹⁹	Gradual transition to the modern energy regulatory principles alongside the energy transition, including that: <ul style="list-style-type: none"> • The electricity sector should rapidly decarbonise by replacing fossil fuel generation with generation from renewable energy sources • With the changing generation mix, the electricity sector should consider both energy and supply chain security • The energy transition should be a just transition and not disproportionately affect vulnerable consumers or communities
2017	Finkel Review ³⁰⁰ and Energy Security Board established ³⁰¹	
2020	Electricity Infrastructure Investment Act (NSW) to support the establishment of renewable energy zones and the development of new grid and utility-scale storage infrastructure to stimulate the deployment of renewable energy ³⁰²	

²⁹³ Queensland Government, *National regulators, market institutions and other bodies*, 15 July 2024, accessed September 2024.

²⁹⁰ D Montoya, *The energy transition: Decarbonisation, decentralisation and digitalisation*, NSW Parliamentary Research Service, August 2023, p 7; D Clarke and P Graham, *Australian Electricity Transitions 1900 to 2050: What will it take for Australia to transition to a net-zero electricity system by 2050?*, CSIRO, December 2022, p 8.

²⁹¹ Ibid, E O'Neill, *Exploring regulatory approaches to consumer vulnerability* (Report for the Australian Energy Regulator, Consumer Policy Research Centre, February 2020, p 38-40).

²⁹⁴ *Australian Energy Market Agreement 2004 between the Commonwealth of Australia, The State of NSW, The State of Victoria, The State of Queensland, The State of Western Australia, The State of South Australia, The State of Tasmania, The Australian Capital Territory, The Northern Territory of Australia (as amended 2013)*.

²⁹⁵ *Clean Energy Act 2011 (Cth)*.

²⁹⁶ *Clean Energy Legislation (Carbon Tax Repeal) Act 2014 (Cth)* sch 1.

²⁹⁷ Energy Consumers Australia, *Energy Consumers Australia*, 2024.

²⁹⁸ United Nations, *Transforming our world: the 2030 Agenda for Sustainable Development*, GA Res 70/1, A/Res/70/1, 21 October 2015 (adopted 25 September 2015), Goal 7 and 13.

²⁹⁹ United Nations, *Paris Agreement*, 2016 (adopted 12 December 2015; entered into force 4 November 2016).

³⁰⁰ A Finkel et al., *Independent Review into the Future Security of the National Electricity Market Blueprint for the Future*, June 2017.

³⁰¹ Energy Security Board, *Who is the Energy Security Board?*, n.d., accessed September 2024.

³⁰² *Electricity Infrastructure Investment Act 2020 (NSW)*

Year	Event	Regulatory model and principles
2021	NSW established a Consumer Trustee ³⁰³	<ul style="list-style-type: none"> • The electricity sector should increasingly adopt circular economy principles • The electricity sector should become more resilient to climate change and natural disasters
2022	Energy and Climate Ministerial Council became a committee of national cabinet ³⁰⁴ Climate Change Act (Cth) legislated 43% emissions reduction target by 2030, and a net zero target by 2050 ³⁰⁵	
2023	Climate Change (Net Zero Future) Act 2023 (NSW) legislated 50% emissions reduction target by 2030 and a net zero target by 2050 ³⁰⁶ Climate objective introduced alongside the existing priorities of reliability, safety, and security of the national electricity system into the National Electricity Objective. ³⁰⁷	

³⁰³ EnergyCo, [The Consumer Trustee](#), n.d., accessed September 2024.

³⁰⁴ Department of Climate Change, Energy, the Environment and Water, [Energy and Climate Change Ministerial Council](#), n.d., accessed September 2024.

³⁰⁵ [Climate Change Act 2022 \(Cth\)](#) s 10(1)(b).

³⁰⁶ [Climate Change \(Net Zero Future\) Act 2023 \(NSW\)](#) s 9(1)(c).

³⁰⁷ [Statutes Amendment \(National Energy Laws\) \(Emissions Reduction Objectives\) Act 2023 \(South Australia\)](#).

Appendix 2: Regulatory framework for consumer protections for NSW energy consumers

NATIONAL ELECTRICITY MARKET	National Electricity Law (NEL)	National Energy Retail Law (NERL)
	National Electricity Regulations (NE Regs)	National Energy Retail Regulations (NE Retail Regs)
	National Electricity Rules (NER)	National Energy Retail Rules (NERR)
	AER Guidelines (1)	AER Guidelines (2)
	AEMO Retail Market Procedures (3)	AEMO Procedures (4)
	Electricity distribution determinations (5)	
FEDERAL	Competition and Consumer Act and Regulations (6)	
	Australian Consumer Law (7)	
	Competition and Consumer (Industry Code – Electricity Retail) Regulations 2019 (8)	
NSW	Jurisdictional Application Acts and Regulations (9)	Jurisdictional Application Acts and Regulations (10)
	Key jurisdictional electricity legislation and regulations (11)	
	Jurisdictional Interpretation Acts (12)	
	Subordinate jurisdictional instruments (e.g. codes, guidelines, etc.)	

Source: author provided based on [AEMC](#) (law current to 13 October 2023).



1. NECF-related AER Guidelines made under National Electricity Rules

- (a) National electricity connection charge guideline (April 2023) (rule 5A.E.3, NER)

2. AER Guidelines made under the National Energy Retail Law and National Energy Retail Rules³⁰⁸

- (a) Retailer authorisation Guideline (December 2014) (section 117, NERL)
- (b) Better Bills Guideline (March 2022) (rule 25A, NERR)
- (c) Retail Exempt Selling Guideline (June 2022) (section 118, NERL; rule 154, NERR)
- (d) Retailer of Last Resort Guideline, Plan and Statement of Approach³⁰⁹ (June 2012) (section 135, NERL)
- (e) Customer Hardship Policy Guideline (March 2019)³¹⁰
- (f) Benefit Change Notice Guidelines (June 2018) (rule 48A, NERR)
- (g) Minimum Disconnection Amount (March 2017) (rule 116, NERR)
- (h) Electricity and gas bill benchmarks for residential customers 2020 (December 2020) (rule 169, NERR)
- (i) Retail Pricing Information Guidelines 2018 (April 2018)³¹¹ (section 61, NERL)³¹²
- (j) Compliance Procedures and Guidelines (September 2018) (section 281, NERL)
- (k) AER (Retail Law) Performance Reporting Procedures and Guidelines (January 2019) (section 286, NERL)³¹³
- (l) AER Compulsory Notice Guidelines (January 2021) (section 28ZF NEL, section 218 NERL and section 68 NGR)
- (m) Sustainable payment plans: A good practice framework for assessing customers' capacity to pay (July 2016)

3. AEMO Electricity Retail Market Procedures³¹⁴

- (a) Market Settlement and Transfer Solution Procedures (MSATS) (clause 7.16.2, NER)
- (b) National Electricity Market Metrology Procedure (clause 7.16, NER)
- (c) Metering Data Provision Procedures (clause 17.6, NER)

³⁰⁸ Under section 218, NERL, the AER may prepare guidelines about the matters that it will have regard to before using its enforcement powers under the NERL. To date, the AER has not published such guidelines.

³⁰⁹ See also version 4 of the [Retailer of Last Resort Plan](#), July 2015.

³¹⁰ Although the AER is not specifically authorised to prepare and publish this document, it is in line with the AER's obligation to approve customer hardship policies or variations (section 45, NERL).

³¹¹ Note the AER Price Comparator website – [Energy Made Easy](#) (see section 62, NERL).

³¹² The AER was in the process of reviewing and updating this guideline but suspended the review in March 2020 due to the COVID-19 pandemic.

³¹³ The AER reviewed and updated this guideline in 2023, however the changes to the guideline don't come into effect until 1 July 2025.

³¹⁴ See AEMO's [Guide to Retail Electricity Market Procedures v 4.0 March 2019](#) for a complete list of Retail Electricity Market Procedures and supporting documents. See also AEMO's [Retail Electricity Market Procedures – Glossary and Framework](#), published pursuant to AEMO's obligations under clause 7.16.1(f) of the NER.

4. AEMO Procedures made under National Energy Retail Law and Rules

- (a) RoLR Procedures (section 144, NERL)

5. Electricity Distribution Determinations

- (a) These determinations are made by the Australian Energy Regulator and determine the costs that may be recovered from energy consumers.

6. Competition and Consumer Act and Regulations

- (a) Prohibiting Energy Market Misconduct (Part XICA, Competition and Consumer Act)
(b) See in particular clause 89 of the Competition and Consumer Regulations 2010 (Cth)
(c) Consumer Data Right (Energy Sector) Designation 2020 (made under s 56AC(2) of the Competition and Consumer Act)

7. The Australian Consumer Law is found in Schedule 2 to the Competition and Consumer Act 2010 (Cth)

8. Competition and Consumer (Industry Code – Electricity Retail) Regulations 2019 (Cth)³¹⁵

9. Jurisdictional Application Acts for National Electricity Law

- (a) National Electricity (New South Wales) Act 1997 (NSW)³¹⁶

10. Jurisdictional Application Acts and Regulations for National Energy Retail Law

- (a) National Energy Retail Law (Adoption) Act 2012 (NSW) and National Energy Retail Law (Adoption) Regulation 2020 (NSW)

11. Jurisdictional Electricity Legislation and Regulations³¹⁷

- (a) Electricity Supply Act 1995 (NSW); Electricity Supply (General) Regulation 2014 (NSW); Electricity Supply (Safety and Network Management) Regulation 2014 (NSW) and Electricity Supply (Corrosion Protection) Regulation 2020 (NSW)

12. Jurisdictional Interpretation Acts

- (a) Interpretation Act 1987 (NSW)

³¹⁵ The Industry Code is a mandatory industry code for the purposes of Part IVB of the [Competition and Consumer Act 2010 \(Cth\)](#). It applies only in electricity distribution regions where prices are not already subject to price regulation and only to certain categories of small customers. The Industry Code is the instrument responsible for determination of the Default Market Offer.

³¹⁶ A regulation making power exists under sections 8A and 9 of [this Act](#).

³¹⁷ Please note other jurisdictional electricity legislation may also be relevant including energy efficiency legislation and safety legislation.

Energy regulation in transition

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