



Australian Government

Department of Climate Change, Energy,
the Environment and Water

Electricity and Energy Sector Plan

Discussion paper

March 2024



© Commonwealth of Australia 2024

Ownership of intellectual property rights

Unless otherwise noted, copyright (and any other intellectual property rights) in this publication is owned by the Commonwealth of Australia (referred to as the Commonwealth).

Creative Commons licence

All material in this publication is licensed under a [Creative Commons Attribution 4.0 International Licence](#) except content supplied by third parties, logos and the Commonwealth Coat of Arms.

Inquiries about the licence and any use of this document should be emailed to copyright@dcceew.gov.au.



Cataloguing data

This publication (and any material sourced from it) should be attributed as: DCCEEW 2024, *Electricity and Energy Sector Plan Discussion Paper*, Department of Climate Change, Energy, the Environment and Water, Canberra. CC BY 4.0.

This publication is available at dcceew.gov.au/publications.

Department of Climate Change, Energy, the Environment and Water

GPO Box 3090 Canberra ACT 2601

Telephone 1800 920 528

Web dcceew.gov.au

Disclaimer

The Australian Government acting through the Department of Climate Change, Energy, the Environment and Water has exercised due care and skill in preparing and compiling the information and data in this publication. Notwithstanding, the Department of Climate Change, Energy, the Environment and Water, its employees and advisers disclaim all liability, including liability for negligence and for any loss, damage, injury, expense or cost incurred by any person as a result of accessing, using or relying on any of the information or data in this publication to the maximum extent permitted by law.

Acknowledgements

The authors thank all individuals who provided input into the development of this paper.

Acknowledgement of Country

We acknowledge the Traditional Owners of Country throughout Australia and recognise their continuing connection to land, waters and culture. We pay our respects to their Elders past and present.

Contents

About this consultation paper	5
1. Introduction.....	6
1.1 The role of the energy sector in Australia’s net zero transformation	8
1.2 The Australian Government has an ambitious but achievable plan for the electricity and energy sector	10
1.3 Have your say.....	12
2. Mobilising investment to transform energy	13
2.1 The energy transformation will require large amounts of investment	13
2.2 Wholesale electricity market design will change to drive efficient investment in a renewable future	15
2.3 Australia as a renewable energy exporter: opportunities and challenges	16
3. Enabling electrification for a smooth transition.....	18
3.1 Electrification is a cost-efficient and effective pathway to decarbonise the Australian economy	18
3.2 Working together across the economy will be important in driving electrification.....	19
3.3 Electrification of Australia’s economy will require careful planning	20
3.4 Information and data will be needed for planning.....	21
4. Growing alternative low carbon fuels	23
4.1 Multiple technologies could play a role in the decarbonisation of the gas sector.....	24
4.2 The gas regulatory framework needs to be fit for the future	25
4.3 Low carbon gas alternatives will be required in hard-to-abate sectors	25
4.4 Liquid fuels need to transition to reach net zero	26
4.5 Low carbon liquid fuels can help decarbonise fuel reliant sectors that can’t electrify	27
4.6 Liquid fuel security needs to be managed through the transition	28
4.7 Actions are needed to transform Australia’s liquid fuels market.....	28
5. Building Australia’s clean energy workforce	31
6. Maximising outcomes for people and businesses	33
6.1 Energy is important to the cost of living.....	33
6.2 The energy transformation will change the way consumers interact with electricity suppliers.....	34
6.3 Community support for the energy transformation will depend on delivering equitable and fair outcomes for all Australians	35
6.4 Circular economy principles will need to be embedded into the energy transformation	36
Questions.....	38
Glossary.....	41
References.....	42

Figures

Figure 1 Systematic transformations in the Electricity and Energy Sector Plan	6
Figure 2 Interactions between the Net Zero and sectoral decarbonisation plans.....	7
Figure 3 Sectoral shares for Australia’s emissions, as a percentage of total emissions (2022–23).....	8
Figure 4 Australian electricity generation mix (1996–97 to 2021–22, 2022).....	9
Figure 5 Liquid fuel, gas and electricity consumption as a share of Australia’s total final energy consumption (2021–22)	23

Boxes

Box 1 Interactions of the Plan with other energy policy programs	11
Box 2 The Australian Government's response to the Community Engagement Review	36

About this consultation paper

In 2022, the Australian Government legislated Australia's greenhouse gas emissions reduction targets to reach 43% below 2005 levels by 2030 and net zero by 2050.

The Electricity and Energy Sector Plan ('the Plan') is one of 6 sectoral decarbonisation plans being developed to support the Net Zero 2050 Plan to help reduce emissions across the economy.

The Plan will set out a pathway to 2050 detailing how the energy sector will contribute to Australia's emissions reduction targets while ensuring reliable, secure and affordable energy supply.

To inform the development of the Electricity and Energy Sector Plan, the Australian Government is seeking feedback on the aspects of the energy transformation that represent the greatest opportunities and challenges.

The Electricity and Energy Sector Plan discussion paper sets out 5 key considerations shaping the future of energy for consideration and feedback:

1. Mobilising investment
2. Enabling electrification
3. Growing alternative low carbon fuels
4. Building Australia's clean energy workforce
5. Maximising outcomes for people and businesses.

These focus areas have been identified through research and consultation with stakeholders such as industry, consumer groups, academics and other experts, and other governments.

Feedback received as part of this consultation will help us identify where we need to take action to unlock opportunities and further progress towards achieving Australia's net zero by 2050 target while prioritising affordable, reliable energy.

Making a submission

The Australian Government is committed to delivering sectoral plans that are robust, ambitious, achievable and meet community expectations.

We welcome submissions from all groups and communities at the forefront of the transition on how they can maximise benefits from the energy sector transformation. We particularly welcome feedback from First Nations peoples and organisations.

Throughout this paper and consolidated on page 38 are questions to help prompt and guide feedback. You do not have to answer all or any of the questions. Broader comments and views are welcome.

We invite you to write a submission or complete the survey on our [Consultation Hub](#). The consultation period will close on Friday 12 April. All submissions received will be treated in accordance with the [Privacy Act 1998](#) (Cth) and [DCCEEW's Privacy Policy](#).

1. Introduction

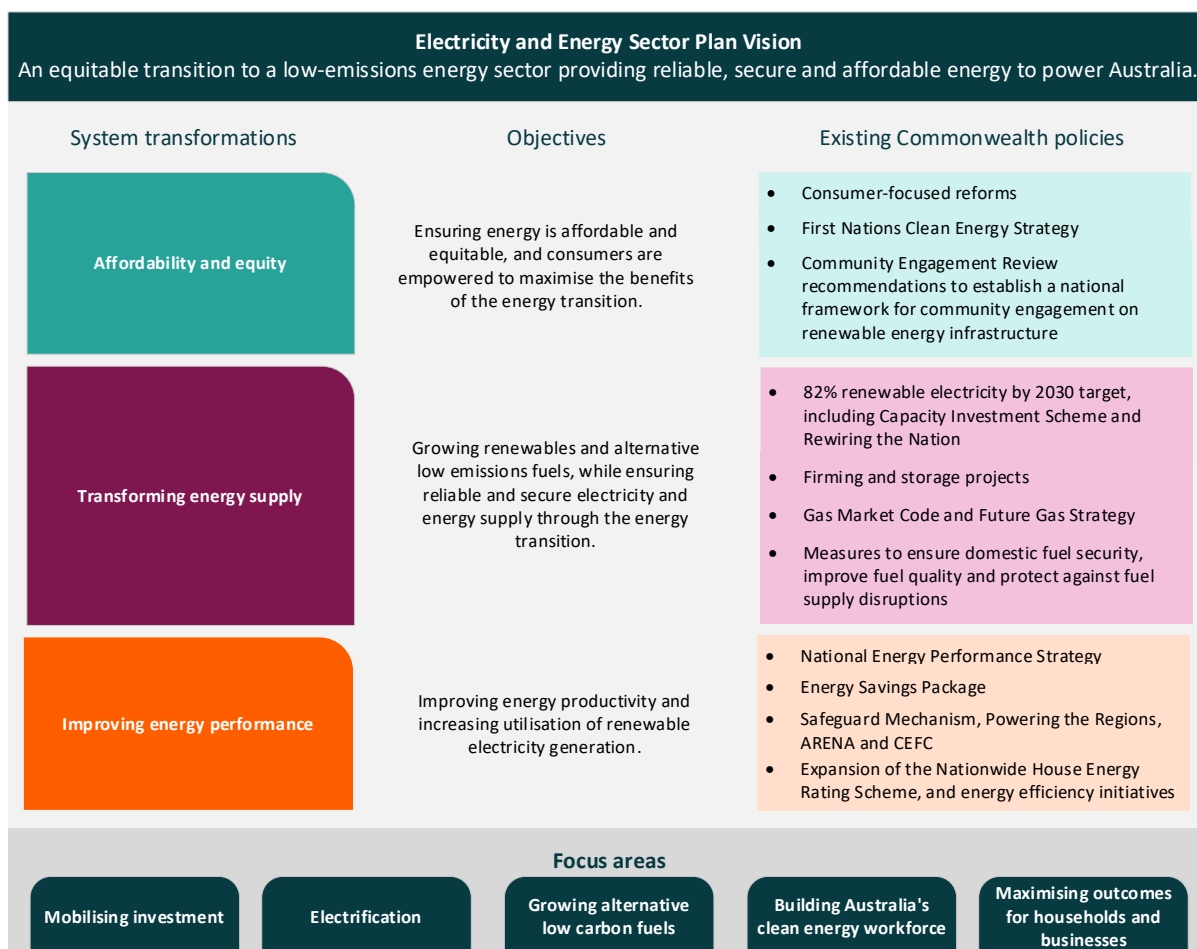
The Australian Government has committed to delivering a Net Zero Plan which will guide how Australia can transform our economy to net zero by 2050.

The Net Zero Plan will be underpinned by 6 sectoral plans for each major sector of the economy:

- electricity and energy
- industry
- resources
- the built environment
- agriculture and land
- transport.

The Electricity and Energy Sector Plan ('the Plan') will set out a credible pathway to decarbonise Australia's electricity and energy sector by 2050 while ensuring reliable, secure, and affordable energy supply (Figure 1).

Figure 1 Systematic transformations in the Electricity and Energy Sector Plan



The Plan will consider the settings that shape Australia’s energy markets for electricity, gas and liquid fuels. This will include options to reduce emissions in the energy supply system, supported by energy demand policies that improve energy performance and management of energy systems. The Plan will build on the Australian Government’s 82% renewable electricity target by 2030 and existing policies and programs across the Commonwealth, state and territory jurisdictions.

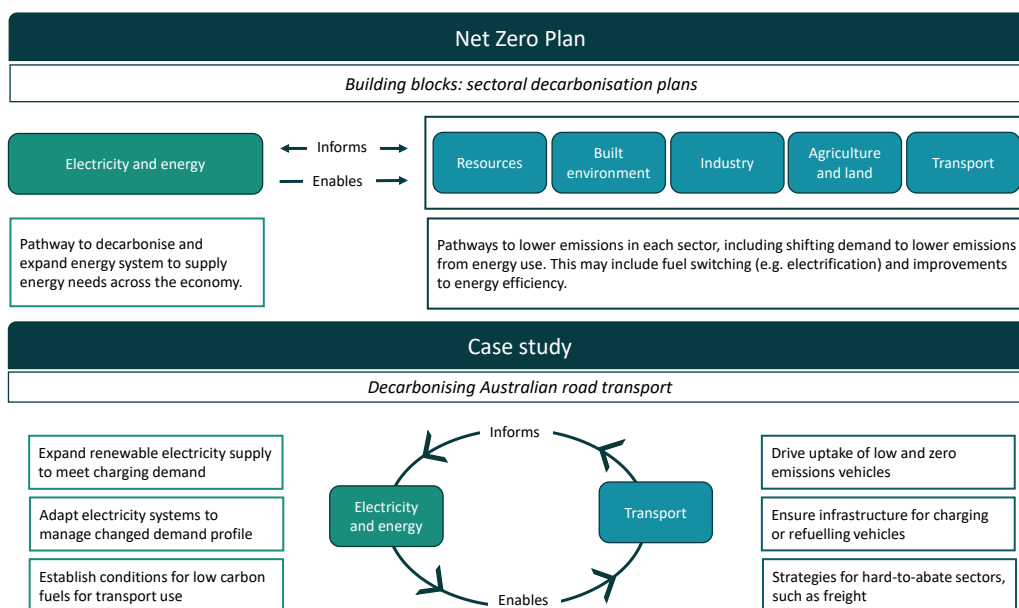
The energy transformation will change our economy and the lives of all Australians. It represents an opportunity to develop new industries, grow our regions, create new jobs and lower energy bills. To make the most of these opportunities, the Australian Government understands the importance of bringing the community along and ensuring no one is left behind. This consultation process is an opportunity to hear from all parts of the community on how this may affect them.

Existing initiatives include work programs under the National Energy Transformation Partnership (the ‘Partnership’), a framework for Commonwealth, state and territory governments to work together on reforms to transform Australia’s energy system. Existing work under the Partnership includes developing a National Renewable Energy Supply Chain Action Plan and a National Consumer Energy Resources Roadmap.

The Plan will articulate the Australian Government’s vision for the energy sector and energy systems out to 2050, in consultation with states and territories. This will provide greater certainty for industry and investors, support efficient investment in Australia’s decarbonisation and maximise benefits of climate action in Australia, including for households and consumers. It will also ensure a coordinated and sequenced energy transformation that maximises decarbonisation across other sectors and delivers benefits to all Australians.

The Electricity and Energy Sector Plan will support decarbonisation across the economy and will interact closely with the pathways provided in all other sectoral plans (Figure 2). The 6 sectoral plans will be developed iteratively, with close collaboration, to deliver a comprehensive and consistent whole-of-economy Net Zero Plan.

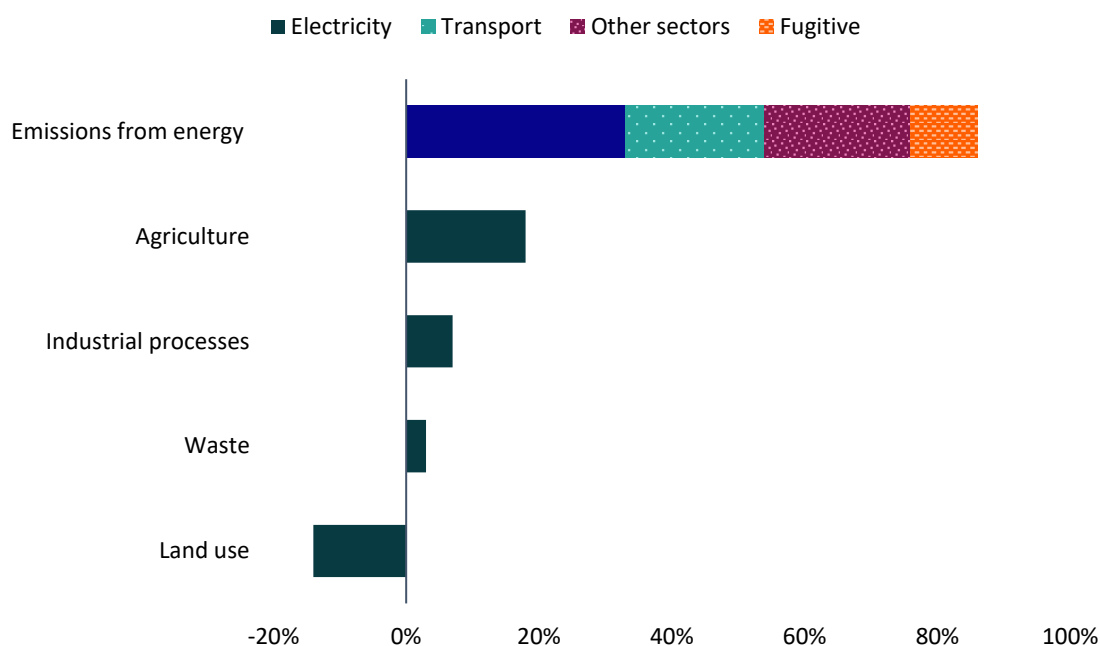
Figure 2 Interactions between the Net Zero and sectoral decarbonisation plans



1.1 The role of the energy sector in Australia’s net zero transformation

Energy accounted for around 85% of Australia’s net emissions in 2022-23, with electricity alone accounting for around a third of emissions (Figure 3).

Figure 3 Sectoral shares for Australia’s emissions, as a percentage of total emissions (2022–23)



Source: Department of Climate Change, Energy, the Environment and Water (DCCEEW), [Australia’s emissions projections 2023](#), November 2023.

Note: Fugitive emissions are unintentional emissions or leakages that occur during the production, processing, transport, storage, transmission and distribution of fossil fuels. ‘Other’ energy use refers to stationary energy excluding electricity generation and transport, which covers direct combustion of fuels, predominantly from the manufacturing, mining and drilling, residential and commercial sub-sectors.

Decarbonising Australia’s energy sector is necessary to reduce greenhouse gas emissions – and with firming renewables the most affordable new build electricity generation, it’s also important for reducing costs. Australia has substantially invested in growing renewables to change how we power our economy, businesses and households in the future. This will involve transformational change in the energy sector with careful planning, to ensure Australians continue to receive reliable and affordable energy.

Two thirds of Australia’s final energy consumption is gas and liquid fuels.¹ Renewable electricity generation will need to increase dramatically as other sectors switch from the use of fossil fuels to electric alternatives, with domestic electricity demand projected to almost double by 2050.² At the

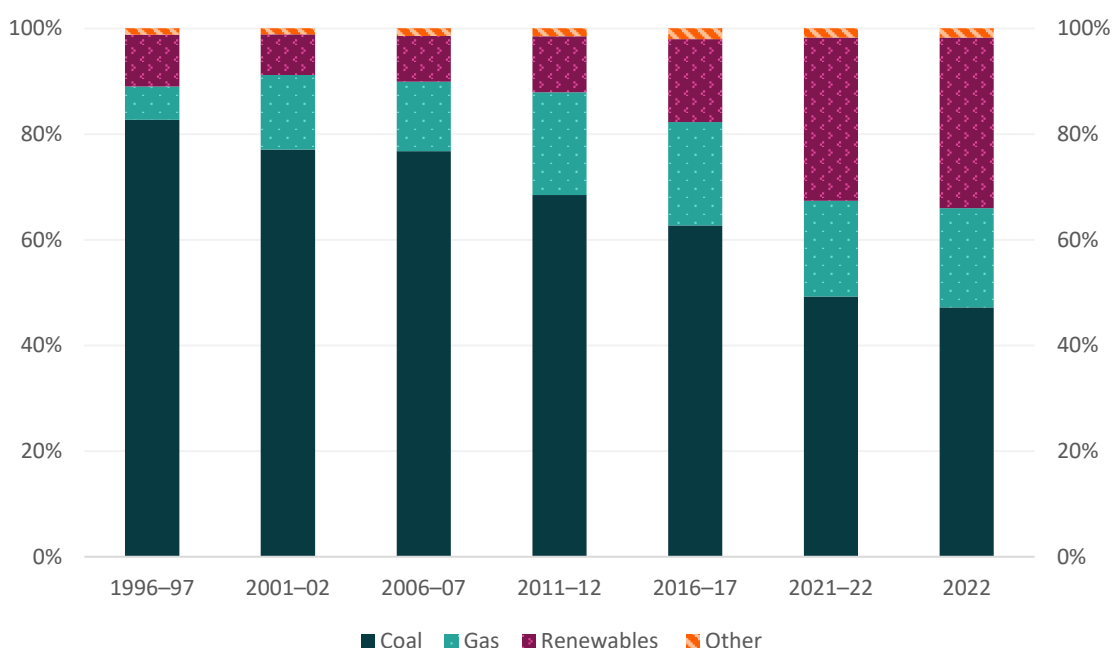
¹ Department of Climate Change, Energy, the Environment and Water (DCCEEW), [Australian Energy Update 2023](#), September 2023.

² Australian Energy Market Operator (AEMO), [Draft 2024 ISP Consultation](#), December 2023.

same time, existing energy infrastructure will need to be replaced and expanded to meet system needs. Where electrification is difficult or not possible, alternative low carbon fuels will need to be supplied to support specific use cases.

Australia’s energy transformation will require economy-wide changes and is already underway. Over the past 15 years, more than a quarter of electricity generated in Australia has shifted from fossil fuel-fired generation to renewable sources such as solar and wind (Figure 4). There has been a 30% reduction in emissions from electricity generation over this same period, equating to roughly 13% of current emissions.³

Figure 4 Australian electricity generation mix (1996–97 to 2021–22, 2022)



Source: DCCEEW, [Australian Energy Statistics](#), Table O, September 2023.

This change has been rapid, with solar generation increasing 25% in the past year and wind generation expanding 4-fold over the past decade.⁴ Consumers have helped to drive this growth with rooftop solar in one-third of Australian homes.⁵ Australia’s electricity supply is increasingly decentralised as households and businesses adopt technologies such as rooftop solar and batteries, supporting opportunities to reduce energy costs. This transformation will need to continue at pace to maintain secure and reliable electricity for households and businesses, as increasingly unreliable coal-fired power plants exit the energy system, and ensure we meet our emissions reduction targets.

³ DCCEEW, [National Greenhouse Gas Inventory Quarterly Update: June 2023](#), November 2023.

⁴ DCCEEW, [Australian Energy Statistics](#), September 2023.

⁵ Australian Renewable Energy Agency (ARENA), [Solar energy](#), January 2024.

1.2 The Australian Government has an ambitious but achievable plan for the electricity and energy sector

The Australian Government has committed to a target of powering 82% of Australia's major electricity grids with renewable sources by 2030, and has an ambition for Australia to become a renewable energy superpower.

The Australian Government has already outlined detailed policies to support its 2030 renewable electricity target. However, continued commitment will be required to tackle the next challenge of growing renewables beyond 2030 and establishing new clean energy industries.

Australia's abundant sunshine and wind provide the opportunity to capitalise on the global transition to achieve net zero emissions. The Government has already identified several priority clean energy industry opportunities through this transition, including in hydrogen, green metals, critical minerals and clean energy manufacturing. This will create jobs for Australian workers and secure a Future Made in Australia, build new clean energy export industries, and maintain Australia's role as a provider of regional energy security.

At the same time, realising Australia's renewable superpower ambitions will also unlock investment in additional renewable energy, infrastructure and supply chains – creating more jobs and opportunities for Australians, and underscoring the importance of the energy sector to Australia's transition.

New regulations and market structures for the energy sector and clean energy industries will need to support this industrial transformation. This will all require careful planning and continued cooperation across all levels of government. The transition from a fossil fuel-powered economy to net zero economy will also need to be carefully managed and sequenced to ensure benefits are equitably distributed across communities.

Outside of this, energy supply and systems will need to be sustainable over the longer term. This includes adopting circular economy principles and opportunities across the energy sector. For example, carbon capture and usage to manufacture synthetic fuels from carbon dioxide, and using waste materials as feedstocks to produce biofuels and renewable gases, could unlock opportunities in the low carbon gas and liquid fuels industries. Additionally, circular strategies for recycling critical minerals required for clean energy technologies can reduce emissions from extracting natural resources. Recycling and repurposing existing infrastructure can also help Australia get more value out of the materials currently in our economy while minimising waste and landfill.

There are benefits for consumers from the energy transformation. For example, improving energy performance will be a critical tool to reduce overall demand on the electricity grid, improve energy reliability and reduce emissions but it can also lower energy bills. The Australian Government is developing a National Energy Performance Strategy to accelerate and boost energy performance measures – the broad management of energy demand through energy efficiency, electrification or fuel switching, and demand flexibility. In supporting decarbonisation efforts, the energy transformation will also benefit livelihoods, security and prosperity, achieved through increasing our resilience to more frequent or intense disasters due to climate change.

Box 1 Interactions of the Plan with other energy policy programs

82% renewable electricity by 2030: the Australian Government has announced detailed policy to get to this target by 2030, which will be a significant task that will put us on track for our 2030 and 2050 emissions reduction targets.⁶

Renewable energy superpower ambitions: the Plan will consider how our renewable superpower ambitions will interact with the workforce, infrastructure, capital and other needs of the domestic energy transformation.

Gas Market Code and Future Gas Strategy: the Plan will reflect measures under the Gas Market Code and will build on insights from the Future Gas Strategy for the future of the energy sector.

National Hydrogen Strategy: the role of hydrogen outlined in the National Hydrogen Strategy will feed into the pathways developed for the Plan.

First Nations Clean Energy Strategy: consultation on the First Nations Clean Energy Strategy will inform the Plan's consideration of opportunities and challenges for first nations communities in the energy transformation.

National Energy Transformation Partnership: development of the Plan will leverage existing frameworks for collaboration between the Commonwealth, state and territory governments.

National Energy Performance Strategy: the Australian Government is developing a national strategy that will maximise the benefits Australians get from our electricity grids through improving energy efficiency, electrification and demand flexibility. This will lower energy bills while reducing how much new renewable generation is needed to 2050 to meet electricity demand.

State and territory policies and targets: the Plan will consider existing policies in state and territory jurisdictions in modelling and development of pathways for the energy sector. This includes:

- individual state and territory renewable energy targets and emissions reduction commitments
- investment in and commitment to developing clean energy industries
- development of state-based sectoral decarbonisation plans
- energy efficiency initiatives.⁷

⁶ DCCEEW, [Australia's emissions projections 2023](#), September 2023.

⁷ A full list of state and territory initiatives are included in Part 5 of the [Annual Climate Change Statement 2023](#).

1.3 Have your say

We are seeking your feedback on the opportunities and challenges we need to address to support an equitable energy transformation while maintaining energy affordability, security and reliability, and achieving Australia's emissions reduction targets. This feedback will inform the policy measures and pathways developed in the Plan.

This discussion paper sets out 5 key considerations shaping the future of energy for consideration and feedback.

1. **Mobilising investment.** Accelerating renewable energy capacity will require significant investment from both government and industry at a time of international competition for green finance.
2. **Enabling electrification.** Electrification is a key tool for reducing energy-related emissions and reducing costs, but it will require substantial expansion of Australia's electricity networks.
3. **Growing alternative low carbon fuels.** Low-carbon fuels will need to be developed for industries that are difficult to electrify, while fuel security challenges are managed.
4. **Building Australia's clean energy workforce.** Australia will need a large skilled workforce to deliver these system-wide changes and we are already facing a shortage of the technical and professional skills required.
5. **Maximising outcomes for people and businesses.** Households and businesses will play a critical role in the energy transformation and need support to engage effectively. Careful policy design and consideration of social licence issues is necessary to ensure an equitable transition.

There are questions posed at the end of this paper, and following each relevant section, to guide stakeholder discussion and feedback. Respondents are welcome to reply to the questions relevant to them, or to provide broader comments and views. Suggestions about where and what policy action is required are particularly welcome. We invite you to write a submission or complete the Have Your Say Survey.

We welcome submissions from all groups and communities at the forefront of the transition on how they can benefit from an orderly and positive transition of the energy sector.

We particularly welcome submissions and feedback from Aboriginal and Torres Strait Islander people and organisations.

2. Mobilising investment to transform energy

Australia's energy transformation to 2050 will require a significant uplift in investment. Investment in renewables has picked up in recent years, driven by declining technology costs, improved access to finance, large private sector capital being mobilised, government incentives and household actions. Nonetheless, even greater amounts of private capital, including from our international partners, will need to be mobilised as the market becomes less characterised by government support post-2030.

2.1 The energy transformation will require large amounts of investment

Decarbonising the Australian economy will require substantial capital investment.⁸ The scale of investment needed will vary depending on:

- global action on climate change
- the pace, scale and quality of electrification in Australia
- the size of Australia's emerging clean energy industries.

The scale of capital investment required remains a challenge at a time when Australia is in a global race, competing for capital and skilled workers while other nations undertake their own clean energy transformation. Compared to our international competitors, Australia has low rates of investment in physical capital (machinery and equipment) and intangibles (like software and research & development) relative to the size of our economy. In 2021, these investment shares were the 3rd and 4th lowest in the Organisation for Economic Co-operation and Development (OECD), respectively.⁹

Investment from globally mobile capital and companies will need to significantly increase if Australia is to meet our energy decarbonisation and renewable superpower goals to 2050. At the same time, global competition for clean energy investment is high. The Australian Government is continuing to focus its efforts on creating a positive investment environment, including providing policy certainty and reducing investment risks.

Attracting capital via strategic positioning in the global market today will enable Australia to unlock the potential of our world class renewable energy resources. This competitive advantage will enable opportunities for significant economic growth in new clean energy industries over the decades to come.

⁸ See for example Climateworks Centre and Climate-KIC Australia, Australian Industry Energy Transitions Initiative (ETI), [Pathways to industrial decarbonisation: Positioning Australian industry to prosper in a net zero global economy](#), August 2023.

⁹ Business Council of Australia, [Australia's investment drought and what to do about it](#), March 2023.

Both public and private investment will play roles in unlocking renewable energy resources, including:

- large-scale investment for energy infrastructure
- utility-scale generation
- clean energy industrial processes
- household and business investment in consumer energy resources to unlock behind-the-meter generation and storage.

The Australian Government has committed to projects that will unlock opportunities for investors in clean energy and other low carbon technologies. This includes Rewiring the Nation, \$20 billion in low-cost finance to unlock investment in the electricity grid, as well as \$2 billion to support large-scale renewable hydrogen projects under the Hydrogen Headstart program.

The Australian Government has also taken action to enable and encourage private investment. The Clean Energy Finance Corporation (CEFC) and the Australian Renewable Energy Agency (ARENA) have played an important role in helping developers obtain finance by directly financing projects and encouraging private investment. The Capacity Investment Scheme (CIS) is a program that provides a national framework to encourage new investment in renewable capacity, including wind and solar, and clean dispatchable capacity, including battery storage. In November 2023, the Australian Government announced a significant expansion of the CIS to deliver a total of 32 GW of new capacity nationally by 2030.

Beyond this, other measures to support investment certainty could include:

- developing a supply chain resilience plan through the National Energy Transformation Partnership (the 'Partnership'), to address risks relating to rising materials costs, supply chain disruptions and the global push to decarbonise
- ongoing work to support social licence and improve community engagement on energy infrastructure, including working with states and territories to implement recommendations of the Community Engagement Review¹⁰
- supporting strategies for securing specialist skills to enable the energy transformation, including through skilled migration where necessary
- developing net zero industrial precincts to lower infrastructure costs and provide direction for investment for establishing new clean energy industries.

Continued investment in RD&D across a portfolio of technologies is necessary to drive innovation to deliver the net zero transition.¹¹ New technologies will be essential to deliver the transition, but there is uncertainty around the viability, long-term costs and scalability of technologies.

There are specific challenges in attracting investment in the small-scale renewable energy projects required to meet the needs of regional and remote Australia, including First Nations communities. The

¹⁰ Andrew Dyer, Australian Energy Infrastructure Commissioner, [Community Engagement Review Report](#), 2023.

¹¹ OECD, [Net Zero+: Climate and Economic Resilience in a Changing World \(Chapter 7\)](#), May 2023.

Government has consulted on strategies to improve First Nations access to finance as part of the First Nations Clean Energy Strategy, to be released in mid-2024.¹²

The Australian Government is also diversifying Australia's electricity mix through the development of the offshore wind industry. Offshore wind can help with energy security and resilience due to its power capacity and availability at times when solar power and onshore wind are not available. Building an offshore wind industry will also provide significant economic opportunities, particularly in the regions. Offshore wind is both energy and jobs rich, yet Australia has come late to this important resource.

2.2 Wholesale electricity market design will change to drive efficient investment in a renewable future

Wholesale electricity market design will need to adjust as increasing renewable generation affects the underlying structure of these markets. Market design has a significant impact on prices and the incentives facing market participants. Investors are making decisions about large and long-lasting investments while future market conditions, including design, could change. Providing guidance around the direction of market design will be important to support confidence in investment.

Wholesale electricity markets have adapted over time as conditions and technologies change. For example, in 2021, the National Electricity Market (NEM) adopted 5-minute settlement windows rather than 30-minute windows. This reform was enabled by improvements in data communications and aimed to improve the efficiency of pricing and investment incentives.¹³ The Western Australian Wholesale Electricity Market (WEM) has recently undergone significant market design reforms to address challenges from an increasingly decentralised and renewable grid. These challenges included more frequent periods of negative pricing.¹⁴

Clear price signals will be required to incentivise investments to meet changing energy system needs, and to provide long term revenue certainty to incentivise investment beyond 2030. These needs include:

- increasing renewable generation
- firming renewables at different times across the day and seasons, and during peak demand, weather droughts or extended outages
- increasing build of various degrees of shallow, medium, and deep energy storage
- encouraging demand flexibility and other innovations.

Further market changes may be required to provide the clarity and incentives needed for investment to meet these objectives. The Partnership sets out a framework for collaboration across jurisdictions to progress associated regulatory reforms so they are fit-for-purpose and streamlined.¹⁵ The first key step towards this commitment was the inclusion of emissions reduction under the National Energy

¹² DCCEEW, [First Nations Clean Energy Strategy: Consultation Paper](#), November 2023.

¹³ AEMO, [What is 5-Minute Settlement \(5MS\)?](#), 2020.

¹⁴ AEMO, [Wholesale Electricity Market Design Summary \(3.3MB\)](#), September 2023.

¹⁵ Energy and Climate Ministerial Council (ECMC), [Energy and Climate Change Ministerial Council](#), September 2022.

Objectives.¹⁶ This amendment requires Australia’s energy market bodies to consider emissions reductions alongside their other objectives (e.g. affordability and reliability) when making regulatory decisions, and when performing regulatory tests.

The Australian Energy Market Commission (AEMC) is also consulting on transmission access reform to provide locational signals for the efficient location of generation, storage and flexible load, and to support Renewable Energy Zones being developed by state governments.¹⁷

2.3 Australia as a renewable energy exporter: opportunities and challenges

The Australian Government has committed to transforming Australia into a renewable energy superpower. Cheap renewable energy will underpin new, internationally competitive, clean industries, which will help to secure Australia’s long-term prosperity in a decarbonising world.

International partners will play a crucial role in Australia’s net zero transformation. Australia currently exports around 80% of its energy production, primarily as fossil fuels such as coal and gas.¹⁸ Over 97% of our exports are to partners now committed to net zero emissions. Over time, Australia has an opportunity to create new clean energy industries to service growing international demand for low and zero emissions products.

Through the global transition, Australia will see many new opportunities created, such as in:

- renewable hydrogen and its derivatives, including green chemicals
- green metals
- critical minerals refining and processing
- manufacturing of renewable generation and storage technologies.

Developing clean export industries will allow Australia to continue supporting the energy security needs of our key trading partners. These export industries will make us more attractive to foreign investors looking to secure their own energy needs and support Australian businesses to access larger markets in a transitioning global economy.

Securing these opportunities depend on our ability to rapidly deploy reliable and clean energy at scale. For example, the Australian Industry Energy Transitions Initiative (ETI) has estimated developing hydrogen and green iron export industries could lead to a 6-fold increase in electricity generation by 2050 – compared to a 2-fold increase to decarbonise our domestic systems without these export industries.¹⁹

¹⁶ ECMC, [Incorporating an emissions reduction objective into the national energy objectives](#), June 2023.

¹⁷ AEMC, [Transmission access reform landing page](#).

¹⁸ DCCEEW, [Australian Energy Statistics](#), September 2023.

¹⁹ Climateworks Centre and Climate-KIC Australia, Australian Industry Energy Transitions Initiative, [Pathways to industrial decarbonisation: Positioning Australian industry to prosper in a net zero global economy](#), August 2023.

Global action on climate change is accelerating and this is driving the biggest economic transformation since the Industrial Revolution. The growth of these new industries will further increase demand for on- and off-grid resources. It will be important to ensure that efforts to boost industrial investment crowd-in, rather than compete with, Australia's domestic energy transformation goals.

Seeking your views: Mobilising investment to transform energy

1. What actions are needed to attract the required large scale private capital and household investment in the energy transformation, with or without government intervention?

When providing feedback, you may wish to comment on:

- the role of the Commonwealth, state and territory governments, private sector, foreign private investment and households for investing in the energy transformation
- components of wholesale electricity markets and supporting energy markets that need to change to facilitate efficient investment in clean energy technologies to 2050
- suggestions for supporting efficient investment in renewable generation and storage
- Barriers and solutions for overcoming investment barriers
- key immediate actions required from the Australian Government to support the transition
- the role for managing energy supply and demand to meet uncertain net zero transition needs, including additional electricity demand from electrification and clean export industries.

3. Enabling electrification for a smooth transition

Electrification involves replacing technologies or processes that use liquid fuels or gas with electricity-powered alternatives. When complemented by renewable generation, electrification presents a cost-efficient and effective means of reducing the emissions and negative health impacts from fossil fuels. Electrification in the residential, light passenger transport and light commercial vehicles sectors, in particular, represents low- or negative- cost abatement opportunities. Electric-powered alternatives are often more efficient uses of energy and provide an effective tool to increase energy performance.

Electrification has been identified as an early decarbonisation option across each of the sectoral plans. These plans will consider opportunities and barriers to electrification across key sectors of the economy. The Plan will examine how Australia's energy systems can enable the electrification required to meet our climate targets and industrial ambitions to become a renewable energy superpower.

3.1 Electrification is a cost-efficient and effective pathway to decarbonise the Australian economy

The International Energy Agency (IEA) has identified electrification as a key tool to reach net zero emissions by 2050 globally. Under a *Net Zero by 2050 Scenario* the IEA expects electricity, as a share of global final energy consumption, to increase from around 20% in 2022 to over 50% in 2050, largely driven by electrification and the growth of new industries.²⁰ In Australia, the Integrated System Plan (ISP) projections developed by the Australian Energy Market Operator (AEMO) identify electrification as a critical enabler for the industrial, transport and other domestic sectors to reach net zero emissions objectives.

Electrification can also improve efficiency of processes and technologies, as electric technologies are generally more efficient than fossil fuel-based alternatives. For example, electric vehicles convert over 77% of the electrical energy from the grid to power at the wheels. Conventional gasoline vehicles only convert about 12–30% of the energy stored in gasoline to power at the wheels.²¹

Increasing electrification will require significant expansion of Australia's renewable electricity capacity and it will be important to have clear investment signals that support this expansion. This will require a range of policies that promote investment certainty to expand renewable electricity generation, which supports domestic energy affordability and reliability and Australia's renewable energy superpower ambitions.

To complement increasing electrification, broader improvements to energy performance will be critical to reduce overall electricity demand, improve energy reliability, and reduce emissions. These improvements can also help households manage their energy bills. The Australian Government is

²⁰ International Energy Agency, [World Energy Outlook 2023](#), October 2023, Figure 3.4.

²¹ U.S. Department of Energy and the U.S. Environmental Protection Agency, [All-Electric Vehicles](#), accessed January 2024.

developing a National Energy Performance Strategy to accelerate and boost energy performance measures – the broad management of energy demand through energy efficiency, electrification or fuel switching, and demand flexibility. Over the last decade, regulating and labelling appliances has saved Australian businesses and households between \$12 to \$18 billion in energy costs, saved between 45 to 67 terawatt-hours of energy consumption, and avoided the cumulative release of between 40 to 60 million tonnes of carbon dioxide.²²

Flexible demand will be valuable in supporting electrification across the economy. Demand flexibility describes consumer’s capacity to shift or adjust their electricity use in response to market signals. Examples of demand flexibility include smart electrification technologies, such as orchestrated water heaters, electric vehicle chargers, and digitalised control systems.²³ By shifting load to the times when renewable energy is abundant and inexpensive, we can make better use of the available energy sources, better utilise our energy assets and reduce systems costs for all users.

Embedding smart technologies as we electrify can also help optimise the way we manage demand – reducing the cost and impact of additional electricity infrastructure. Emerging technologies like artificial intelligence, machine learning and quantum computing present opportunities to improve management and use of energy – for example, by facilitating predictive maintenance and enabling smart demand-response systems.

3.2 Working together across the economy will be important in driving electrification

Governments, energy sector advocates, large energy users, and consumers will have important roles in supporting electrification.

The Australian Government will play an important role in providing policy certainty to ensure our energy systems are equipped to manage increased electricity demand, including from increased electrification. State and territory governments will continue to play an integral role in supporting the transition of our energy networks and have responsibility for policies and programs which may impact the speed of transition.

Transmission and distribution network service providers and private investors will drive improvements in electricity infrastructure to ensure access to reliable and secure electricity as electrification accelerates. Network providers and retailers can also empower their customers to electrify, by helping to identify opportunities and providing information on the benefits of electrification.²⁴

Households, businesses and industries have already invested significantly in electrification to take advantage of cost benefits and reduce their emissions. Residential and commercial energy consumers are investing in energy efficient electrical appliances and heating solutions, while rapidly installing

²² DCCEEW, [It’s now easier to sell energy-efficient appliances](#), September 2023.

²³ See for example [Flexible demand and demand control technology and development](#), RACE for 2030 CRC, 2021.

²⁴ Examples include [AGL’s Electrify Now program](#), [AusNet’s trial](#) to determine how vulnerable households can benefit from electrification, and [Origin Energy’s Electric Vehicles Smart Charging Trial](#).

rooftop solar and residential storage. The electrification of high energy demand sectors – including the industrial and the transport sectors – will require rapid and sustained expansion of Australia’s energy systems.

Barriers to electrification are not consistent across consumer cohorts – for example, renters lack the autonomy to choose to electrify their homes, while technology constraints may prevent some industrial users from electrifying. First Nations households may face additional barriers to electrification. More than half of First Nations households lived in private rentals or in social and community housing in 2021,²⁵ compared to just under a third of Australians in the same year.²⁶ The Australian Government will work to identify and address specific barriers to these cohorts through each of the sectoral plans.

3.3 Electrification of Australia’s economy will require careful planning

Electrification is already occurring across the economy, and our energy systems will need to adapt to effectively manage the increased demand.

AEMO’s Integrated System Plan (ISP) provides a roadmap for the efficient development of the National Electricity Market (NEM) through designing the lowest cost, secure and reliable energy system capable of meeting Australia’s emission reduction targets. In the [Draft 2024 ISP](#), AEMO estimates that residential electricity consumption from electrification (electric heating and cooking processes) and electric vehicles will be 0.33 TWh in 2023-24. Under the ISP’s *Step Change* scenario – which AEMO considers the most likely scenario – this will increase to around 57 TWh in 2049-50. AEMO expects a greater increase in the business and industry sectors, in which electrification of transport and industry is forecast to increase electricity consumption from 1.3 TWh (2023-24) to approximately 65 TWh (2049-50). In Western Australia up to 57 TWh of electrification across all sectors is projected to 2050, driven largely by the industrial sector.²⁷

However, AEMO’s 2023 Electricity Statement of Opportunities noted that the pace, scale and location of electrification remain uncertain but will significantly influence the growth of NEM electricity consumption.

Electrification will increase electricity demand. If electrification is pursued out of step with the expansion of renewable energy capacity, it may have unintended outcomes such as extended reliance on fossil fuel alternatives. Developing a more detailed understanding of the incentives and barriers that dictate current rates of electrification – and future intentions to electrify – will be crucial to ensuring our energy systems are well-equipped to support accelerated electrification.

²⁵ Australian Institute of Health and Welfare (AIHW), [Housing circumstances of First Nations people](#), September 2023.

²⁶ AIHW, [Home ownership and housing tenure](#), April 2023.

²⁷ Commonwealth Scientific and Industrial Research Organisation (CSIRO), [Multi-sector energy modelling 2022](#), December 2022.

3.4 Information and data will be needed for planning

While demand flexibility will allow more efficient use of our existing energy networks, further investment to meet increased demand will be necessary. From 2022 to 2030, demand is forecast to grow by approximately 30% across the NEM, WEM in Western Australia and Darwin-Katherine Interconnected System in the Northern Territory²⁸. AEMO forecasts that the annual electricity generation in the NEM will need to nearly double by 2050 – from 180 TWh in 2022 to 320 TWh – to serve the electrification of Australia’s transport, industry, offices, and homes.

Having up to date information and data about Australia’s electrification intentions and clean export industry developments is important for planning ahead to ensure Australia’s electricity needs can be met.

Australia’s renewable energy superpower ambitions rely on a diverse, secure, and abundantly electrified economy, supplying low-cost clean energy to households and industry for large scale exports. To date, the Australian Government has made significant investments to support the enabling requirements for increased electrification. This includes supporting renewable energy generation and storage projects (through the expanded Capacity Investment Scheme, Community Batteries for Household Solar Program and Community Solar Banks Program), electric vehicle charging stations (through Driving the Nation Fund) and transmission infrastructure (through the Rewiring the Nation Program). However, additional investment in renewable generation, transmission and firming capacity will be required as demand from electrification continues to increase to 2050.

²⁸ Based on the central scenarios in the [2023 AEMO NEM Electricity Statement of Opportunities](#), [2023 AEMO WEM Electricity Statement of Opportunities](#) and [2021 Northern Territory Government Darwin-Katherine Electricity System Plan](#).

Seeking your views: Enabling electrification for a smooth transition

2. What actions are required to ensure Australia’s energy systems can enable increased electrification, while maintaining equity, reliability and security?
3. What insights do you have on the pace, scale and location of electrification, and how to embed this in system planning?
4. How can electrification efforts be sequenced to align with expansion of electricity generation and network capacity?

When providing feedback, you may wish to comment on:

- barriers to electrification and additional measures needed to meet the required pace and scale of electrification
- system improvements to enable electrification across the economy – including increased smart electrification and demand flexibility
- the role of the Australian, state, and territory governments to support electrification.

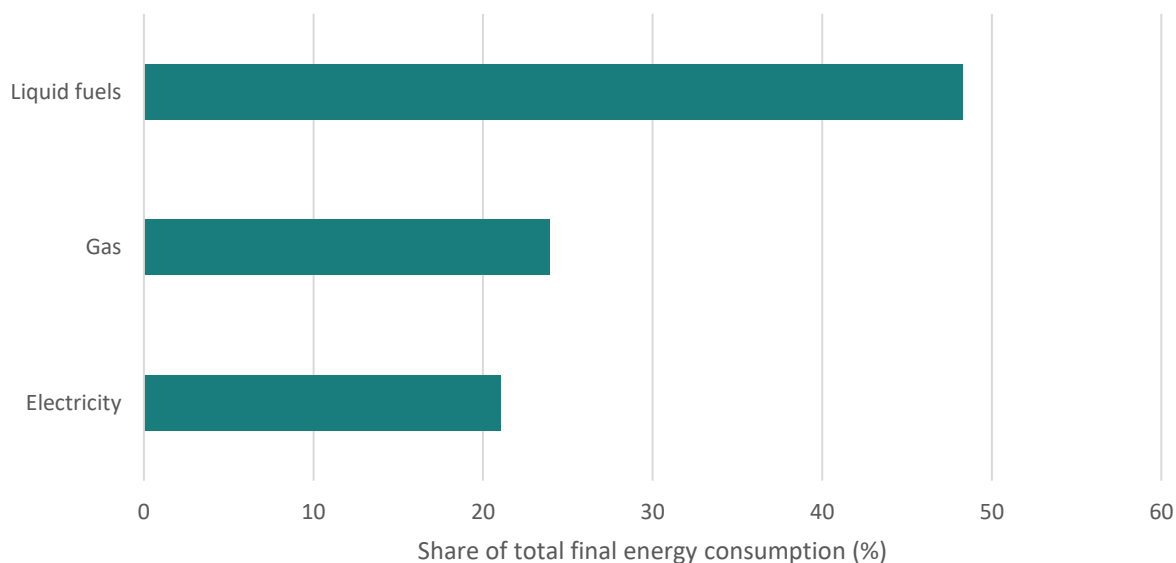
4. Growing alternative low carbon fuels

The decarbonisation of our electricity sector is well underway but further policies are needed to address emissions from gas and liquid fuels (including petrol, diesel, and jet fuel), which are critical enablers of our economy and make up around two thirds of Australia's final energy usage (Figure 5).

Gas is widely used by Australian households and industry. It is also a key export that provides long-term regional energy security to our trading partners. While around 70% of our total liquid fuel is consumed by the transport sector, diesel also supports other sectors including mining, manufacturing and agriculture.²⁹ Liquid fuels also support defence, essential services and backup electricity generation.

Domestic emissions from the gas and liquid fuels sectors will need to reduce for the economy to reach net zero by 2050. However, transition risks will need to be closely managed. This includes ensuring that energy remains affordable for all Australians, and domestic reliability and fuel security is maintained while still meeting decarbonisation goals.

Figure 5 Liquid fuel, gas and electricity consumption as a share of Australia's total final energy consumption (2021–22)



Source: DCCEEW, [Australian Energy Statistics](#), Table H, September 2023.

Note: Final consumption excludes energy use in transformation, such as gas to generate electricity and energy use to refine petroleum.

²⁹ DCCEEW, [Australian Energy Statistics](#), September 2023.

4.1 Multiple technologies could play a role in the decarbonisation of the gas sector

Increased electrification will displace a significant proportion of current gas use in certain sectors, particularly commercial and residential sectors. However, some businesses in hard-to-abate industries have few options to electrify at this time.³⁰ In particular, there are industrial users of gas that currently have no commercially viable option to move to low carbon alternatives. These include users with high heat processes and processes that use gas as a chemical feedstock. These users may require gas, including low carbon gases such as biomethane or hydrogen, through to 2050.

Gas is and will remain an important energy source for the electricity sector for backup generation and to balance renewable electricity supply. Because gas-fired power generation (GPG) is highly flexible, it is relied on to quickly deliver reliable electricity demand that exceeds the available capacity of non-gas generation. GPG will continue to provide a dispatchable source of generation during periods of low variable renewable energy production throughout the energy transformation period. Gas will be required to fuel GPG until commercially viable low carbon alternatives are available.

To drive significant emissions reductions in these hard-to-abate industries, the Australian Government recognises that over the longer-term, low carbon alternatives will be needed, such as biomethane and hydrogen. Low carbon gases may have the potential to help mitigate forecasted potential gas shortfalls on the east coast of Australia in the long-term.³¹ The Australian Government's renewable energy superpower ambition includes a vision for Australia being a net-producer of these low carbon alternatives, based on its comparative advantages of abundant and low-cost renewable energy potential.

The Australian Government is also developing a Future Gas Strategy to provide a medium-term (to 2035) and long-term (to 2050) plan for gas production and consumption in Australia, as well as considering the role that Australian liquefied natural gas (LNG) plays in our trade partners' energy transformations. There are many industrial processes that are still currently difficult to transition to renewable energy sources.

The Net Zero Industrial Sector Plan will consider opportunities to decarbonise gas use in the industrial sector. The Electricity and Energy Sector Plan will consider options to grow towards low carbon gas alternatives while ensuring reliable and secure energy supply through the transition.

Carbon capture use and storage (CCUS) technologies have the potential to reduce emissions from the use of gas and other fossil fuels, including the manufacture of industrial materials such as cement. These CCUS technologies capture carbon dioxide emissions from industrial processes to be used in other industrial processes or permanently stored deep underground.

³⁰ The Resources Sector Plan will cover gas exploration and production activities and use of gas in the resources sector. The Industrial Sector Plan will consider gas use in the industrial sector. The Built Environment Plan will consider gas use in buildings and households. The scope of this Plan – as it relates to gas – is the use of gas in electricity generation and supply-side implications of the transition.

³¹ AEMO, [2023 Gas Statement of Opportunities](#), 2023.

CCUS may support businesses in hard-to-abate sectors meet their obligations under the Safeguard Mechanism reforms, but the cost and effectiveness of these technologies at scale remains uncertain.

The Safeguard Mechanism reforms provide an incentive for new CCUS projects to meet abatement goals by opening the possibility of earning Safeguard Mechanism Credits if CCUS projects are successful in lowering emissions below baselines.

Future developments around the commercial feasibility of CCUS will have implications for Australia's energy mix to 2050.

4.2 The gas regulatory framework needs to be fit for the future

Regulatory settings will need to be considered as electrification accelerates and use of gas networks declines. It is important to ensure that the gas regulatory framework is fit for purpose into the future as demand for, and use of, gas changes.

Governments and regulators may need to consider whether the regulatory framework appropriately:

- allocates risks and costs between pipeline owners and consumers, to ensure there is a fair and equitable transition to net zero
- supports an orderly transition to net zero, without significant and volatile price increases
- supports orderly and safe disconnection and decommissioning, including managing safety risks if and when customers choose to exit networks
- ensures market participants have certainty to maintain gas supply infrastructure, where and while it is needed, and support infrastructure upgrades to support the deployment of low carbon alternatives
- supports a workably competitive market.

There are transition risks associated with the potential downsizing of the gas sector and/or changes to the sector to adapt to low carbon alternatives. Governments, regulators, and pipeline owners will need to work together to ensure current and future investments in gas pipelines reflect an appropriate and considered allocation of these risks.

4.3 Low carbon gas alternatives will be required in hard-to-abate sectors

The Australian Government is supporting the development of low carbon gas alternatives. Together with the state and territory governments, amendments have been made to bring hydrogen and other alternative gases, such as biomethane, into the national gas regulatory framework. This measure provides regulatory certainty to support investment in innovative projects that will reduce emissions in gas pipelines.

Australia is well placed to play a significant role in the global hydrogen industry due to our renewable energy potential, the availability of space to support renewable electricity generation, existing industries and supply chains, and our role as a reliable energy supplier. Australia also has a skilled resource and energy workforce and a long history as a trusted supplier of energy security and resources

exports. Achieving the Australian Government's hydrogen ambitions will help crystallise Australia's renewable energy superpower potential.

4.3.1 Biomethane offers a viable gas alternative for the hard to abate sector towards 2050

Biomethane is a refined biogas that can be produced from waste feedstocks and is chemically nearly identical to pipeline gas. As a result, biomethane can be transported through existing gas infrastructure.

Biomethane industries developed overseas have often needed initial government support. Current mechanisms available to the biomethane and biogas industry to unlock investment are the Australian Carbon Credit Unit scheme. Calls have also been made to improve the certification and emissions accounting when biomethane is delivered through a shared gas network. The Australian Government consulted on priorities for further products under its Guarantee of Origin (GO) scheme in October-November 2023.

Feedstocks for biomethane can also be used to make different products, such as aviation fuels and biodiesel. Understanding the availability and optimal uses for feedstocks will help determine what role biomethane can play in a net zero economy.

4.3.2 Hydrogen can also help to decarbonise gas

Hydrogen offers the potential to replace gas for high temperature industrial applications, in medium to heavy duty transport, and where gas is required as a feedstock to produce chemicals like ammonia and methanol.

The Australian Government is assisting the development of the hydrogen industry through several initiatives, including the Hydrogen Headstart program, the Regional Hydrogen Hubs Program and the development of the Guarantee of Origin Scheme. These schemes are an initial investment for the nascent industry, and signal Australia's intent on becoming a renewable energy superpower. The Australian Government is leading a Review of the National Hydrogen Strategy in collaboration with the states and territories.

ARENA has had an investment focus on renewable hydrogen research, development and deployment for a number of years and has funded a wide range of projects, pilots and feasibility studies in Australia. Hydrogen is central to several priorities in ARENA's General Funding Strategy, including to priorities to commercialise clean hydrogen, support the transition to low emissions metals and decarbonise land transport. The CEFC also administers the Advancing Hydrogen Fund under its investment mandate.

4.4 Liquid fuels need to transition to reach net zero

Australia's liquid fuel market has changed over the past two decades. Most domestic refineries have closed, and the market is increasingly reliant on imports of crude oil and refined fuel, which account for over 90% of our total fuel consumption.³² Australia has access to diverse global supply chains, which

³² DCCEEW, [Australian Petroleum Statistics](#), 2024.

encourages competitive prices but also increases market complexity and exposes Australia to global geopolitical disruptions.

The emissions footprint of Australia’s liquid fuel use is almost as large as that of coal combustion.³³ While our liquid fuel use has increased only slightly (4%) over the past decade, diesel use has increased by almost 30% over this period.³⁴

Australia’s overall reliance on liquid fuels is projected to continue well into the 2030s and beyond. Looking forward, petrol demand is expected to decline slowly as electrification options, energy efficiency and energy conservation techniques develop. However, demand for diesel and jet fuel is expected to remain steady or increase. This is due to slow development and deployment of feasible alternative energy options, and to increased activity by fuel users. Given this, liquid fuels need to play a role in Australia’s pathway to 2050, and fuel security risks need to be managed through the transition.

4.5 Low carbon liquid fuels can help decarbonise fuel reliant sectors that can’t electrify

Some industries will remain reliant on liquid fuels in the short to medium-term because there are currently significant technical and cost challenges in switching operations to use electricity or hydrogen. This is particularly true in transport sectors (aviation, heavy vehicles, maritime), construction, mining, and agriculture.

The Australian Government is committed to supporting a low carbon liquid fuels (LCLF) industry in Australia. These fuels offer shorter-term decarbonisation solutions because they can be incorporated into existing fuel systems, and production technologies are available. LCLF are fuels produced from feedstocks that emit low- to zero- lifecycle emissions compared to the fuels they are displacing. LCLF are produced sustainably from waste materials, biomass, or combining hydrogen from low- or zero-carbon feedstocks with captured carbon dioxide. Domestic production of LCLF can also help with long-term fuel security by diversifying our fuel sources and decreasing our dependence on imported liquid fuels.

Australia is well placed to lean into a LCLF industry. We have access to renewable feedstocks, and several LCLF production facilities and projects are already underway. The Australian Government is also investing in projects through the Sustainable Aviation Fuel Funding Initiative and the Hydrogen Headstart program, which will help catalyse LCLF production pathways.

Nonetheless, Australia’s LCLF industry is still developing and key challenges must be considered. These include high capital and production costs, reaching efficient scales of production, and managing ongoing competition for feedstocks. There are also challenges around enabling and valuing supply in Australia and ensuring production is sustainable.

The Australian Government is considering a framework to support the domestic LCLF industry and help the market overcome barriers in the short, medium and long term. As a start, we are working on new

³³ DCCEEW, [National Inventory Report 2021](#), April 2023, Figure 3.5

³⁴ DCCEEW, [Australian Petroleum Statistics](#), 2024.

fuel quality standards to enable supply of LCLF such as renewable diesel.³⁵ Additionally, we are considering certification and accounting frameworks to support a domestic industry. Policies in this area will need to drive and align with broader government priorities, including emissions reduction and a nature positive approach to environment and water resource management. This means that, in building the LCLF industry, waste hierarchy must be followed and innovation encouraged to ensure feedstocks used are weighted in favour of feedstocks that maximise decarbonisation outcomes. It will also be important to promote socially acceptable pricing of LCLF in the longer-term, and collaboration across all levels of government to harmonise and manage risks to decarbonisation programs.

While our focus is on a domestic industry, imported LCLF supply should also be encouraged as it can support end user needs in the near term and may be an effective abatement option.

4.6 Liquid fuel security needs to be managed through the transition

Fuel security remains a priority, so Australians have reliable access to fuels at affordable prices. Our economy continues to rely on fossil-based liquid fuels, and any large supply disruption events would have widespread impacts. A domestic LCLF industry can improve the sustainability and security of Australia's fuel, but it will take time.

The Australian Government is building a domestic fuel reserve, through the Minimum Stockholding Obligation which commenced on 1 July 2023, and supporting the operation of domestic refining capability. These measures are at the centre of our existing fuel security framework.

It will be important to ensure Australia maintains diverse and resilient supply chains through the transition. We will need to address challenges around diesel, which is expected to transition more slowly than other liquid fuels. Our fuel infrastructure will remain critical even in a rapid energy transformation. Australia's energy security and affordability could be significantly undermined by unplanned or premature retirement of fuel infrastructure in Australia and abroad, including refineries and other supply, distribution or storage infrastructure.

It is important fuel security is maintained while we seek to meet both energy and climate objectives through the transition.. The Plan will provide an overview of our long-term fuel security focus and guide the energy industry to make investment decisions that encourage an orderly and cost-effective transition to net-zero.

4.7 Actions are needed to transform Australia's liquid fuels market

We are committed to increasing the share of domestically produced LCLF in our fuel mix. However, we need to take a coordinated and balanced approach to drive this and manage reliability. To achieve this, we propose to focus on actions that place Australia's net-zero targets at the centre of liquid fuel security, establish a policy framework to support industry innovation and investment, and enhance our long-term resilience against major disruptions. Policy options are proposed to fall under the 4 policy focus areas outlined below. Through the sectoral plan process, we plan to engage with industry

³⁵ DCCEEW, [Enabling supply of renewable diesel in Australia: a consultation paper on establishing a paraffinic diesel fuel standard for Australia](#), November 2023.

on policy options to ensure any proposed actions and timing of transition milestones will support both industry and broader national interests, including for fuel users.

Policy focus areas	1. Decarbonise our liquid fuel mix	2. Reduce fossil based liquid fuel demand	3. Ensure fuel security and reliability	4. Manage supply chain vulnerabilities
Reason:	Driving LCLF supports decarbonisation efforts and de-risks fuel supply through diversification	Improving energy efficiency and promoting behavioural change reduces emissions and fuel demand	Enhancing and extending fuel security actions will ensure climate and energy objectives are met through the transition	Preparing for disruptions ensures government and industry can quickly respond to emerging fuel supply chain risks

We will also work to increase energy security and reduce costs for regional and remote communities reliant on diesel generation, while minimising impacts of the transition. This includes working with First Nations communities that are currently reliant on diesel generation to secure and reliable clean energy supplies, as part of the First Nations Clean Energy Strategy.

Seeking your views: Growing alternative low carbon fuels, and managing fuel security

5. What policy settings and certainty are required to support a fair, equitable and orderly transition for the decarbonisation of both natural gas and liquid fuels?
6. What actions are required to establish low carbon fuel industries in Australia, including enabling supply and demand, and what are the most prospective production pathways?
7. Are the proposed policy focus areas for managing the liquid fuels transition (outlined in Section 4 of the discussion paper) the correct areas to focus on, and what is missing?

When providing feedback, you may wish to comment on:

Gas

- considerations for the role of gas to 2050, and how these should be balanced
- challenges for ensuring the decarbonisation of gas in Australia is fair, equitable and orderly
- Commonwealth, state and territory government policies and regulatory changes needed to manage the impact of transition on the gas industry and consumers, particularly vulnerable households, as gas use is decreased over time.

Liquid fuels

- key risks for fuel security in the near, medium and long-term and policy actions required.

Low carbon fuels

- barriers and opportunities for building low carbon fuel industries (gaseous, liquid and solid), including for users and producers, and policies required across supply chains to drive low carbon fuel industries in the short, medium and long term
- trade-offs and other uses for feedstocks, and where and when particular fuels should be prioritised
- different fuel production pathways, including biogenic and synthetic, and how these will change over time.

5. Building Australia's clean energy workforce

Australia's energy transformation will require a substantial workforce transformation. If we are to be a world-leading supplier of clean energy, we need the workforce and the skills to support that ambition. This also presents an opportunity to develop a more diverse workforce and create sustainable employment for future generations. This includes opportunities to revitalise regional labour markets as growth in technical clean energy occupations is expected to be concentrated in regional Australia.

The transformation of the energy workforce represents opportunities for Australia and the energy sector. New jobs, skills, qualifications, training pathways, technologies and industries will emerge over the next 30 years, creating new employment opportunities. Employment diversity in the energy sector is low. The energy transformation presents an opportunity to address participation issues that exist in the industry.³⁶

This transformation also presents a major challenge. The future energy sector needs a technically skilled and diverse workforce, particularly engineers and electricians (to design, construct, operate and maintain renewable energy systems) and corporate professionals (for community liaison, commercial trading and project management). Jobs and Skills Australia have identified 38 critical occupations for the clean energy transformation, and estimate that demand for these 38 occupations is likely to increase by around 15% in the next seven years to deliver the net zero transformation.³⁷

There is an emerging shortage of people with the skills and training to support the transformation. Jobs and Skills Australia analysis suggests that Australia is likely to experience significant shortages in electrical, building and engineering trades.³⁸ Skilled migration can play a role in addressing some skills shortages, particularly for highly specialised roles. Australia will need a fit-for-purpose migration system and an attractive labour market to attract specialised workers given significant international competition for these skills. Even so, migration alone will not meet our future workforce needs and it is not a substitute for training Australians.

New occupations are developing that are not officially measured or planned for in the current system, so official data sources may need to evolve to better understand energy workforce developments through the transition. Among specialised roles required include community engagement specialists to support best practice engagement and adjust community engagement to specific communities.

The energy transformation will particularly impact regional workforces, presenting both challenges and opportunities. Clean energy activities will be regionally located, and JSA analysis shows that transition-related employment growth will be stronger in the regions than urban centres.³⁹ However, regions that are currently reliant on fossil fuel industries will be exposed to transition risks so it is

³⁶ Jobs and Skills Australia (JSA), [The Clean Energy Generation](#), October 2023.

³⁷ JSA, [The Clean Energy Generation](#), October 2023.

³⁸ JSA, [Towards a National Jobs and Skills Roadmap: 2023 Annual Jobs and Skills Report](#), October 2023.

³⁹ JSA, [The Clean Energy Generation](#), October 2023.

important Government works with the private sector and communities to optimise training and investment. Regional communities, particularly those with large fossil fuel industries, will need improved access to education and training to gain the skills needed for future jobs.

The Australian Government is investing in skills and training to support the energy transformation. This includes the New Energy Apprentices program which is providing additional support to up to 10,000 apprentices across 40 occupations. The new National Skills Agreement will also provide up to \$12.6b to the Vocational Education and Training (VET) system over 5 years to support priority skills, including energy sector trades.

The forthcoming National Energy Workforce Strategy will provide a co-ordinated, people-centred and national approach to ensure Australia has a pipeline of highly skilled and diverse workers to support the energy transformation. The Strategy will consider opportunities for reskilling labour in energy and resources to ensure transferable skills and capacity building for newer kinds of energy generation and more.. It will also consider the education and skills support needed to ensure that regional communities benefit from the energy transformation, and opportunities for the new clean energy workforce to improve diversity outcomes, particularly through increasing female and First Nations participation.

In addition, the Australian Government is investing \$83.2 million over 4 years from 2023–24 to establish a national Net Zero Economy Authority (NZEA) to promote orderly and positive economic transformation associated with decarbonisation and energy system change in regional areas, including support for impacted workers. A key pillar of the NZEA work will be supporting workers who are impacted by the net zero transformation. This will involve supporting workers in emissions-intensive facilities, like coal-fired power stations, to access new employment, skills and opportunities.

Seeking your views: Building Australia’s clean energy workforce

8. What actions are required to ensure workforce requirements for the energy transformation are met, while supporting equitable outcomes?

When providing feedback you may wish to comment on:

- key specialist skills that need to be supported
- barriers and opportunities for recruiting and retaining skilled workers, including First Nations Australians and women
- opportunities for regional workforce and workers in fossil fuel industries
- considerations for upskilling and reskilling the existing energy workforce.

6. Maximising outcomes for people and businesses

People are at the centre of the energy transformation. The transition is changing the way Australians interact with energy providers because of new market operations, technological advancements and decarbonisation objectives. These changes are creating opportunities for households and businesses to contribute to the energy transformation, and new challenges for policymakers to manage. The rapid expansion in the options available to consumers is beneficial, but it is important that we ensure the consumers are protected against the potential risks from new models.

Simultaneously, ensuring community support and social licence is a key enabler for the energy transformation. It will be necessary to ensure all Australians are able to access information on the energy transformation and are able to access these benefits. There are opportunities to ensure all segments of the community are able to share in these benefits. The transition can have the twin benefits of increasing equity and helping us to meet our decarbonisation objectives.

6.1 Energy is important to the cost of living

The energy system of the future will involve renewable energy that is increasingly distributed throughout homes, businesses and communities with rooftop solar, batteries and community grid options. This is a significant shift from our current energy market but one that can deliver lower cost, more reliable and secure energy over the long term.

Energy bills are a significant part of household budgets. Low-income households spend as much as 5.7% of their annual income on electricity and as much as 4.4% of annual income for gas – twice as much as average-income households.⁴⁰ Over the past 2 years, this has been exacerbated by international events and supply constraints resulting in historically high energy prices. High energy costs are also being faced by households in remote Australia, including First Nations households, who may be off-grid and often rely on diesel generation.

Energy affordability is enhanced by the deployment of renewable energy, which is the cheapest form of electricity, replacing aging and increasingly unreliable coal assets as they retire. The Australian Government is also working with states and territories to ensure the efficient use of existing and new network infrastructure can make sure no more infrastructure is built than necessary, minimising energy network costs that are passed to consumers.

Energy customers are concerned about high prices and increasingly about value for money.⁴¹ This is not fully reflected in switching behaviour. A significant number of customers are on plans with a calculated annual cost equal to or higher than the default offer (47% of residential customers and 42% of concession customers), and 4 in every 5 residential customers could lower their bills if they switched

⁴⁰ Australian Energy Regulator (AER), [Annual retail markets report 2022-23](#), November 2023.

⁴¹ Energy Consumers Australia, [Sentiment Survey](#), December 2023

to an available better offer.⁴² Market-wide information on finding a more competitive energy plan is available on services such as the Energy Made Easy and Victorian Energy Compare government websites. Greater awareness of available tools and supports could assist customers to reduce their energy costs. The Australian Government recognises there may also be benefit to targeted information for customers who remain disengaged or face barriers to engaging with the energy market.

6.2 The energy transformation will change the way consumers interact with electricity suppliers

Households are playing an increasingly critical role in the energy transformation and need support to engage effectively.⁴³ Electricity grids are moving away from a centralised, one-way supply of energy from generators to customers and toward a distributed and increasingly two-way balance of clean energy between traditional generators, homes, and businesses. Changes to energy infrastructure to enable the energy transition are more than just increasing large-scale renewables as aging coal-fired power retires.

Electricity consumers are participating in the renewable energy transformation through unprecedented investment in household consumer energy resources (CER). Rooftop solar is now on the roofs of nearly 1 in 3 Australian homes.⁴⁴ Solar panels and battery storage (including household electric vehicles and community batteries) provide consumers the opportunity to be more self-sufficient, reduce their annual energy bills, and interact with the energy market in more dynamic ways. In November 2023, Energy and Climate Change Ministers agreed to develop a National Consumer Energy Resources Roadmap – Powering Decarbonised Homes and Communities, to unlock consumer benefits for locally generated and stored power. The roadmap will deliver national reforms for efficient and effective CER integration, deliver on emissions and renewable energy commitments, and drive positive outcomes for all consumers, while supporting the system as a whole.

Better coordination of CER can help to deliver more affordable and secure energy, while reducing our need for building new transmission and distribution lines to connect new clean energy sources to electricity grids. Recent CSIRO analysis suggests that improved CER co-ordination would reduce average electricity bills across all households, whether or not they own CER, by \$30 to \$50 per annum from 2030–2050.⁴⁵ These savings reflect the lower peak demand profile achieved by co-ordinating CER, which reduces costs across the system.

Consumer trust in a fit-for-purpose energy market is required to drive this coordination. The new energy market and corresponding roles and responsibilities are still being developed. Energy consumer protections which were designed for simple arrangements with retailers will need to be reconsidered. This represents an opportunity to review existing shortfalls in the consumer protection legislation –

⁴² Australian Competition and Consumer Commission, [Inquiry into the National Electricity Market - December 2023 Report](#), December 2023.

⁴³ Energy Consumers Australia, [Stepping Up: A smother pathway to decarbonising homes](#), August 2023.

⁴⁴ ARENA, [Solar energy](#), January 2024.

⁴⁵ Graham, P. et al., CSIRO, [Consumer impacts of the energy transition: modelling report](#), July 2023.

for example, improving protections for First Nations households in areas where disconnections are commonplace.

Increased energy market complexity means all consumers could benefit from a simple and safe way to interact with energy services, and may need extra support to make good decisions about complex offerings. If and where that complexity moves beyond a level that is reasonable for a consumer to understand, alternatives should be explored to ensure the market remains focussed on delivering the best possible outcomes for its customers.

A successful energy transformation will require that consumers are serviced by a fit-for-purpose protections framework and can be confident that the transition is designed with their interests.

6.3 Community support for the energy transformation will depend on delivering equitable and fair outcomes for all Australians

Enabling consumers to engage fully in the energy transformation and realise the benefits of CER orchestration for electricity grids will require high levels of trust in Australia's energy systems, ability to access information about how they can maximise benefits and support where consumers are unable to invest in consumer energy resources on their own.

The Australian Government, along with all Energy Ministers, is committed to achieving an equitable energy transformation for all Australians.⁴⁶ Decarbonising homes and businesses will require significant upfront costs and some households may face barriers to making investments such as installing rooftop solar or batteries, purchasing an electric vehicle or electrifying gas appliances (for example, renters, or occupants of live-in houses or apartments which are not suitable).⁴⁷ Access to affordable and reliable energy is a human right enshrined in the United Nations Sustainable Development Goals. Consumers vulnerable to or experiencing hardship must not end up shouldering an inequitable share of the burden and costs of the transition, and should receive their fair share of the benefits.

Delivering an equitable energy system will mean that all consumers, including low-income, First Nations and culturally diverse groups, need to be given tailored consideration throughout the transition. This may include financial support, but also reforming the protections framework and initiatives to improve access to useful information. In particular, the systemic disadvantage experienced by Australian First Nations peoples will require a specific focus to ensure that hardship measures accurately reflect their rights and interests, especially in remote and regional areas. The Australian Government has commented on particular issues for First Nations Australians associated with disconnection and pre-payment meters in remote communities.

In its *Towards Energy Equity Strategy*, the Australian Energy Regulator (AER) identified systemic challenges in supporting consumers vulnerable to or experiencing hardship. The AER's Game Changer project presented a compelling case for change given persistent levels of high and increasing debt

⁴⁶ ECMC, [Meetings and communiques](#), November 2023.

⁴⁷ Energy Consumers Australia, [Stepping Up: A smother pathway to decarbonising homes](#), August 2023.

levels, disconnections and failed payment plans. Governments are considering the reforms recommended by the AER and other measures to address consumer hardship.

An equitable transition will also require that low-income and disadvantaged households can access the benefits of appropriate consumer protections, consumer energy resources and more energy efficient equipment and appliances through the transition. Actions could be taken to better balance opportunities, risks, costs and benefits between the energy industry and energy consumers, and across energy consumer cohorts including those vulnerable to or facing hardship.

The transition will also involve community-level impacts, particularly for communities directly affected by new transmission infrastructure as well as changes to regional workforces and industries. To realise the benefits of new energy projects with community interests, this will require involving communities, landholders and stakeholders, including First Nations peoples.

Box 2 The Australian Government's response to the Community Engagement Review

The Australian Government engaged the Australian Energy Infrastructure Commissioner (AEIC) to lead a community engagement review (the 'Review') to improve community engagement on new energy infrastructure projects. The Review, which was publicly released in February 2024, provided advice on improving community engagement throughout the planning, development and operation of renewable energy infrastructure projects.

The Australian Government has accepted in principle all recommendations of the Review, including working with states and territories to implement recommendations. Future policy initiatives must grapple with the challenges of community participation and engagement. Actively involving communities in the planning and decision-making processes is key to building and maintaining support for the energy transformation and ensuring community benefits.

6.4 Circular economy principles will need to be embedded into the energy transformation

In 2022, Australia's Environment Ministers committed to achieving a circular economy and the Australian Government is currently developing a National Circular Economy Framework, informed by recommendations from the Circular Economy Ministerial Advisory Group. Initiatives such as product stewardship for solar panels and recycling of other renewable energy infrastructure are not only important to reducing emissions, but also important to supporting social licence for the transition. Options that support a circular economy, such as waste to energy proposals, also need to consider waste hierarchy. To date, electricity generation from waste, including landfill gas, has played a small but significant role in Australia's electricity system, in addition to being an important way of reducing methane emissions.

Seeking your views: Maximising outcomes for people and businesses

9. What actions are required to ensure better energy outcomes for people and businesses, and maximise their benefit from the energy transformation?
10. What social licence and circular economy aspects should be considered as part of the pathway for the energy transformation?

When providing feedback you may wish to comment on:

- barriers and solutions to Australia’s energy markets providing optimal energy outcomes for people from the energy transformation, including household consumer energy resources and electrification
- needs for different segments of the community, e.g. first nations and people experiencing vulnerability or hardship, that would require bespoke policy focus
- gaps and additional measures in the Australian Government’s existing actions for helping people manage energy costs and utilise support
- changes to regulatory settings and market design to optimise the way Australia’s energy markets provide energy services and supply to people.

Questions

For more information on how to have your say, please go to consult.dcceew.gov.au.

Submissions will close on AEDT 5pm 12 April 2024.

Further stakeholder engagement opportunities will be communicated through consult.dcceew.gov.au.

Seeking your views: Discussion paper questions

Mobilising investment to transform energy

1. What actions are needed to attract the required large scale private capital and household investment in the energy transformation, with or without government intervention?

When providing feedback, you may wish to comment on:

- the role of the Commonwealth, state and territory governments, private sector, foreign private investment and households for investing in the energy transformation
- components of wholesale electricity markets and supporting energy markets that need to change to facilitate efficient investment in clean energy technologies to 2050
- suggestions for supporting efficient investment in renewable generation and storage
- barriers and solutions for overcoming investment barriers
- key immediate actions required from the Australian Government support the transition
- the role for managing energy supply and demand to meet uncertain net zero transition needs, including additional electricity demand from electrification and clean export industries.

Enabling electrification for a smooth transition

2. What actions are required to ensure Australia's energy systems can enable increased electrification, while maintaining equity, reliability and security?
3. What insights do you have on the pace, scale and location of electrification, and how to embed this in system planning?
4. How can electrification efforts be sequenced to align with expansion of electricity generation and network capacity?

When providing feedback, you may wish to comment on:

- barriers to electrification and additional measures needed to meet the required pace and scale of electrification
- system improvements to enable electrification across the economy – including increased smart electrification and demand flexibility
- the role of the Australian, state, and territory governments to support electrification.

Growing alternative low carbon fuels

5. What policy settings and certainty are required to support a fair, equitable and orderly transition for the decarbonisation of both natural gas and liquid fuels?
6. What actions are required to establish low carbon fuel industries in Australia, including enabling supply and demand, and what are the most prospective production pathways?
7. Are the proposed policy focus areas for managing the liquid fuels transition (outlined in Section 4 of the discussion paper) the correct areas to focus on, and what is missing?

When providing feedback, you may wish to comment on:

Gas

- considerations for the role of gas to 2050, and how these should be balanced
- challenges for ensuring the decarbonisation of gas in Australia is fair, equitable and orderly
- Commonwealth, state and territory government policies and regulatory changes needed to manage the impact of transition on the gas industry and consumers, particularly vulnerable households, as gas use is decreased over time.

Liquid fuels

- key risks for fuel security in the near, medium and long-term and policy actions required.

Low carbon fuels

- barriers and opportunities for building low carbon fuel industries (gaseous, liquid and solid), including for users and producers, and policies required across supply chains to drive low carbon fuel industries in the short, medium and long term
- trade-offs and other uses for feedstocks, and where and when particular fuels should be prioritised.
- different fuel production pathways, including biogenic and synthetic, and how these will change over time.

Building Australia's clean energy workforce

8. What actions are required to ensure workforce requirements for the energy transformation are met, while supporting equitable outcomes?

When providing feedback you may wish to comment on:

- key specialist skills that need to be supported
- barriers and opportunities for recruiting and retaining skilled workers, including First Nations Australians and women
- opportunities for regional workforce and workers in fossil fuel industries
- Considerations for upskilling and reskilling the existing energy workforce.

Maximising outcomes for people and businesses

9. What actions are required to ensure better energy outcomes for people and businesses, and maximise their benefit from the energy transformation?
10. What social licence and circular economy aspects should be considered as part of the pathway for the energy transformation?

When providing feedback you may wish to comment on:

- barriers and solutions to Australia’s energy markets providing optimal energy outcomes for people from the energy transformation, including household consumer energy resources and electrification
- needs for different segments of the community, e.g. first nations and people experiencing vulnerability or hardship, that would require bespoke policy focus
- gaps and additional measures in the Australian Government’s existing actions for helping people manage energy costs and utilise support
- changes to regulatory settings and market design to optimise the way Australia’s energy markets provide energy services and supply to people.

Other

11. What are other gaps in Australia’s energy sector decarbonisation policy and what actions are required to address them?

Glossary

Acronym	Definition
ACCC	Australian Competition and Consumer Commission
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
AIHW	Australian Institute of Health and Welfare
ARENA	Australian Renewable Energy Agency
CCUS	Carbon capture use and storage
CEFC	Clean Energy Finance Corporation
CER	Consumer energy resources
CIS	Capacity Investment Scheme
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DCCEEW	Department of Climate Change, Energy, the Environment and Water
ECMC	Energy and Climate Change Ministerial Council
ETI	Australian Industry Energy Transition Initiative
GPG	Gas-fired power generation
IEA	International Energy Agency
ISP	Integrated System Plan
JSA	Jobs and Skills Australia
LCLF	Low carbon liquid fuels
LNG	Liquefied natural gas
NEM	National Electricity Market
NZEA	Net Zero Economy Agency
OECD	Organisation for Economic Co-operation and Development
The Plan	Electricity and Energy Sector Plan
The Partnership	National Energy Transformation Partnership
RD&D	Research, development and deployment
The Review	The Community Engagement Review
VET	Vocational Education and Training
WEM	Wholesale Electricity Market

References

- AGL, *Electrify Now*, accessed January 2024. [Electrify Now - Help Save Money on Your Energy Bills \(agl.com.au\)](https://www.agl.com.au)
- AusNet, *AusNet trial to look at impact of electrification on vulnerable households*, October 2023. <https://www.ausnetservices.com.au/news/ausnet-trial-to-look-at-impact-of-electrification-on-vulnerable-households>
- Australian Bureau of Statistics, *Monthly Consumer Price Index Indicator*, November 2023. <https://www.abs.gov.au/statistics/economy/price-indexes-and-inflation/monthly-consumer-price-index-indicator/nov-2023>
- Australian Competition and Consumer Commission, *Inquiry into the National Electricity Market - December 2023 Report*, December 2023. <https://www.accc.gov.au/about-us/publications/serial-publications/inquiry-into-the-national-electricity-market-2018-25/inquiry-into-the-national-electricity-market-december-2023-report>
- Australian Energy Market Operator (AEMO), *2022 Integrated System Plan*, June 2022. <https://aemo.com.au/-/media/files/major-publications/isp/2022/2022-documents/2022-integrated-system-plan-isp.pdf?la=en>
- *2023 Electricity Statement of Opportunities*, August 2023. https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/nem_esoo/2023/2023-electricitystatement-of-opportunities.pdf?la=en&hash=D8CC2D9AC8D9F353194C9DD117095FB4
- *Draft 2024 Integrated System Plan*, December 2023. https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2023/draft-2024-isp-consultation/draft-2024-isp.pdf?la=en
- *What is 5-Minute Settlement (5MS)?*, 2020. <https://www.aemo.com.au/-/media/files/electricity/nem/5ms/program-information/2021/5ms-factsheet.pdf>
- *Wholesale Electricity Market Design Summary*, September 2023. <https://aemo.com.au/-/media/files/initiatives/wem-reform-program/wem-reform-market-design-summary.pdf>
- Australian Renewable Energy Agency, *Origin Energy Electric Vehicles Smart Charging Trial*. March 2023. <https://arena.gov.au/projects/origin-energy-electric-vehicles-smart-charging-trial/>
- *Solar energy*. January 2024. <https://arena.gov.au/renewable-energy/solar>
- Brinsmead, T.S., White, S., Bransden, C., Stanley, C., Hasan, K., Alexander, D., Sprague, M., Northey, J., Walgenwitz, G., Nagrath, K., Briggs, C., Leak, J., Harkins-Small, L., Murray-Leach, R. and Jennings, K. *Flexible demand and demand control. Final report of opportunity assessment for research theme B4*, RACE for 2030 CRC. October 2021. [Flexible demand and demand control. Final report of opportunity assessment for research theme B4](https://www.aemo.com.au/-/media/files/initiatives/wem-reform-program/wem-reform-market-design-summary.pdf)

- Business Council of Australia, *Australia's investment drought and what to do about it*, March 2023. <https://www.bca.com.au/australia-s-investment-drought>
- Centre for International Economics, *What existing economic studies say about Australia's cost of abatement*, July 2019. https://www.dcceew.gov.au/sites/default/files/documents/what-existing-economic-studies-say-about-australias-cost-of-abatement_0.pdf
- Clean Energy Council, *Clean Energy Australia Report 2023*, April 2023. <https://assets.cleanenergycouncil.org.au/documents/Clean-Energy-Australia-Report-2023.pdf>
- Climateworks Centre and Climate-KIC Australia, Australian Industry Energy Transitions Initiative, *Pathways to industrial decarbonisation: Positioning Australian industry to prosper in a net zero global economy*, August 2023. <https://www.climateworkscentre.org/resource/pathways-to-industrial-decarbonisation-positioning-australian-industry-to-prosper-in-a-net-zero-global-economy/>
- Department of Climate Change, Energy, the Environment and Water, *Australian Energy Statistics*, September 2023. <https://www.energy.gov.au/energy-data/australian-energy-statistics>
- *Australia's Emissions Projections 2023*, November 2023. <https://www.dcceew.gov.au/climate-change/publications/australias-emissions-projections-2023>
- *National Inventory Report 2021*, April 2023. <https://www.dcceew.gov.au/climate-change/publications/national-inventory-report-2021>
- Energy and Climate Change Ministerial Council, *Energy and Climate Change Ministerial Council*, September 2022. <https://www.energy.gov.au/energy-and-climate-change-ministerial-council>
- *Incorporating an emissions reduction objective into the national energy objectives*, June 2023. <https://www.energy.gov.au/energy-and-climate-change-ministerial-council/working-groups/governance-working-group/incorporating-emissions-reduction-objective-national-energy-objectives>
- *Meetings and communiques*, November 2023. <https://www.energy.gov.au/energy-and-climate-change-ministerial-council/meetings-and-communiques>
- Energy Consumers Australia, *Sentiment Survey*, December 2023. ecss.energyconsumersaustralia.com.au/sentiment-survey-dec-2023/
- *Stepping Up: A smother pathway to decarbonising homes*, August 2023. <https://energyconsumersaustralia.com.au/publications/stepping-up>
- Graham, P., Meher-Homji, Z., Havas, L., Foster, J... *Consumer benefits of the energy transition: modelling report*. Commonwealth Scientific and Industrial Research Organisation. July 2023. <https://publications.csiro.au/publications/publication/PIcsiro:EP2023-0538>
- International Energy Agency (IEA), *Electrification*, n.d. <https://www.iea.org/energysystem/electricity/electrification>

- *Net Zero Roadmap – 2023 Update*, September 2023.
<https://www.iea.org/reports/netzero-roadmap-a-global-pathway-to-keep-the-15-0c-goal-in-reach>
- *World Energy Outlook 2023*, October 2023. <https://www.iea.org/reports/world-energy-outlook-2023>
- Jobs and Skills Australia, *The Clean Energy Generation*, October 2023.
<https://www.jobsandskills.gov.au/publications/the-clean-energy-generation>
- 2023 Skills Priority List: Key Findings Report, September 2023.
<https://www.jobsandskills.gov.au/data/skills-shortages-analysis>
- New Zealand Ministry for the Environment, *Marginal abatement cost curves analysis for New Zealand*, January 2020. https://environment.govt.nz/assets/Publications/Files/marginal-abatement-cost-curves-analysis_0.pdf
- U.S. Department of Energy and the U.S. Environmental Protection Agency, *All-Electric Vehicles*, accessed January 2024. <https://www.fueleconomy.gov/feg/evtech.shtml>