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26 April 2024

To: Department of Climate Change, Energy, the Environment and Water
RE: Electricity and Energy Sector Plan consultation

Thank you for the opportunity for the Institute for Energy Economics and Financial Analysis (IEEFA) to provide input on the Electricity and Energy Sector Plan discussion paper. IEEFA is an energy finance think tank that examines issues related to energy markets, trends, and policies. The Institute's mission is to accelerate the transition to a diverse, sustainable and profitable energy economy.

In IEEFA's view, the Electricity and Energy Sector Plan should:

- Set a plan for decarbonisation of Australia's energy systems in line with the Paris Agreement to keep warming below 1.5 degrees Celsius.
- Clearly articulate the future state of the energy system – including saturation levels of rooftop solar, instantaneous 100% renewable electricity, decommissioned gas networks and zero coal capacity.
- Outline what is required to achieve the 82% renewables target (and the future energy system end state) and to achieve high levels of DER uptake and electrification.
- Aim to deliver an efficient energy system and maximise the economic opportunities for Australia.
- Inform and guide the Integrated System Plan (ISP), the Consumer Energy Resources (CER) Roadmap, the Gas Statement of Opportunities (GSOO), the Electricity Statement of Opportunities (ESOO), the National Electricity Performance Strategy (NEPS) and other energy and electricity system plans.
- Give equal focus to large scale-energy resources as distributed energy resources (DER), and equal focus to the supply side as to the demand side.
- Explain the initiatives, policies and system-level changes that will be needed to deliver the Plan.
- Be developed based on the updated National Energy Objectives, which include consideration of achievement of emissions reduction targets.

Moreover, as further detailed in our submission, the Plan should:

- Mobilise investment to transform energy by:
    - Making strategic adjustments to the Capacity Investment Scheme (CIS) to help mobilise investments in large-scale renewables.
    - Providing a firm coal exit schedule that the energy industry can rely on, delivering certainty for investors in new capacity.

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  - Mobilising consumer investment in DER by developing the policies, regulations, markets and standards to support DER uptake and effective DER integration.
  - Mobilising investment in energy performance by supporting households and businesses to make decisions that lower their energy bills.
  - Attracting private capital through a range of measures.
- Enable electrification for a smooth transition by:
  - Improving appliance standards to encourage new appliances to be efficient, flexible and electric.
  - Providing targeted policy support to make electrification accessible to all.
  - Avoiding electrification delays that lock consumers into higher costs and higher emissions.
  - Taking advantage of spare capacity in the existing electricity system.
- Conscientiously plan for the future of liquid and gaseous fuels by:
  - Developing an equitable plan to phase down residential gas networks.
  - Reserving alternative gases such as hydrogen and biomethane for their highest-value end uses.
- Building Australia's clean energy workforce.
- Maximise outcomes for people and businesses by:
  - Acknowledging that DER can provide a range of benefits and measures need to be taken to realise these benefits. In particular, electric vehicles (EVs), distributed storage and demand flexibility can support the grid and the economy more broadly.
  - A review of network economic regulation will be required to ensure investment in networks and DER is efficient, and network prices are not higher than necessary.
  - A governance review will also be required to ensure Australia can move at the pace required.

Regards,

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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?

The Capacity Investment Scheme can unlock investment in large-scale renewables and storage

The Capacity Investment Scheme (CIS) will support investment in 23 gigawatts (GW) of new renewables to help Australia reach its 82% target. However, adjustments to the scheme could help ensure success in reaching this target. The Electricity and Energy Sector Plan should inform CIS targets and planning.

IEEFA modelling has found that 36GW of new renewables is required to reach 82% – this is similar to AEMO's draft 2024 Integrated System Plan (ISP) findings. To meet the capacity requirements, the federal government should consider expanding the CIS *or* ensuring that New South Wales (NSW)'s commitments to install 12GW of renewables are counted as additional to the federal government's 23GW.[1]

IEEFA has also suggested further initiatives to ensure the success of the CIS in our recent submission to the Department of Climate Change, Energy, the Environment and Water (DCCEEW). The suggestions include:

- Setting a standing offer to accelerate the CIS – making CIS support available to any project that can reach construction commitment within 18 months. This would encourage faster renewables development.[2]
- Given the limited time available to meet the CIS capacity targets, the auction rounds could be oversubscribed in terms of capacity – agreeing to support more capacity than the capacity required, but only on the condition that the capacity is committed to construction by a certain date.[3] This would also encourage faster renewables deployment.

Coal exit certainty is needed

The Electricity and Energy Sector Plan should provide a firm coal exit schedule that extends far into the future and that investors can rely upon to make informed decisions. It should demonstrate how Australia can remain within 1.5 degrees Celsius and meet the 82% renewables by 2030 target.

A certain coal exit schedule would help ensure reliability in the electricity system and the achievement of the renewables target. It would deliver investment certainty for investors in new

[1] IEEFA. Submission: Expanded Capacity Investment Scheme (CIS) – Design Paper. 25 March 2024.
[2] Ibid.
[3] Renew Economy. Five ways to save Capacity Investment Scheme, and Australia's renewable target, from attack by zombies. 19 April 2024.

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renewable and storage capacity. As we wrote in our submission to the Orderly Exit Management Framework (OEMF) consultation:[4]

"IEEFA's understanding is that coal power stations need to come out of the system faster than has been planned, in order to meet emissions reduction goals. The Australian Energy Market Operator (AEMO)'s Draft 2024 Integrated System Plan (ISP) forecasts coal power stations will exit two to three times faster than their announced dates, which would be in line with a 1.8-degree trajectory.[5] To keep in line with 1.5 degrees would require even faster coal exits.

"Governments and the energy industry need to focus on building renewables and storage as quickly as possible to replace coal power plants, while also encouraging greater use of cost-effective options to reduce or shift demand to reduce the need for power supply capacity. Once enough renewables and storage are built to ensure reliability, coal plants should close as soon as possible.

"We believe there is merit in exploring options to ensure reliability as coal exits and to help deliver an orderly transition. We outlined various such mechanisms in a paper There's a Better Way To Manage Coal Closures Than Paying To Delay Them*.[6] In particular, developing additional system reserves could be a good option for the NEM to explore further at this point in time, as well as financial bond mechanisms to penalise owners of ageing power stations if they do not adhere to minimum reliability performance requirements or elect to close without providing adequate notice."*

Mobilising consumer investment in DER

Australian consumers have invested around $25 billion on rooftop solar and other distributed energy resources (DER).[7] DER has a large and growing role in the electricity system, as forecast by the Australian Energy Market Operator (AEMO) in its draft 2024 ISP.

The Electricity and Energy Sector Plan should give equal focus to DER as to large-scale electricity resources. To ensure consumers continue to invest in DER and gain the maximum level of benefits from existing investments, the right policies, regulations, markets and standards need to be developed. The various measures are outlined in our IEEFA report *Growing the Sharing Energy Economy*, and summarised below. These measures should be included in the Electricity and Energy Sector Plan and/or the Consumer Energy Resources (CER) Roadmap.

1. Ensure appropriate technical standards are in place:

[4] IEEFA. Submission to Energy Ministers Australia regarding the Orderly Exit Management Framework Consultation. 8 February 2024.
[5] AEMO. Draft 2024 Integrated System Plan. December 2023.
[6] IEEFA. There's a Better Way To Manage Coal Closures Than Paying To Delay Them. September 2021.
[7] IEEFA. Faster Decarbonisation: What State Governments Can Do To Support Distributed Energy Resources. May 2022.

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- Create a DER Technical Authority to set a vision for DER technical standards; develop a technical standard work program; monitor, review and set DER technical standards; consider issues related to compliance and enforcement of standards in their development; and provide advice on standards to other government and energy market bodies, and undertake related reviews.

2. Remove static constraints on existing solar:

- Agree to prioritise the implementation of flexible exports (dynamic operating envelopes) across the National Electricity Market (NEM) and the Wholesale Electricity Market (WEM) by 2025.
- Agree to work collectively to ensure distribution networks are being operated at voltages that reduce consumer costs and improve consumer outcomes, especially rooftop solar exports and appliance longevity.

3. Unlock flexible demand:

- Make a rule to include aggregated household demand in the wholesale demand response mechanism.
- Direct the AEMO to develop more flexible baseline methods, for both commercial and industrial, and aggregated residential demand response in line with international best practice.
- Agree to legislate a requirement for priority household appliances to be sold with "demand response capability" under the Commonwealth Greenhouse and Energy Minimum Standards (GEMS) Act 2012.
- Agree to develop a national strategy for flexible domestic hot water with a priority on considering how best to support both the electrification of gas hot water systems, and making existing electric hot water systems demand-responsive.

4. Fast-track distributed storage:

- Advocate to the Federal Treasurer that the Commonwealth's Small Business Energy Incentive run for three years, until 20 June 2026.
- Advocate to the Federal Government to allow aggregated storage (and, where possible, flexible demand) to participate in the CIS.
- Consider other ways to support behind-the-meter (BTM) storage, including for reasons of resilience, and including through the Small-scale Renewable Energy Scheme (SRES).
- Agree that the new DER Technical Authority develop an electric vehicle (EV)-to-grid (V2G) integration workplan.

5. Create a level-playing field in network services:

- Commission a thorough, independent review of distribution network revenue regulation with the objective to ensure the revenue regulation supports

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decarbonisation, the integration of DER and improved consumer outcomes, as well as economic efficiency.

6. Ensure fit-for-purpose governance:

- Issue a Statement of Expectations to all energy market institutions (the Australian Energy Markets Commission (AEMC), AEMO, the Australian Energy Regulator (AER)) stating that the National Electricity Objectives' emissions reduction objective requires rapid integration of both large- and small-scale renewables, storage and flexible demand, and ensuring that Australia regulation and its implementation are world-leading.
- Commission an independent review of energy market governance and its fitness for purpose for integrating DER and the energy transition. This could be completed within six months.

Source: IEEFA.[8]

Unlocking investment in energy performance

IEEFA recommended a range of measures to mobilise investment in energy performance in our 2024-25 pre-budget submission.[9] Investments in improving energy performance can reduce energy bills for households and businesses. IEEFA's recommendations include:

- Household cost-of-living busters:
  - Tax deductions for minimum energy performance rental standards.
  - Support and grow one-stop consumer energy shops nationally.
  - Electrification industry capacity building.
  - Top up funding for social housing energy retrofits.
- Assist commercial and industrial sector with energy performance:
  - Financial support for first wave of industrial heat pumps.
  - Simplify and support large energy-using businesses' energy performance decision-making.
  - Extend the Small Business Energy Incentive.
- Further energy performance proposals:
  - Build refrigeration industry capacity.
  - Establish a domestic hot water strategy.
  - Upgrade funding for GEMS and DER standards.

These should be considered in the Electricity and Energy Sector Plan.

[8] IEEFA. Growing the Sharing Energy Economy. 13 October 2023.
[9] IEEFA. Submission to the Australian Treasury's consultation on 2024–25 Pre-Budget submissions. 31 January 2024.

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Solutions to attract private capital

Australia has set ambitious goals to achieve net zero emissions by 2050 and become a renewable energy superpower. To realise this vision, a significant transformation of the energy sector is required, necessitating substantial investments in clean technologies, infrastructure and innovation. To achieve net zero and turn Australia into a renewable energy leader, substantial investment will be needed: approximately A$12 billion annually for the electricity sector until 2050, and more than A$40 billion yearly to decarbonise other economic sectors and boost energy-intensive exports.[10]

Structural barriers and regulatory uncertainties also deter long-term investor commitments. This submission identifies key obstacles and proposes remedies to attract private capital. With supportive policies and regulations, Australia can unlock investments needed for a low-carbon future. In this section, we discuss some of the financial risk mitigation solutions and incentive mechanisms to attract private capital.

Enhancing risk capital avenues

The Australian government could consider expanding the role and capabilities of the Clean Energy Finance Corporation (CEFC) to go beyond its current strategy of debt and equity co-investments.[11] The CEFC could implement a comprehensive suite of catalytic financial instruments like credit enhancement mechanisms (loan guarantees, loan loss reserves, subordinated debt) in line with the tools used by green banks in other countries to address financial uncertainties pertaining to clean energy infrastructure debt:

- Mitigate financing risks and uncertainties for large-scale clean energy infrastructure projects, which currently face challenges attracting debt financing at scale, for example due to perceived higher risks given for early-stage technologies.
- Increase the loan-to-project value ratios from the current level of 50%-60% to around 70% by absorbing some of the debt risks through credit enhancement tools.

By deploying such catalytic capital instruments, the CEFC may be able to unlock higher private investment, especially from large sources like Australia's $3.5 trillion superannuation funds, which is crucial for financing Australia's net zero transition. More importantly, it can alleviate some of the financial uncertainties hampering investment from institutional investors like super funds by ensuring appropriate risk adjusted return.

Expanding the Future Fund's mandate for the energy transition

The government could consider broadening the mandate of Australia's $270 billion Future Fund, the nation's sovereign wealth fund, to include a specific focus on investing in clean energy infrastructure within Australia, alongside its existing risk-return objectives. Assigning 10%-15% of

[10] IFM Investor. Super-powering the energy transition in Australia: A policy blueprint to facilitate superannuation investment. November 2023
[11] IEEFA. Energising Australia's Green Bank. 28 February 2024

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the Fund's investments to clean energy infrastructure could yield significant catalytic effects, instilling investor confidence and encouraging further investment in the energy transition sector.

This would involve making patient, strategic equity investments in Australian critical minerals, grid infrastructure and established renewable energy firms. By leveraging the Future Fund's meticulous due diligence processes, approvals could be expedited, attracting additional capital from other investors. Furthermore, the fund could create an early-stage risk capital pool to invest in early-stage domestic clean-tech companies. Such a strategic investment approach would aim to bolster domestic capabilities and achieve scale in pivotal energy transition sectors, while maintaining majority Australian ownership and maximising tax benefits.

Potential incentives for clean energy sector

Accelerated deductions/depreciation for clean energy assets

Accelerated depreciation or amortisation for clean energy capital expenditure investments would enable investors to claim larger tax deductions for the costs of their investments in new equipment during the initial years of a project. Such provisions would enhance the after-tax profits earned by investors, thereby increasing the likelihood of these investments being undertaken. Notably, accelerated deductions are already in place for capital expenditures within sectors such as petroleum, mining, primary production and environmental protection.[12] Similar benefits are available for distributed energy projects under the US Inflation Reduction Act (IRA).[13]

Expanding tax concessions for clean tech venture capital

Existing venture capital tax concessions could be expanded to incentivise investment in early-stage Australian clean energy and technology firms. This entails explicitly including clean energy and technology companies in the definition of "eligible venture capital investments" and increasing investment caps to accommodate the higher capital needs of clean tech firms.[14]

Moreover, providing more generous tax offsets/credits for investments in the clean-tech sector would further incentivise investment. These expansions could attract more investment into local startups developing crucial clean energy and emissions reduction technologies, helping them secure vital funding during their early, risky stages.

Catalysing demand for green hydrogen-based products such as green explosives can help drive investment

Helping catalyse demand for clean energy products can help drive investments in a financially sustainable way as it reduces the need for long term support by government. For example, IEEFA

[12] PWC. Australia, Corporate – Tax credits and incentives. Last Reviewed 4 April 2024
[13] Federal Energy Management Program. Overview of Inflation Reduction Act Incentives for Federal Decarbonization.
[14] PWC. Australia, Corporate – Tax credits and incentives. Last Reviewed 4 April 2024.

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recently investigated ways in which the decarbonisation of domestic ammonia production could be accelerated.[15] We found that:

"Decarbonising ammonia and ammonium nitrate facilities presents the opportunity of a triple win: alleviating domestic gas market pressure; reducing emissions; and catalysing Australia's emerging green hydrogen.

"However, progress is slow. Most proposed green ammonia projects remain at an early stage and are focused on exports rather than replacing gas in domestic production. High production costs for green hydrogen (and therefore green ammonia) compared with conventional methods, a lack of demand at premium prices, and insufficient policy drivers are hindering widespread adoption.

"Just above half of Australia's ammonia production is used to produce explosives, with the remainder used for exports or to produce fertilisers. As major ammonia consumers through purchased explosives, miners wield significant influence and purchasing power, and can play a pivotal role in accelerating the transition to green hydrogen and ammonia. However, miners currently lack incentives to adopt green explosives due to cost considerations, a lack of policy mechanisms, and limited transparency or scrutiny regarding their contribution to company emissions. By quantifying and setting reduction targets on upstream emissions from explosives products, miners could guarantee offtake and provide the certainty required to shift investment from suppliers.

"IEEFA estimates that a complete shift to green explosives would be affordable for miners. We found that switching to 20% green ammonia for explosives production by 2025 would increase mining operating costs by less than 0.1%. This could be done by blending green hydrogen and existing gas-based hydrogen with minimal asset upgrades. A full switch to 100% green ammonia for explosives production by 2030 would increase mining operating costs by up to 0.4%, but this impact could be much lower in particularly favourable regions or if future gas prices increase. This would mean up to a 0.7% reduction in mining profit margins.

"Government support will be crucial to drive and complement action by miners, by addressing data transparency challenges and reducing investment risk. Adapting existing schemes such as Renewable Energy Certificates could drive investment in explosives inputs. The creation of a similar market-based mechanism offers the opportunity of recognition for miners' action, and financial incentives and competitive advantages for ammonia producers. Other emerging initiatives such as a hydrogen Guarantee of Origin (GO) scheme could also provide a consistent, accurate approach to tracking emissions from production of hydrogen and derivative products such as ammonia. Investment support can cover shortfalls in miners' commitments, while regulatory measures can mandate full decarbonisation of explosives production. Other measures such as legislating Scope 3 emissions reductions or placing limits on the use of offsets would also accelerate action across the ammonia supply chain."

[15] IEEFA. How mining could ignite Australia's green hydrogen boom. 29 February 2024.

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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?

Improving appliance standards is an effective enabler for the electrification transition

In IEEFA's recent briefing note *Appliance standards are key to driving the transition to efficient electric homes*, we noted that: "The continued installation of gas and resistive electric appliances is locking Australian consumers into $3.4 billion in unnecessary costs each year", but that "Improving minimum energy performance standards for space heating, hot water and cooking appliances via the Greenhouse and Energy Minimum Standards (GEMS) Act could mitigate these costs and help manage the electrification transition."[16]

In addition to facilitating a shift away from gas appliances with high running costs, our analysis found that improved appliance standards would also "[…] significantly reduce the stock of resistive electric appliances, replacing them with alternatives that consume less electricity. As well as increasing the savings for consumers, this has the effect of offsetting some or all of the added electricity demand from electrification."

[16] IEEFA. Appliance standards are key to driving the transition to efficient electric homes. 23 April 2024.

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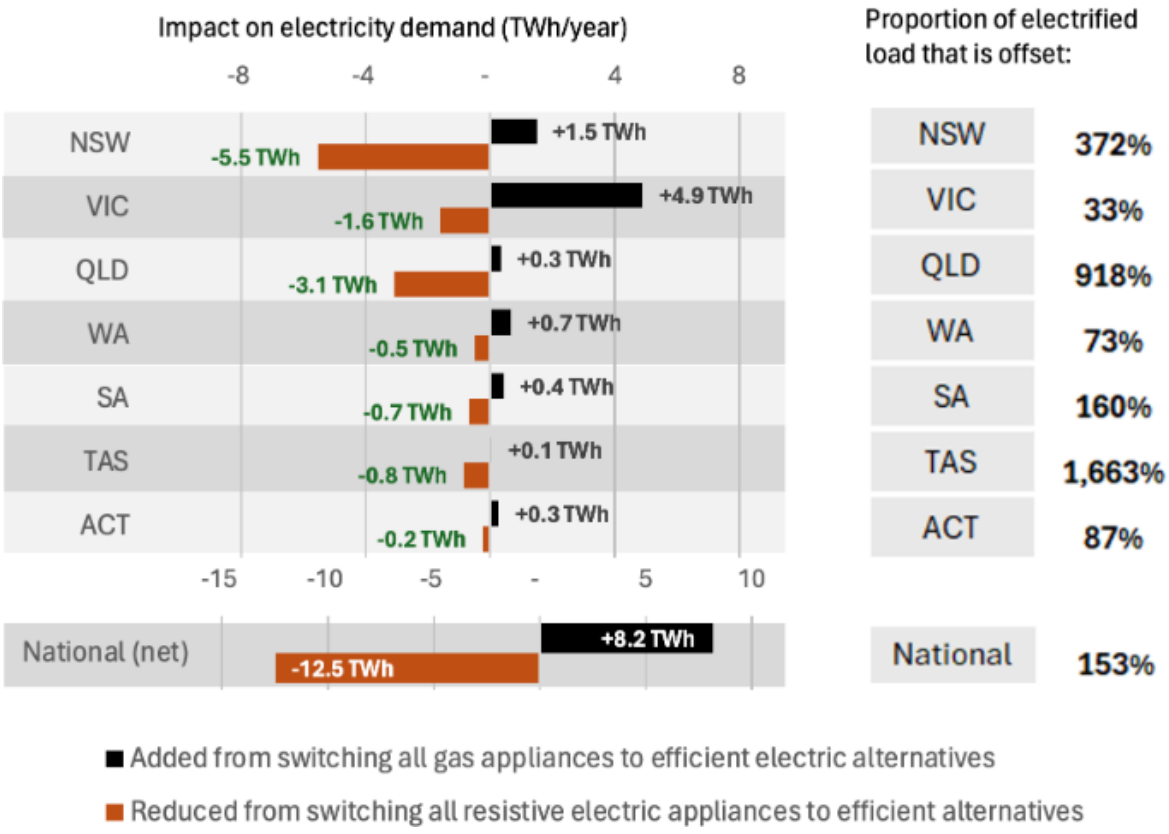
Figure 1: Effect of fully switching gas and resistive electric appliances to efficient electric alternatives



Source: IEEFA. Appliance Standards are key to driving the transition to efficient electric homes.

Additionally, we found that: "With the right policy supports, improved appliance energy performance standards can also present an equitable approach for renters, who are generally locked out of the choice to switch to higher efficiency appliances. Such standards would require that rental providers upgrade their appliances to efficient alternatives once existing inefficient appliances reach their end of life."

Policy support

IEEFA research has identified several other policy priorities that could support the transition to all-electric homes.

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a. Prioritise funding for energy performance and electrification to reduce energy bills

IEEFA's submission to the Senate Inquiry into Residential Electrification noted that "households that consume gas are more exposed to energy price inflation than if those loads were switched to electricity."[17]

On that basis, our 2024-25 pre-budget submission suggested several "Household cost-of-living busters" that could reduce energy bills by enabling electrification.[18] These included:

- Tax deductions for landlords to meet residential rental property minimum standards.
- Support for the establishment and growth of one-stop consumer energy shops nationally.
- Improved accreditation and training available for electrification.
- Top-up funding for social housing energy retrofits.
- Financial and technical support for heat pump deployment in a representative sample of industrial businesses.
- Legislation and on-budget support for energy productivity measures for energy-using businesses above a certain size.
- Extension of the Small Business Energy Incentive.
- Measures to build refrigeration industry capacity.
- Funding for the development of a national domestic hot water strategy.

b. Identify and implement solutions for hard-to-electrify homes

IEEFA has noted that: "70% of Australian homes are detached houses, which are one of the easiest archetypes to electrify or switch to higher-efficiency electric appliances. However, a growing number of Australians live in higher-density dwellings including townhouses and apartments."[19]

Work is needed to understand the size and nature of the hard-to-electrify housing stock. For these dwellings, case-by-case solutions may need to be implemented, which could include:

- "Resistive electric appliances […] when there is no alternative", while also "prioritising other actions – such as off-peak timers for hot water systems, and thermal efficiency upgrades".[20]
- Targeted deployment of biomethane for the hardest-to-electrify cases, noting this is likely to be too supply-constrained to be a mainstream fuel option for most dwellings.[21]

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[17] IEEFA. Senate inquiry on residential electrification. 28 September 2023. Page 3.
[18] IEEFA. Submission to the Australian Treasury's consultation on 2024–25 Pre-Budget submissions. 31 January 2024. Pages 4-7.
[19] IEEFA. Appliance standards are key to driving the transition to efficient electric homes. 23 April 2024. Page 8.
[20] Ibid. Page 8.
[21] IEEFA. 'Renewable gas' campaigns leave Victorian gas distribution networks and consumers at risk. 17 August 2023. Page 12.

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c. Strengthen standards and market arrangements to support greater uptake of energy efficiency, DER and demand flexibility

In its report *Managing the transition to all-electric homes*, IEEFA noted that*: "Transitioning to all-electric homes offers a significant opportunity to reduce consumer energy bills. However, bills and total energy system costs could be minimised if electrification is accompanied by other key demand-side actions."*[22]

The report also states: *"The effective orchestration of DER also offers a significant opportunity to optimise the energy system and reduce bills for all consumers, consideration should be given as to how to best make use of DER in tandem with newly electrified loads.*

"There is a significant untapped demand flexibility potential in electric appliances. However, unlocking this potential is likely to require revisions to electricity market arrangements to value residential demand flexibility, and an update to the GEMS Act requiring that priority household appliances be sold with demand-response capabilities."[23]

IEEFA's report *Growing the Sharing Energy Economy* provides further detail around some of these recommendations.[24]

d. Reduce the upfront cost burden

IEEFA has previously observed that: "Efficient electric appliances usually cost more to purchase and install than gas or resistive electric appliances. Low or zero interest loan schemes provide a simple financial mechanism to overcome this, but only if they are accessible and deliver genuine net savings to consumers."[25]

While some Australian jurisdictions have implemented low or zero interest loan schemes, these are often subject to limitations. IEEFA recommends that: "More work is needed in this space to design and implement financing solutions that are effective, accessible and profitable for consumers"[26]

Accelerated electrification can support energy security and affordability

Electrification should not only be seen as a burden on Australia's energy system. It also has the potential to help improve energy security, reliability and affordability. For example, IEEFA found

[22] IEEFA. Managing the transition to all-electric homes. 2 November 2023. Page 34.
[23] Ibid. Page 35.
[24] IEEFA. Growing the Sharing Energy Economy. 13 October 2023.
[25] IEEFA. Appliance standards are key to driving the transition to efficient electric homes. 23 April 2024. Page 8.
[26] Ibid. Page 8.

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that untapped cost-effective interventions to improve gas efficiency and expedite electrification could ensure future gas demand does not exceed forecast supply in the Southern states:[27]

"Australia is leaving many cost-effective opportunities to quickly reduce gas demand on the table. It is lagging on energy efficiency, which offers significant untapped opportunities. [...] Electrification with efficient heat pumps also has the potential to dramatically reduce gas use in residential buildings and industry. [...]

"IEEFA modelled nine illustrative energy efficiency and electrification opportunities in southern states' residential buildings and industry. [...] In total, the interventions achieve a near 80% reduction in gas use across residential buildings and industry. They also achieve significant gas demand reductions in the short term, with a reduction in gas demand of about 22% by 2027 and a 42% reduction by 2030 compared with 2022. [...] We found that these reductions could eradicate the [expected] gas supply gap."

These interventions could also address expected excess gas demand on peak days:[28]

"IEEFA's analysis shows that cost-effective, targeted gas demand reduction interventions would lower peak day demand enough to eradicate anticipated peak day excess demand under AEMO's 1-in-2 and 1-in-20-year scenarios. [...] Some of the gas demand reduction interventions will lead to additional electricity demand. However, we calculated that even if all the additional electricity was generated by gas-powered plants, the interventions would still be enough to eradicate the excess gas demand in the 1-in-2-year scenario."

As shown in these reports, interventions of this kind would reduce costs for consumers by cutting energy consumption and avoiding costly investments in new supply:

"For example, if gas appliances were replaced by efficient electric appliances at the end of their life, the average Victorian home could save $1,200 a year on its energy bills. Further, we estimate that each year of delay to ending the sales of new gas appliances costs Victorians a collective $876 million in locked-in lifetime costs. [...]"

"Improving gas efficiency and increasing the use of highly efficient electric appliances would have the double benefit of reducing market tightness and increasing the predictability of energy bills. [...] For example, we calculated that a household's winter energy costs would be only 90% higher in winter compared with summer by using heat-pump based appliances compared with 167% higher for gas-based equipment."[29]

"Increasing gas supply will instead come at a high cost that would have to be recovered through energy bills, while also undermining governments' emissions reduction efforts."[30]

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[27] IEEFA. Reducing demand: A better way to bridge the gas supply gap . 16 November 2023.
[28] IEEFA. No shortage of solutions to gas supply gap. 19 April 2024.
[29] Ibid.
[30] IEEFA. Reducing demand: A better way to bridge the gas supply gap . 16 November 2023.

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Ensuring that electrification is done flexibly will also reduce energy costs for Australians:[31]

"Efficient electrification can also make the renewable electricity transition easier by providing a large capacity of flexible demand. Electric water heating could be set to run in the middle of the day when solar generation is at its highest, reducing minimum demand issues and acting as an energy storage system. The University of Technology Sydney (UTS) recently [estimated that] this would provide more than $6 billion in savings for consumers by 2040. [...] However, there are currently no requirements for hot water systems to be made flexible, and the default settings are still generally for them to run overnight."

3. What insights do you have on the pace, scale and location of electrification, and how to embed this in system planning?

Uptake of efficient electric appliances is rapidly increasing

Some of IEEFA's recent research has looked into appliance sales trends that underpin EnergyConsult's 2021 Residential Baseline Study.[32] These trends indicate that gas appliance sales still appear to be high – at around 940,000 units per year.[33]

However, we have also observed much more recent trends that could point to a rapid shift in uptake of electrification.

Recent data from the Clean Energy Regulator shows that "heat pump hot water system sales in New South Wales (NSW) have more than quadrupled between 2022 and 2023", which "correlates with the introduction of heat pump rebates under the state's Energy Savings Scheme"[34]

This is significant. Although we do not know how many of these systems are replacing gas hot water systems, the data demonstrates that "NSW has the capacity to install more than 25,000 new heat pump hot water systems per quarter, which approximately aligns to IEEFA's analysis of the pace needed to electrify all gas hot water systems in the state by 2050."[35]

Meanwhile, Victoria is also experiencing record applications for heat pump hot water rebates under its recently announced scheme.[36]

These states may provide critical learnings regarding the opportunities and challenges in scaling up residential electrification demand, which to date has been slower in other states and territories.

[31] IEEFA. Fast, efficient, flexible electrification can cut energy bills and support the shift to renewables. 6 March 2024.
[32] EnergyConsult. 2021 Residential Baseline Study for Australia and New Zealand for 2000 to 2040. November 2022.
[33] IEEFA. Appliance standards are key to driving the transition to efficient electric homes. 23 April 2024. Page 2.
[34] Ibid. Page 3.
[35] IEEFA. Appliance standards are key to driving the transition to efficient electric homes. 23 April 2024. Page 3.
[36] Solar Victoria. Demand for hot water rebates at record levels. 13 March 2024.

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Ensuring new appliances are efficient and electric is the most economical way to move to all-electric homes

IEEFA's analysis found that ensuring new appliances are efficient and electric, rather than gas, is one of the most economic and equitable ways to transition towards all-electric homes.[37]

In 2024, the Victorian government intends to explore the feasibility of requiring gas appliances to be replaced with electric appliances at end-of-life, through a Regulatory Impact Statement and associated consultation.[38]

However, there are also approaches that could see this embedded at a national level – for example, by improving minimum energy performance standards (MEPS) for appliances under the GEMS Act.

4. How can electrification efforts be sequenced to align with expansion of electricity generation and network capacity?

IEEFA notes that Australia's current electricity generation and network capacity does not broadly present a significant barrier to the sequencing of electrification efforts. Conversely, there are significant costs associated with delaying residential electrification.

Residential electrification leads to immediate emission savings, which accelerate in the long term

IEEFA's analysis of residential electrification in Victoria found that, despite the state having the most emissions-intensive power system in Australia, electrification of residential loads resulted in an immediate net reduction in emissions.[39]

IEEFA's submission to the Senate Inquiry on Residential Electrification noted that: *"an accurate comparison of the emissions impact of gas versus electric appliances ought to consider the lifetime energy consumption of both appliances, and associated emissions given likely changes to the emissions intensity of electricity production. Considering this, IEEFA analysis finds that the lifetime emissions for gas cooktops, heating systems and hot water systems are up to 4.9 times that of their efficient electric counterparts.*

"This implies that electrifying a representative household today will lead to immediate emissions reductions under the current emissions intensity of Australia's electricity grid, and that these reductions will accelerate under future decarbonisation of electricity.

[37] IEEFA. Managing the transition to all-electric homes. 2 November 2023. Page 4.
[38] Victorian Department of Energy, the Environment and Climate Action. Gas Substitution Roadmap Update. December 2023. Page 8.
[39] IEEFA. Managing the Transition to All-Electric Homes. 2 November 2023. Page 13.

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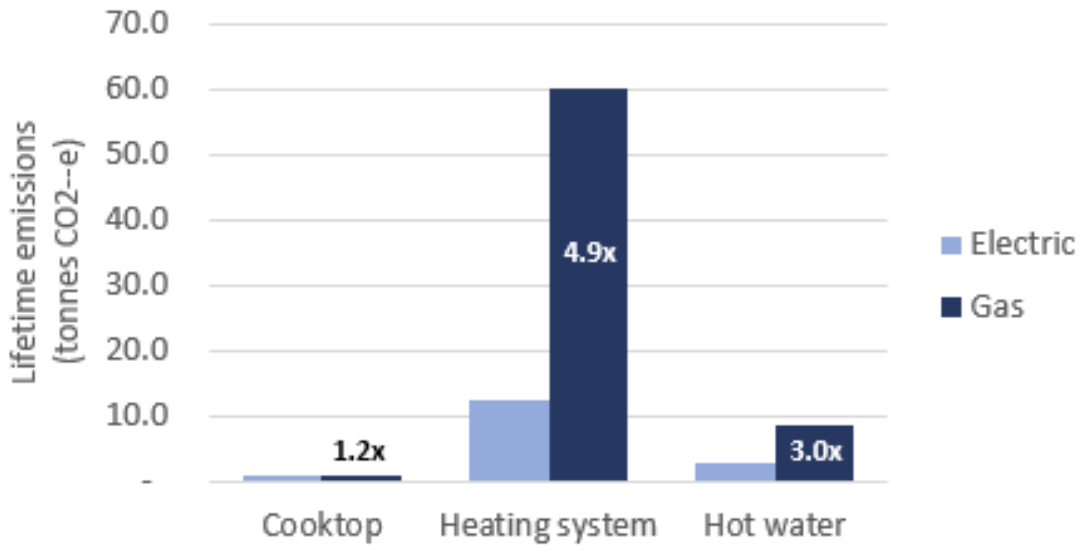
"Conversely, if household electrification were delayed and consumers continue to purchase more gas appliances, this is likely to lock in high emissions over the lifetime of those appliances." (see Figure 2)[40]

Figure 2: Lifetime emissions of gas appliances are much higher than electric appliances



Source: IEEFA.[41]

Delaying residential electrification costs Australian consumers $1.2 billion annually

In IEEFA's submission to the Senate Inquiry on Residential Electrification, we noted that residential is already economical for consumers: "Household electrification is already an NPV [net present value]-positive decision in most scenarios, whether opting to electrify prematurely or at the end of life of existing appliances."[42]

IEEFA's subsequent analysis has quantified the cost of delay of switching from gas to efficient electric appliances as $1.2 billion annually.[43] This is the lifetime cost lock-in that could be avoided if all gas appliances sold per year in Australia were converted to efficient electric alternatives (see Figure 3).

[40] IEEFA. Submission to Senate Inquiry on Residential Electrification. 28 September 2023. Page 10.
[41] Ibid. Page 11.
[42] Ibid. Page 9.
[43] IEEFA. Appliance standards are key to driving the transition to efficient electric homes. 23 April 2024. Page 4.

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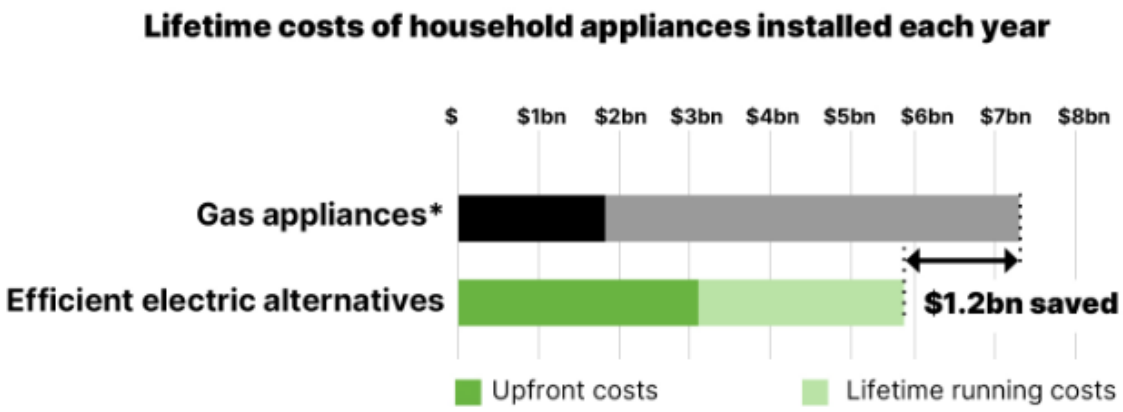
Figure 3: Continued installation of gas appliances locks consumers into high lifetime costs.



Source: IEEFA.[44]

Most electricity distribution networks have spare capacity to deal with electrified loads

IEEFA's submission to the Senate Inquiry on Residential Electrification observed that electricity networks are unlikely to present a significant barrier to electrification.[45] IEEFA considered Victoria – the state with the largest residential gas load to electrify – and noted:

"[There is] considerable headroom to electrify Victoria's winter loads before peak demand would exceed historic highs. […] Furthermore, national data from the AER suggests that distribution networks are a long way from exceeding their capacity. Overall distribution network utilisation, defined as maximum demand divided by capacity, is currently only 42%, with utilisation of individual networks varying from as low as 18% (Essential Energy, NSW) to no more than 71% (Powercor, Vic)."

Efficient, flexible electrification can be an asset, not a burden for the electricity system

When considering the effects of electrification on the future energy system, it is important to consider the opportunities form ensuring electrification is efficient and flexible. For example, IEEFA analysis found that if appliance standards were used as a mechanism to encourage uptake of efficient electric appliances, the combination of switching both gas and resistive electric appliances to efficient electric alternatives could offset some or all of the added annual demand from electrification.[46]

[44] IEEFA. Appliance standards are key to driving the transition to efficient electric homes. 23 April 2024. Page 4.
[45] IEEFA. Submission to Senate Inquiry on Residential Electrification. 28 September 2023. Page 6.
[46] IEEFA. Appliance standards are key to driving the transition to efficient electric homes. 23 April 2024. Page 6.

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We have also noted that*: "Efficient electrification can also make the renewable electricity transition easier by providing a large capacity of flexible demand. Electric water heating could be set to run in the middle of the day when solar generation is at its highest, reducing minimum demand issues and acting as an energy storage system."*[47]

Additionally, we found: *"A conservative assessment of how DER and electrification could impact consumer electricity bills was recently undertaken by the CSIRO for Energy Consumers Australia (ECA). It modelled delivered electricity prices if the uptake of electric appliances, electric vehicles (EVs) and home storage was aligned to AEMO's most likely Step Change scenario. It found that the growth in volume of electricity sold would be more significant than the growth in peak demand, leading to increased utilisation of distribution networks and lower prices."*[48]

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?

A managed phase-down of residential gas networks is essential

Forecasts increasingly agree that a long-term decline in Australian residential gas consumption is likely. This assertion is underpinned by a fundamental shift to the underlying of economics of gas versus electricity in homes, and government policies to support efficient electrification.

Residential electrification will have significant ramifications for gas distribution networks, as they recover more than 80% of their revenue from residential customers (or 93% in Victoria).[49] Specifically, there is a risk that gas network assets are left stranded as customers leave the network. This raises urgent questions around the most economical and equitable way to allocate gas networks' stranded asset risks.

IEEFA has modelled the potential impacts of residential electrification on gas distribution networks in Victoria. We found that "in a scenario where all gas appliances were replaced with electric appliances at end of life, the fixed and volumetric tariffs charged by gas distribution networks may need to increase an average of 7.7% and 7.5% a year respectively to enable networks to fully recover their costs".[50]

Such price rises would raise significant equity concerns, as some users including renters and apartment-dwellers are unable to choose to leave the gas network.

[47] IEEFA. Fast, efficient, flexible electrification can cut energy bills and support the shift to renewables. 6 March 2024.
[48] Ibid.
[49] IEEFA. Appliance standards are key to driving the transition to efficient electric homes. 23 April 2024. Page 8.
[50] IEEFA. Managing the Transition to All-Electric Homes. 2 November 2023. Page 19.

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Conversely, "if an annual real price cap of 2.5% pa were applied from 2028 [...] this could lead to a cumulative $3.5 billion in unrecovered costs [for Victoria's gas distribution networks] between 2023 and 2050".[51]

This modelling illustrates the critical need to develop a fair approach to the allocation of stranded asset risks between consumers and networks. The AER has made interim decisions that reallocate some risks from networks to consumers in Victoria, but it has signalled that it does not view these as long-term decisions.

Fully regulated gas networks in Australia operate under a 'price cap' regulatory regime where, by design, their business is exposed to demand risks. Since at least 2014, gas networks have benefited from this exposure – achieving returns on regulated equity that are far above the expected rate of return for a low-risk business.[52]

Reallocating risks from gas networks to consumers is likely to be inequitable and incompatible with respect to the National Gas Objective, which promotes "the long term interests of consumers of covered gas".[53]

A managed plan to phase down residential gas networks is needed, and the federal government is well placed to lead this. Among other factors, such a plan will need to consider:

- The current allocation of demand risks between gas networks and their consumers, and a preferred equitable allocation of demand and stranded asset risks in future.
- A physical plan for decommissioning gas infrastructure that maintains safety and reliability for the diminishing consumer base, while providing targeted solutions for hard-to-electrify homes.

Targeting new projects should be a priority to minimise costs

Significant costs are usually associated with retrofitting assets to make them compatible with low-carbon fuels. Hence, ensuring that new assets are built to run on low-carbon fuels from construction will lower the costs associated with the transition. IEEFA recently conducted an analysis of the opportunities to decarbonise domestic ammonia production.[54] We found that:

"Current proposals for a gas-based expansion of CSBP's ammonia plant in Kwinana, Western Australia, would add about 0.5MtCO2e to Australia's emissions each year. However, instead of proceeding as planned, the expansion offers an opportunity to demonstrate large-scale integration of renewables and green hydrogen in the domestic ammonia supply chain. It could create demand for about 53,000 tonnes of green hydrogen – 18% of the green hydrogen production currently proposed across Australia for domestic use, and more than twice the planned capacity in Western Australia." [...]

[51] IEEFA. Managing the Transition to All-Electric Homes. 2 November 2023. Page 21.
[52] Ibid. Page 24.
[53] AEMC. National Energy Objectives. Accessed 23 April 2024.
[54] IEEFA. How mining could ignite Australia's green hydrogen boom. 29 February 2024.

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"The convergence of miner influence, market-driven incentives and government support forms a compelling case for accelerating Australia's transition to green ammonia. [...] The proposed CSBP plant expansion provides a timely and pivotal moment for miners to catalyse change and drive the adoption of green ammonia in Australian mining and the emergence of a green hydrogen industry."

The government should not bankroll unnecessary gas-based investments

In IEEFA's 2024-25 Pre-Budget Submission, we highlighted that some government funds are currently support projects with questionable financial business cases, and which will lock in future reliance on gas.[55] Instead, we argued that government funds could be used to accelerate the energy transition:

"IEEFA does not see a credible economic rationale for providing public funding for the development of the Beetaloo sub-basin or the Middle Arm precinct (which is centred around a proposed new liquefied natural gas (LNG) export facility). Moreover, IEEFA notes that development of a new LNG export facility would undermine the project's stated objective of creating a "decarbonised economy", given the Scope 3 emissions associated with gas when it is used by the consumer.

"In June 2023, IEEFA published a report on the proposed Middle Arm precinct, which highlighted many risks associated with both the Middle Arm precinct and extracting shale gas from the Beetaloo. Notably, the robust market for LNG exports anticipated in the plan is unlikely to materialise. LNG markets are going through an unprecedented change due to a coming wave of new LNG supply from low-cost suppliers, and Australia will be less able to compete on cost as its traditional customer base shrinks. This will undermine the financial success of the Beetaloo (and Barossa) gas investments." [...]

"IEEFA would like to see some of the government funding – in areas such as hydrogen export projects, hydrogen blending in gas pipeline networks, as well as the federal finances earmarked for Middle Arm project and the Beetaloo sub-basin – redirected to initiatives to reduce gas demand."

Forecasting exercises should not overestimate gas investment needs

AEMO forecast in its 2024 GSOO that there will be excess gas demand events by 2028, and a significant increase to the long-term forecast for gas power generation (GPG).[56] However, IEEFA

[55] IEEFA. Submission to the Australian Treasury's consultation on 2024–25 Pre-Budget submissions. 31 January 2024.
[56] AEMO. Gas Statement of Opportunities (GSOO). March 2024. For Australia's East Coast Gas Market. Page 4.

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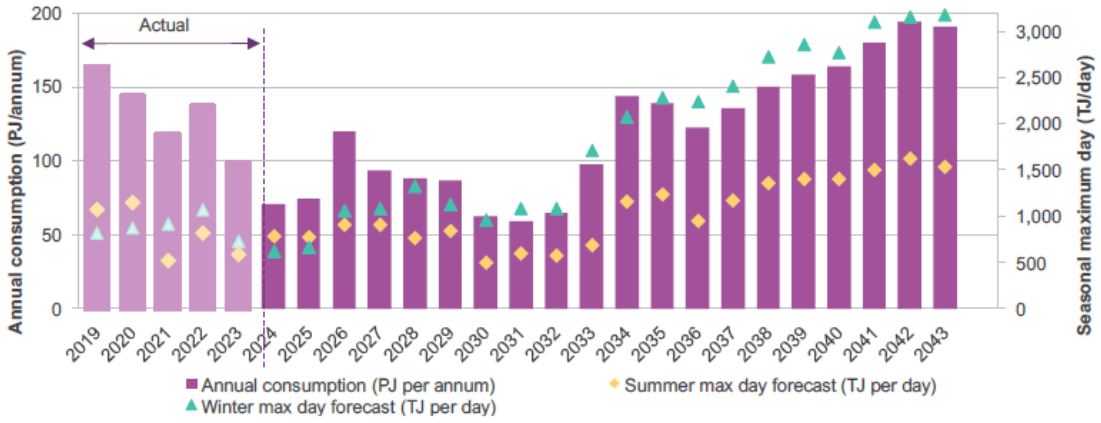
finds these forecasts carry a high amount of uncertainty, and previous AEMO forecasts have overestimated the demand for GPG in the NEM.

In the 2023 GSOO, the NEM-wide forecast gas use for power generation was 123 petajoules (PJ), or 54% higher than actual 2023 total GPG consumption.[57] AEMO has conceded that "GPG forecasts are variable and depend on various factors in the NEM which are challenging to predict."[58] This leaves the possibility open for further overestimation.

AEMO's gas demand for GPG is shown in Figure 4, demonstrating that 2024 demand is projected to be half of 2019 levels. However, AEMO then forecasts it to rise out to 2043 and exceed 2019 levels.

Figure 4: AEMO's forecast demand for gas power generation



Source: AEMO.[59]

Further declines in gas-fired power generation are likely, with two gas-fired power stations earmarked for closure by 2026, both in South Australia. One of these is the 800MW Torrens Island B power station, the largest gas-fired power plant in the NEM.[60] The other is the 180MW Osbourne power station.[61] A third gas-powered station in South Australia is to close by 2032 when the 240MW Hallett gas turbine is due to shut its doors.[62] The three plants have a combined generation capacity of 1,220MW.

AEMO anticipates two open-cycle gas turbine (OCGT) generators will come online by the end of 2024: the 320MW Tallawarra B and the 750MW Kurri Kurri gas plants, both in NSW, which amount to a combined 1,070MW.[63] This will result in a net reduction in gas-fired power capacity over the AEMO 10-year outlook period. Both the new gas plants are to be used as peaking power plants. They will not be running as much as Torrens Island B has been over its 47-year life, as a

[57] AEMO. 2024 Gas Statement of Opportunities - For Australia's East Coast Gas Market. March 2024. Page 98.
[58] Ibid. Page 40.
[59] Ibid. Page 7.
[60] AGL. Torrens Island 'B' Power Station to close by 2026. 24 November 2022
[61] AEMO. 2023 Electricity Statement of Opportunities. August 2023. Page 8.
[62] Ibid. Page 8.
[63] Ibid. Page 8.

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baseload-type power plant running most of the day. Peaking power plants traditionally operate only a few hours a day.

IEEFA analysed AEMO's latest GPG forecasts in its recent Submission to AEMO's 2024 Draft Integrated System Plan (ISP), and found that they needed further qualification.[64] There were significant changes in AEMO's modelling assumptions that relate to GPG and competing technologies such as utility-scale storage, which were not adequately discussed in the draft ISP. Additionally, it is unclear whether high levels of GPG would still be cost-effective for energy consumers if the costs of upstream developments needed to mitigate gas supply shortfalls were considered.

The 2024 GSOO forecasts that gas demand in buildings and industry is likely to decline quicker than previously forecast. However, recent developments including uptake of heat pump hot water systems in NSW and policy developments in Victoria suggest that residential demand may face even steeper declines.

It was claimed that high gas prices on the east coast were to blame when Australia's largest plastics maker Qenos called in the administrators in April, with the Australian Industry Group warning that high gas prices could close other local manufacturing plants. The high gas prices were blamed on the start-up of LNG exports from the Queensland port of Gladstone.[65]

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?

Government shouldn't rely on CCUS to decarbonise industries

IEEFA does not agree with the premise in the Electricity and Energy Sector Plan discussion paper that 'Carbon capture use and storage (CCUS) technologies have the potential to reduce emissions from the use of gas and other fossil fuels'. We have reservations about its adaption in hard to abate sectors. In previous research we have argued that: "Carbon capture and storage (CCS) is an expensive and unproven technology that distracts from global decarbonisation efforts while allowing the oil and gas industry to conduct business as usual."[66]

Australia hosts one of the best examples of the underperformance and near irrelevance of the CCS efforts through the Gorgon CCS facility, which is part of the part of Chevron's 15.6 million tonnes per annum (Mtpa) Gorgon liquefied natural gas (LNG) venture. The Gorgon CCS facility has consistently sequestered far less carbon dioxide (CO_2) than it was designed to do, capturing less than 4% of the total emissions the Gorgon LNG project pumps into the atmosphere. In the fiscal year to 30 June 2023, the Gorgon CCS injected just 34% of the 5 million tonnes (Mt) of CO_2 it captured in the 12-month period.[67] The table below illustrates the significant underperformance of the Gorgon CCS venture.

[64] IEEFA. Submission to AEMO 2024 Draft ISP Consultation. 21 February 2024. Page 4.
[65] The Australian Financial Review. Gas costs could sink more manufacturers after Qenos: AIG. 18 April 2024.
[66] IEEFA. Carbon Capture and Storage. An unproven technology that cannot meet planetary CO2 mitigation needs.
[67] IEEFA. Australia's CCS expansion poses increased risks. 20 December 2023.

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Table 1: CCS in Australia – Gorgon

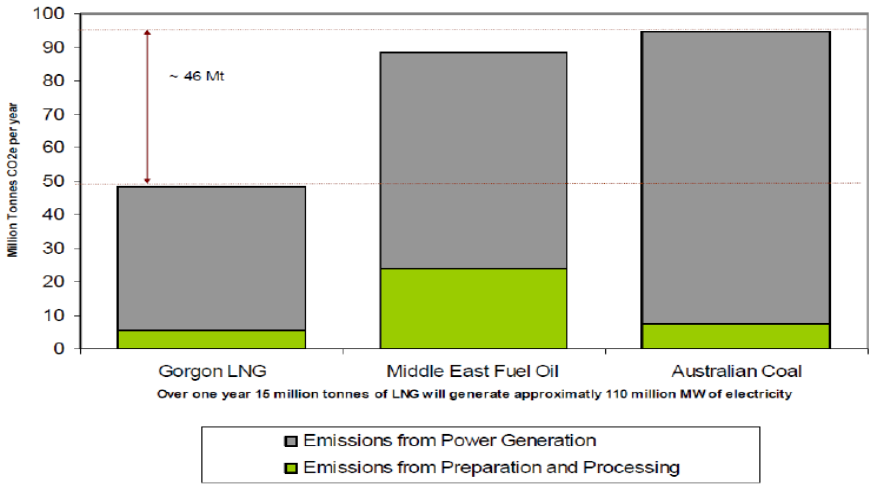
Global Carbon Capture and Storage performance				
Year	Volume of CO_2 removed	Volume of CO_2 injected	Target 80% of CO_2 removed	Shortfall from target
2016-17	1	0	0.8	0.8
2017-18	3.5	0	2.8	2.8
2018-19	3.7	0	3	3
2019-20	3.9	2.7	3.1	0.4
2020-21	3.2	2.2	2.5	0.4
2021-22	5	1.6	4	2.4
2022-23	5.05	1.72	4.04	2.32
Total	**25.35**	**8.5**	**20.24**	**12.12**
Summary	**16.85mt pumped into atmosphere**	**(33% of total)**	**(42% of target)**	**(58% of target)**

Source: Chevron.

The combined Scope One and Two emissions were a total of 8.33Mt of CO_2 in 2022-23, which means Scope Two emissions at Gorgon was 3.28Mt. None of the Scope Two emissions are required to be abated through the CCS, which means around a fifth of the Scope One and Two emissions at Gorgon was abated in the CCS in the 2022-23. This share is dramatically lower when all emissions are considered.

Chevron is not required to disclose its Scope Three emissions, but it did provide an estimate for total emissions from Gorgon in one of the project's planning documents. This estimate is just below 50Mt of CO_2 if all of the LNG sold is used to generate electricity in the Asia Pacific region. Assuming that Scope One, Two and Three emissions from Gorgon is 50Mt, the amount of CO_2 abated by Gorgon's CCS is 3.4%. See graph below.

Figure 5: Gorgon LNG and Scope Three emissions



Source: Chevron.

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The oil and gas industry has used CCUS as a distraction from global decarbonisation efforts, as the data from the Gorgon CCS clearly shows that there is no net saving in CO_2 abatement using CCS for oil and gas production facilities.

IEEFA has also studied the adoption of CCUS in the steel sector. The study found there are no commercial-scale CCUS plants for coal-based steelmaking anywhere in the world, with almost nothing in the pipeline.[68] Our report stated: "Major steelmakers are turning increasingly to direct reduced iron (DRI)-based steelmaking to replace coal-consuming blast furnaces. CCUS faces being left behind as it was in other sectors like power generation."

The steel sector is an important industry to decarbonise as it directly accounts for 2.6 gigatonnes of CO_2 annually, equal to 7% of the total global greenhouse gas emissions from the energy system, and more than the emissions from all road freight.[69]

It is not just the steel sector where CCUS has failed to make any traction. IEEFA has written numerous reports on CCUS and found that the technology has failed to capture more than 80% of the CO_2 it has removed in industries including hydrogen, fertilizers and ethanol.[70]

IEEFA is not supportive of CCUS projects generating carbon credits under the Safeguard Mechanism. The performance failings of CCUS and the unresolved questions about the permanence of buried CO_2 in CCS ventures underlines that this unproven technology should not be seen as a solution under any federal government policy. Taxpayer money should not be used to support CCUS, which should be left to the private sector.

In addition, there are many issues associated with the reliance on carbon credits for reducing the emissions associated with new fossil fuel developments. Besides integrity and permanency concerns of carbon offsets, recent analysis shows that using the land sector to offset fossil fuel emissions is risky. According to a study by Climate Analytics:

"Fossil fuel emissions have a very long lifetime in the atmosphere. Each tonne of carbon released into the atmosphere is long-lived, with around 40 percent remaining after 100 years, 20-25% remaining after 1,000 years, and up to 20% after 10,000 years. Land-based offsets do not and cannot guarantee such long-term sequestration."[71] *[…]*

"There is therefore a fundamental difference between directly reducing a source of CO_2 emissions by one tonne, and offsetting that same tonne of CO_2 emissions through sequestration in trees or soil. The direct reduction of emissions does so permanently, whereas the CO_2 that is captured and stored in trees or newly sequestered soil carbon will at some point be released back into the atmosphere."[72]

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[68] IEEFA. Carbon capture for steel? 17 April 2024.
[69] International Energy Agency (IEA). Iron and Steel Technology Roadmap - Towards more sustainable steelmaking. October 2020.
[70] IEEFA. Carbon Capture and Storage. An unproven technology that cannot meet planetary CO2 mitigation needs.
[71] Climate Analytics. Why offsets are not a viable alternative to cutting emissions. February 2023. Page 3.
[72] Ibid. Page 14.

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The Climate Analytics report also states that pathways that "limit warming to 1.5°C" substantially increase "carbon sequestration in the terrestrial biosphere while also reducing CO_2 emissions from fossil fuels very rapidly towards zero".

It adds that: *"In the IPCC 6th Assessment Report, CO_2 emissions excluding negative emissions from CO_2 removal still fall 45% from 2020 to 2030 in 1.5°C compatible pathways that meet sustainability constraints. Carbon removal in these pathways is therefore in addition to ambitious CO_2 emissions reductions. Most of the mitigation in these pathways is emissions reduction rather than emissions removal."*[73]

IEEFA also has reservations about CCUS being considered part of a circular economy, as stated in the discussion paper for this inquiry.[74] So far there has been no commercial production of synthetic fuels from CCUS. IEEFA sees no role for public funds to finance this speculative endeavour and believes any research and development in this area should be confined to the private sector.

Alternative gases should be reserved for highest-value end uses

IEEFA is of the view that green hydrogen has a role in the energy transition and that its use should be focused the most economical use of the fuel given the resources required to produce it. Energy commentator and New Energy Finance founder Michael Liebreich has developed the Hydrogen Ladder, which showed that the most economical use of green hydrogen is in the production of fertilizers and methanol, followed by steel production and as a fuel in shipping and aviation, chemical feedstock and long-duration grid-balancing.[75] The least economic options for green hydrogen were domestic heating and power generation using non-stored hydrogen. Hydrogen as a fuel for cars, buses and trains was the second most uneconomic use of the fuel.

IEEFA has undertaken research on hydrogen and aligns with much of the Hydrogen Ladder framework. In February 2024, IEEFA published a report that concluded that green hydrogen could play a key role in decarbonising Australia's ammonia production facilities, presenting a triple win by alleviating domestic gas market pressures; reducing emissions; and catalysing Australia's emerging green hydrogen industry.[76]

IEEFA research has identified iron ore and steel as an important sector to develop green hydrogen.[77] Our Submission to the Review of the National Hydrogen Strategy stated:

"Australia is not a major steelmaker, but it is the world's largest exporter of iron ore, giving it a highly significant position in the global steel supply chain. Australia's Pilbara region is blessed with high renewable energy resources as well as abundant iron ore. Green iron could be

[73] Climate Analytics. Why offsets are not a viable alternative to cutting emissions. February 2023. Page 19.
[74] DCCEEW. Electricity and Energy Sector Plan. Discussion Paper. March 2024. Page 10.
[75] Liebreich Associates. Hydrogen Ladder 5.0. 19 October 2023. Page 1.
[76] IEEFA. How mining can ignite Australia's green hydrogen boom. 29 February 2024.
[77] IEEFA. IEEFA submission to the Review of the National Hydrogen Strategy. 18 August 2023. Page 3.

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produced via direct reduced iron (DRI) processes adjacent to the places where iron ore and renewable energy for producing green hydrogen are available. Green iron could be shipped cost-effectively to other countries for low-carbon steelmaking in electric arc furnaces (EAFs) and finishing processes, instead of freighting both iron ore and hydrogen separately at higher cost.

"Potentially, the full steelmaking process using Australian iron ore, green hydrogen and renewable energy could be completed onshore via DRI-EAF, with low-carbon crude steel exported instead of iron. However, many nations are likely to be reticent to fully offshore their steelmaking capacity and may strategically prefer to import green iron that could be processed into steel domestically via EAFs that could be powered by renewable energy. Some major steelmakers are now considering replacing the import of iron ore with the import of green iron."

The focus on hydrogen should be on ammonia and steel and other metals processing sectors. It does not make financial sense to try to create a new export industry of direct hydrogen exports, or to use hydrogen in gas distribution networks.[78,79].

IEEFA has analysis found that "running electric appliances at home is four times cheaper than using biomethane, and more than ten times cheaper than using hydrogen due to their high relative efficiencies"; and that "significant practical and technological constraints would need to be overcome before existing infrastructure could be repurposed to deliver biomethane and hydrogen to homes."[80]

We also noted that "biomethane in small volumes could perform a transitional or longer-term role in buildings that are particularly challenging to electrify. However, it is difficult to see how biomethane supply could be expanded to a level comparable to the amount of fossil gas currently supplied in Victoria's distribution networks."[81]

Liquid fuels need to transition to reach net zero

IEEFA is concerned that Australia has not done more about addressing its energy security vulnerabilities, which include an over-reliance on imported petroleum products, in particular diesel imports which account for around half of the total import requirements for Australia's transport fuels consumption.[82]

Australia imported $60.46 billion worth of crude oil and petroleum products in the 2022-23 fiscal year to 30 June. That compares with the $74.22 billion Australia received in export earnings from LNG shipments. In other words, 81% of the income from LNG exports was spent on transport fuels so Australians could get from A to B as well as undertake their work tasks in their cars, lorries, planes and ships. That is not good for Australia's trade balance, and this balance could

[78] IEEFA. IEEFA submission to the Review of the National Hydrogen Strategy. 18 August 2023. Page 4.
[79] Ibid. Page 5.
[80] IEEFA. 'Renewable gas' campaigns leave Victorian gas distribution networks and consumers at risk. 17 August 2023. Page 9.
[81] Ibid. Page 14.
[82] DCCEEW. Australian Petroleum Statistics 2024. Data extract February 2024.

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reduce further in the foreseeable future as renewed tensions in the Middle East push up the oil price, at a higher rate than gas prices.

From an energy security perspective, the current tensions between Israel and Iran highlight the risk Australia would face in the event of a sharp rise in oil prices, a curtailment in oil exports from the Persian Gulf, or both, which could impact Australia's ability to fuel its transport system.

The US Energy Information Administration (EIA) has stated that the Strait of Hormuz is the world's most important oil chokepoint because large volumes of oil flow through the strait: "In 2022, its oil flow averaged 21 million barrels per day (b/d), or the equivalent of about 21% of global petroleum liquids consumption."[83]

One of the reasons Australia is in a vulnerable energy security predicament is the lack of adequate policies over the years to address fuel efficiency, which has left Australia with one of the most fuel-thirsty transport fleets in the developed world, with little done until recently to boost the take-up of EVs.[84]

Australia has also suffered from the perception that it is an energy superpower, but its dependence on importing its transport fuel requirements undermines this narrative. However, Australia has a great opportunity to change this through a more aggressive policy on EVs, along with a robust information strategy to counter the misinformation about EVs presented by certain industry, political and media interests. A strong and fast take-up of EVs, along with development of adequate charging infrastructure, will boost investment and jobs, and speed up the energy transition strategy for fuel retailers such as Viva Energy and Ampol. Moreover, it will boost demand for renewable energy, both in regional and urban areas, which in turn boosts investment and jobs.

Some of Australia's diesel demand is taken up from burning the fuel to generate electricity – often in remote areas. This should be a priority to address, by encouraging both public and private investment in batteries and renewable microgrids. Australia burnt about 7 million barrels of oil products for electricity generation in the 2021-22 fiscal year, or about 19,300 barrels a day.[85] Another policy the federal government could adopt is to stop the diesel fuel rebate to miners, particularly coal miners. The ending of this rebate should prompt miners to seek investments in either electric trucks or hydrogen-powered trucks.[86]

7. Are the proposed policy focus areas for managing the liquid fuels transition the correct areas to focus on, and what is missing?

There has been a lot of discussion on low-carbon liquid fuels, such as biofuels and sustainable aviation fuels, but so far the development of these fuels into a sustainable, economically viable

[83] US Energy Information Administration (EIA). Today in Energy. The Strait of Hormuz is the world's most important oil transit chokepoint. 21 November 2023
[84] Department of Infrastructure, Transport, Regional Development, Communications and the Arts. Fuel Efficiency Standard to promote cleaner cars. April 2023.
[85] DCCEEW. Australian Energy Statistics 2023.
[86] The Guardian. Australian taxpayers could save $7.8bn a year if diesel fuel rebates scheme was wound back. 9 March 2021.

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fuel source has been slow. A thorough financial assessment should be made on any project promoting viable low-carbon fuels before any public funds are invested in any venture.

Maximising outcomes for people and businesses

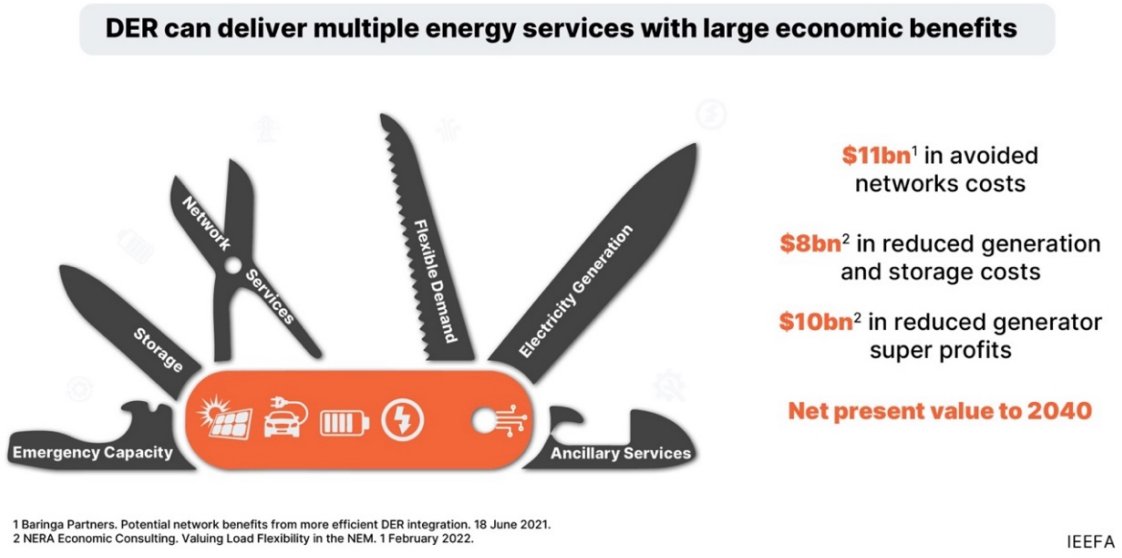
8. What actions are required to ensure better energy outcomes for people and businesses, and maximise their benefit from the energy transformation?

Measures need to be taken to realise the benefits of DER

IEEFA conducted a meta-analysis of a range of studies on DER and found that DER could deliver $19 billion in economic benefits by 2040 (NPV). However, significant changes in the electricity system are needed to access these benefits – as explored earlier in this submission. The Electricity and Energy Sector Plan and/or the CER Roadmap should be informed by the economic cost/benefits of DER and outline the measures needed to realise the potential benefits from DER.[87]

Our report found: *"Distributed energy resources (DER) can reduce the amount of large-scale renewable generation needed, reduce the amount of transmission and distribution network build, provide Frequency Control Ancillary Services (FCAS), emergency power supplies (individually and through the Reliability and Emergency Reserve Trader (RERT) scheme), as well as flexible demand, including demand response. Offering such an array of possibilities, DER can be seen as the Swiss Army knife of the electricity system."*

Figure 6: DER – the Swiss Army knife of the electricity system



Source: IEEFA.

[87] IEEFA. DER could provide $19 billion economic boost by 2040. February 2024.

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"This meta-analysis finds that, based on the results of studies by Baringa Partners and NERA Economic Consulting, DER integration could deliver a ***combined net present value (NPV) of more than $19 billion by 2040.*** *The Baringa study found $11 billion in distribution and transmission network avoided costs and benefits of DER integration. Meanwhile the NERA study found $8 billion in generation and storage cost reductions resulting from high levels of DER with high flexibility.* ***In addition, there is $10 billion in wholesale market super profit reductions which would benefit consumers****, according to the NERA study.*

"The Baringa and NERA studies had no overlap in their modelled value streams. Summing two separate studies like this is not without risk, especially as the Baringa study is based on 2020 forecasts and does not include flexible demand more broadly or from electrification. Nonetheless, ***the $19 billion figure gives a sense of the magnitude of the economic benefits that could be unlocked if the energy transformation supports DER investment and integration.***

"Further research is needed to fully understand the economic value of rooftop solar, battery storage and flexible demand. […]

"Our meta-analysis concludes that we need significant, courageous action on DER integration as soon as possible if we want to underpin Australia's future economic prosperity with lower electricity and transport costs, and electrification to eliminate dependency on gas. ***DER must not come second in policy, planning and regulation to transmission and large-scale generation.*** *DER must be considered on equal terms, with more thoughtful recognition of the multiple benefits outlined in this report."* [88]

Certain DER technologies offer significant benefits that should be explored in detail in the Plan

A number of DER technologies have the potential to provide many services to the grid, and benefits to the energy system overall, and IEEFA believes these technologies should be considered in detail in the Electricity and Energy Sector Plan. Some of these technologies and how the Plan should consider them are outlined below.

Distributed storage

Distributed storage is a vital component of a renewables-rich grid. In particular, it can help to soak up abundant daytime rooftop solar electricity and export it to households and the grid in evening peak periods. It can offer significant benefits to the grid, and therefore needs to be considered as an integral part of the Plan. Saturation DER modelling performed by ITP Renewables, where 70% of homes had rooftop solar and storage and could trade with one another, found that:[89]

[88] IEEFA. DER could provide $19 billion economic boost by 2040. February 2024.
[89] IEEFA. Saturation DER modelling shows distributed energy and storage could lower costs for all consumers if we get the regulation right. 27 April 2023.

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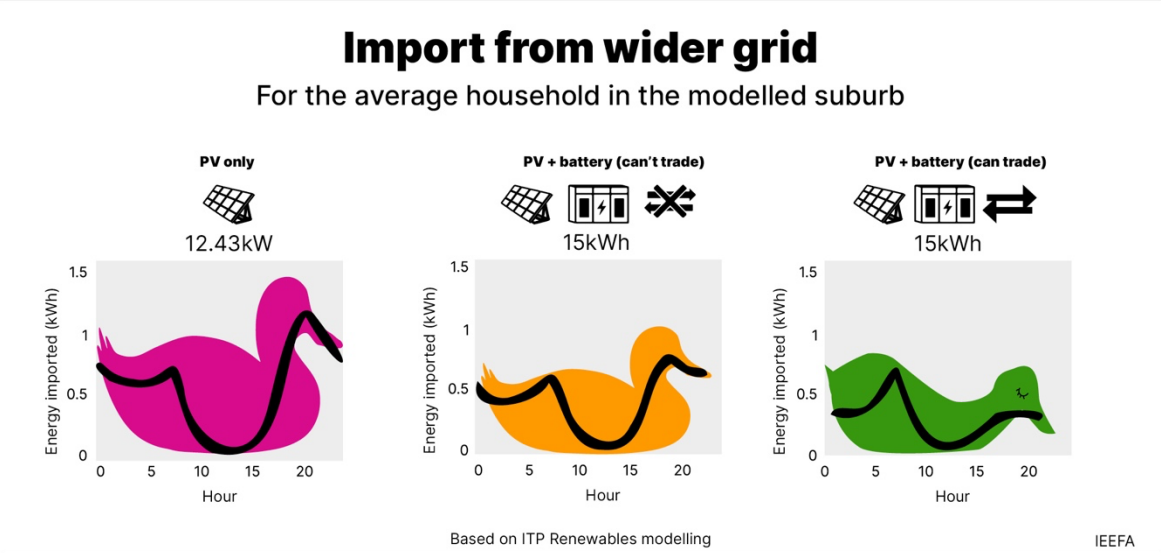
- Rooftop solar plus battery trading could reduce the 4pm-8pm wholesale market evening peak by 67%-92%, putting the duck to sleep in the famous solar-created supply-demand duck curve.
- Minimum demand increased by 21% in the scenario where batteries can trade – easing concerns about minimum demand.
- Solar PV alone reduced the average summer network peak by 28% and moved it 2.5 hours later in the day.

Figure 7: Flattening the duck curve



Source: IEEFA based on ITP Renewables modelling[90]

EVs with V2X functionality should be explored in detail in the Plan

The Electricity and Energy Sector Plan should consider the huge role that EVs will play in the future energy system, and outline how to best harness EV technology. The Plan should have a particular focus on V2G functionality, which could enable power stored in EVs to be delivered to the grid at times that would benefit the system and the EV owner.

As we wrote in our submission to the EV inquiry[91]: *"Electric vehicles are essentially a large "battery on wheels". EVs can complement a renewables-based power system by storing variable renewable energy and using it to power vehicles or other loads at different times of the day, reducing the reliance on higher-cost and higher-emissions electricity generated from coal or gas.*

EVs are anticipated to change the shape of power demand, which can reduce energy costs for consumers overall. CSIRO found that there are $500pa of benefits for all consumers arising from EV uptake by 2050, regardless of if the consumer owns an EV or not. These benefits arise by

[90] IEEFA. Saturation DER modelling shows distributed energy and storage could lower costs for all consumers if we get the regulation right. 27 April 2023.
[91] IEEFA. Submission: Inquiry into the transition to electric vehicles. 20 March 2024.

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managing EV energy consumption to avoid adding to peak demand, which can result in reduced network, generation and storage expenditure. The EV consumption would increase the utilisation of the networks, acting to reduce energy unit costs that networks need to recover from each customer. [92]

Most EVs have unidirectional (one-way) charging capability. However, if two-way (bidirectional) charging is available and consumers take up this technology, significantly greater economic opportunities are on offer for Australia.

EVs with two-way charging capability can not only import from the grid, storing renewable power and powering vehicles with it, but they can also export that energy back to a building, load or the grid. Electric vehicles with "vehicle-to-everything" (V2X) capability can export power from the vehicle battery to power a home or building (V2H or V2B), to power the grid (V2G), or to directly power an electrical appliance (V2L). This can help enhance energy system security. It could also provide financial benefits for those who own the EVs and reduce the need for large-scale storage build.

A household with an EV that has V2X functionality could make money from exporting to the grid if the standards, market settings and regulatory landscape allow for this. Studies indicate the revenue for households could be $1,000 to $3,700 a year.[93]

The EVs with V2X functionality could help fortify the energy system by providing valuable storage capacity. EnX estimates that by 2050 the total battery capacity in the EV fleet would be about four times the NEM's total storage requirement.[94] *"Flexible bidirectional charging (Vehicle to grid) from only 10% of EVs could provide 37% of total NEM storage needs, offsetting around $94 billion of large-scale battery storage investment (at current prices)".*

Figure 8: EV fleet capacity forecast to have more storage capacity than the NEM's requirements

Source: enX.

[92] CSIRO. Consumer impacts of the energy transition: modelling. July 2023. Page 26.
[93] IEEFA. Submission to the New Vehicle Efficiency Standard consultation. 1 March 2024.
[94] enX. V2X.au Summary Report – Opportunities and Challenges for Bidirectional Charging in Australia. 2023. Page 3.

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NERA economic consulting has modelled the economic benefits arising from flexible charging/ discharging of EVs in a high EV uptake world. They modelled EV flexibility in the system in two ways:

- Deferred charging – i.e. charging an EV at a different time than it usually would (such as charging before or after peak demand periods instead of during peak demand periods).
- V2G – "where an EV uses its actual battery to discharge to the grid, to be recharged later".[95]

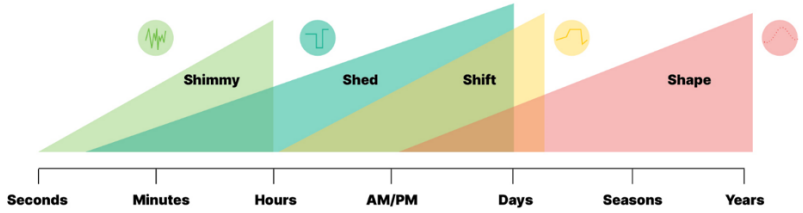
NERA found that: "More flexible EV charging has a low marginal cost and delivers savings to consumers between $3-5 billion."[96]

To access the potential benefits on offer arising from EVs, quantified by CSIRO, NERA and enX, Australia needs an EV-grid integration strategy to ensure we are charging EVs at times of day when we have abundant renewable power, and helping deliver energy to households, businesses and the grid when it is most needed (by using V2X functionality). We don't have the policy, standards and regulations in place to enable V2X in Australia. This should be a focus, to enable Australia to access the significant benefits on offer from EVs.

Demand flexibility should be explored in the Plan

Flexible demand is a key component to a system with higher amounts of variable renewable energy. Flexible demand can help soak up abundant renewable energy, reduce peak demand and provide balancing services to the grid. Flexible demand can provide services over a range of timescales, as shown in Figure 9. Enabling flexible demand to provide these services can deliver significant economic benefits to the grid, as explored by NERA and Energy Synapse. These should be considered in the Plan.

Figure 9: The Types of Flexible Demand by Timescale



		Wholesale Market & Grid Scale Renewable Support	Network Investment Savings	Contingency & Emergency Reserve	Distribution Network Support	Frequency Control Ancilary Services
Shift	Moving demand sporadically in response to an external signal	High	Medium High	Low	Medium Low	N/A
Shape	Moving demand routinely according to a standard long-term pattern	Medium High	Medium High	Low	Medium Low	N/A
Shed	Switching off equipment	Medium Low	High	High	Low	Medium Low (Lower only)
Shimmy	Moving demand over very short timescales in response to an external signal	N/A	N/A	N/A	High	High

Source: IEEFA graphic based on Lawrence Berkley National Laboratory (LNBL) and Race for 2030 CRC

[95] NERA Economic Consulting. Valuing Load Flexibility in the NEM. 1 February 2022. Page 17.
[96] ARENA. Load Flexibility Study Technical Summary. April 2022. Page 11.

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In particular, the Plan should support the implementation of efficient, flexible and electric residential hot water systems. UTS modelling found that if there were no sales of residential gas hot water systems post 2025, and all hot water systems are electrified and controllable by 2035, consumers could save up to $6.7 billion a year by 2040. This would also make available 22GW/45 GWh/day of flexible demand, roughly equal to two-thirds of peak demand.[97] A national strategy for domestic hot water should be developed to ensure new hot water systems are efficient, electric and flexible.[98]

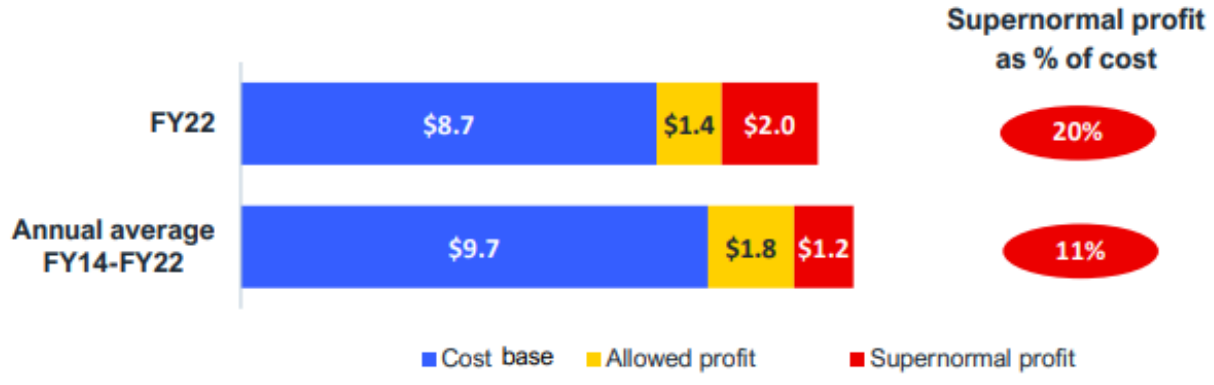
Ensuring investment in networks and DER is efficient will require a review of network economic regulation

Existing weaknesses in the economic regulation of monopoly electricity network businesses mean they have been achieving profits in excess of the required, allowed level of profit. The regulation of electricity networks should be revised to reduce the supernormal profits, and public monitoring and reporting of network profits should be undertaken. As we wrote in our report:

"An analysis of this data shows that supernormal profits have been recorded every year since 2014, and that these were excessive in eight of the past nine years. Estimated sector-wide supernormal profits were persistent, averaging about $1.2 billion a year over FY14-FY22 or 11% of total cost (including allowed profits). In FY2022, the combined actual profits were $3.4 billion, 2.5 times the risk-adjusted, allowed profit of $1.4 billion – a supernormal profit of $2 billion."[99]

The estimated supernormal profits in FY22 compared with the nine-year period FY14-FY22 are summarised in Figure 10.

Figure 10: Network cost and profit outcomes annual ($ billion real)



Source: IEEFA.

[97] UTS Institute for Sustainable Futures. Domestic Hot Water and Flexibility. 5 June 2023. Page 1.
[98] IEEFA. Growing the Sharing Energy Economy. October 2023.
[99] IEEFA. Power prices can be fairer and more affordable. November 2023.

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Our report argued: *"NEM Ministers should obtain independent expert advice to test the IEEFA analysis and identify suitable remedies to bring network profits to reasonable levels. Potential remedies include changes to the laws and rules governing the economic regulation of monopoly networks, alongside the introduction of greater transparency and independent monitoring of network profits by the Australian government.*

These changes could be made in time to come into effect from mid-2024. Without these changes, excessive supernormal network profits and less affordable power bills will likely continue for the foreseeable future.

Substantial new regulated network investment is required to support the energy transformation to allow the timely replacement of high-emissions power stations with renewable energy and storage. Excessive network profits are inefficiently raising consumer bills and impeding this transformation.",[100]

Furthermore, the economic regulation of distribution networks is not currently enabling DER to compete on a level playing field with networks. Given the huge amounts of rooftop solar, EVs and distributed storage expected to come online in the coming years, the economic regulation of distribution networks should be adjusted to enable growth and appropriate integration of DER. A broad review of distribution network economic regulation should be completed to ensure networks are enabling the fast uptake and effective integration of DER. As we wrote in our report *Growing the Sharing Energy Economy*:

"Network revenue regulation was designed to reward distribution businesses for delivering one-way flows of electricity, including the construction of assets to meet peak network flows. Networks now need to enable two-way flows and DER integration to support decarbonisation. A review of distribution network revenue regulation is needed to enable DER to provide network services on a level playing field with expenditure on network assets, and to make sure that in a DER-rich future, networks are used efficiently and that distribution network costs can be reduced for consumers."[101]

A governance review will also be needed to ensure that Australia can move at the speed required

The governance of the NEM will be key to achieving the 82% renewables target. A governance review should be undertaken to ensure we are operating in a manner that will accelerate Australia quickly towards 82% renewables.[102]

[100] IEEFA. Power prices can be fairer and more affordable. November 2023. Note: The AER's extensive consultation over the 2022 rate of return instrument did not reveal evidence that allowed returns were insufficient to support the necessary new regulated investment for the energy transformation.
[101] IEEFA. Growing the Sharing Energy Economy. October 2023. Page 8.
[102] Ibid. Page 46.

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"While energy market governance has been reviewed several times since the NEM was created, its fitness for purpose to meet Australia's decarbonisation goal of 43% by 2030 and 82% renewables by 2030 has never been evaluated. [103]

Energy ministers should "*Commission an independent review of energy market governance and its fitness for purpose for integrating DER and for the energy transition to be completed within six months. While previous reviews have considered the governance of the energy market intuitions, none have done so when there was the current level of urgency of renewable energy, storage and flexible demand deployment.* [104]

9. What social licence and circular economy aspects should be considered as part of the pathway for the energy transformation?

Reliance on fossil fuels is incompatible with a circular economy

IEEFA notes that critical minerals are generally recyclable, whereas fossil fuels are burnt, add greenhouse gases to the atmosphere, and are hence not recyclable. Government policies that would extend the life of fossil fuel assets beyond their usefulness, when cleaner, more recyclable alternatives are feasible, would therefore be incompatible with circular economy principles.

Social licence considerations are important, but must be balanced to achieve least cost outcomes

In IEEFA's submission to AEMO's consultation on the 2024 Draft Integrated System Plan (ISP), we noted "*a more robust consideration of social licence issues that impact the timing and feasibility of new large-scale renewables and transmission projects [...] is important. However, such analysis must also consider the social licence issues that impact alternative technologies.*"[105]

"For example, non-renewable projects that have faced significant social licence setbacks in recent years include:

- *New upstream gas developments.*
- *Gas infrastructure developments.*
- *Coal mine expansions.*
- *Coal power plant life extensions."*

"Another way to consider social licence issues is to give greater attention to Distributed Energy Resources (DER) which don't share the same social licence issues as large-scale generation and Transmission."

[103] IEEFA. Growing the Sharing Energy Economy. October 2023. Page 45.
[104] Ibid. Page 47.
[105] IEEFA. Submission to AEMO's 2024 Draft ISP. 21 February 2024. Page 17.