APA Submission

Future Gas Strategy Consultation

November 2023

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Robert Jeremenko
A/g Deputy Secretary
Resources and Strategy
Department of Industry, Science and Resources

Lodged online

13 November 2023

RE: APA Submission to the Future Gas Strategy Consultation

Dear Mr Jeremenko,

Thank you for the opportunity to comment on the Commonwealth Government's Future Gas Strategy Consultation Paper (Consultation Paper).

APA is an ASX listed owner, operator, and developer of energy infrastructure assets across Australia. Through a diverse portfolio of assets, we provide energy to customers in every state and territory. As well as an extensive network of natural gas pipelines, we own or have interests in gas storage and generation facilities, electricity transmission networks, and 681 MW of renewable generation infrastructure.

We are actively involved in the energy transition taking place across Australia. In August 2022, we published our inaugural Climate Transition Plan which outlines APA's pathway to net zero operations emissions by 2050.

As outlined in the Consultation Paper, the Government recognises that gas will play a key role in the energy transition. Regulatory settings must therefore support continued investment in gas infrastructure and new gas supplies. This will ensure that consumers continue to receive both reliable gas and electricity as the energy market transitions.

Renewable gases will be critical to achieving emissions reductions in many sectors of the economy. Similar to the success of the existing Renewable Energy Target (RET), a market based renewable gas scheme will help drive the development of renewable gases such as hydrogen and biomethane. Policy decisions should encourage the market to find the best opportunities for renewable gas commercialisation, and not explicitly rule out any use cases while the market is developing.

We would welcome the opportunity to discuss our submission in more detail. Should you have any questions or queries, please contact John Skinner on 02 96930009 or john.skinner2@apa.com.au.

Regards,

Beth Griggs
General Manager
Economic Regulatory & External Policy

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1 Submission

Key points

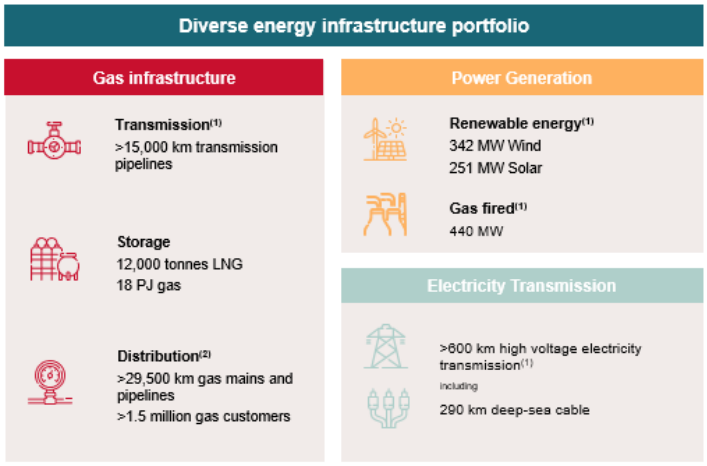
- Gas will play a key role in the energy transition. As coal power stations retire and become less reliable, gas-powered generation (GPG) will have an increasingly important role in supporting the security and reliability of the energy system.
- Governments should work closely with industry partners to support and fast-track the development of new gas reserves. The Beetaloo Basin, in particular, is a natural gas resource of potentially significant scale that, if proven, can help offset the very significant gas supply shortfalls that may commence later this decade.
- The development of new LNG import terminals is likely to represent a less reliable, higher cost and higher emissions option compared to investment in new gas fields and infrastructure to deliver domestic gas.
- Gas infrastructure has an essential role to play in helping Australia achieve least cost decarbonisation. As experience in Europe is showing, repurposing gas transmission pipelines is a cost-efficient and safe option to transport renewable gases.
- Similar to the success of the RET over the past 20 years, a technology neutral, market based renewable gas scheme will help drive the development of renewable gases such as hydrogen and biomethane.

1.1 APA as a partner of choice in Australia's energy transition

APA is a leading Australian Securities Exchange (ASX) listed energy infrastructure business. Consistent with our purpose to strengthen communities through responsible energy, our diverse portfolio of energy infrastructure delivers energy to customers in every state and territory on mainland Australia.

Our 15,000 kilometres of natural gas pipelines connect sources of supply and markets across mainland Australia. We operate and maintain networks connecting 1.4 million Australian homes and businesses to the benefits of natural gas. And we own or have interests in gas storage facilities, gas-fired power stations.

Figure 1



We also operate and have interests in 681 MW of renewable generation infrastructure, while our high voltage electricity transmission assets connect Victoria with South Australia, New South Wales with Queensland and Tasmania with Victoria.

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In 2022, we completed the acquisition of Basslink Pty Ltd, which owns and operates the 370km high voltage direct current electricity interconnector between Victoria and Tasmania. The acquisition adds a third electricity interconnector to APA's energy infrastructure portfolio and is consistent with our strategy to play a leading role in the energy transition.

Most recently, we announced the acquisition of Alinta Energy Pilbara, an energy infrastructure business in Western Australia (WA) with gas and solar generation, battery storage and electricity transmission assets. Alinta Energy Pilbara also has an extensive pipeline of wind, solar, gas and electricity transmission projects. The acquisition is consistent with our strategy to play a leading role in the energy transition.

APA actively supports the transition to a lower carbon future. In August 2022, we published our inaugural Climate Transition Plan which outlines our commitments to support Australia's energy transition and pathway to achieve net zero operations emissions by 2050. We recently launched our inaugural Reconciliation Action Plan which aims to support our journey in building better relationships with First Nations peoples in order to strengthen communities through responsible energy – this is a key focus of APA's sustainability strategy.

As a national and leading energy infrastructure business, we take a customer-led approach to the development of new energy infrastructure, working to meet our customers' needs by delivering reliable, affordable and low emissions energy solutions. APA can support Australia's net zero ambitions through the timely delivery of supporting infrastructure. We also have recent experience developing and connecting renewable generation assets to the national electricity grid. Our ownership and operation of generation assets means we are well placed to help facilitate the energy transition. We have:

- extensive experience working with communities
- a track record of partnering with governments in financing and managing delivery contracts and interfaces
- trust from stakeholder groups as a national operator of complex energy infrastructure
- a proven social licence to operate

1.2 Gas is essential for energy security during the energy market transition

This section relates to questions 2, 3, 4, and 5.

The Consultation Paper highlights that gas is expected to play a key role in navigating the energy market transition and helping Australia meet its net zero ambition targets as the electricity sector moves to renewable energy sources.[1] The transition Australia faces in displacing ageing thermal generation with large volumes of renewable energy is not without its challenges and 'gas, alongside electricity storage, will support electricity grid firming'.[2]

[1] Commonwealth Government, *Future Gas Strategy Consultation Paper* (Consultation Paper, September 2023) 7.
[2] Ibid 7.

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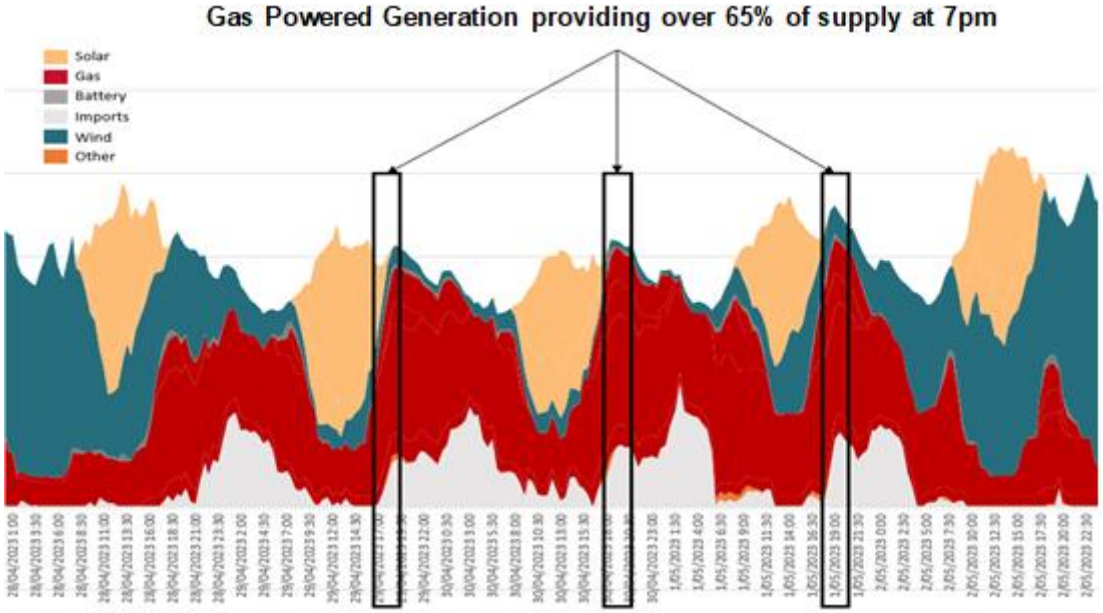
As recent experience in South Australia has shown, periods of low wind and solar availability require significant volumes of long duration dispatchable resources to be available to support the reliability and security of the system. Without GPG providing long duration dispatchable generation, South Australia is unlikely to have developed its renewable energy capacity to the extent that it has in such a short time frame.

Absent replacement dispatchable resources in other states, issues are likely to be experienced as coal power stations retire. The role of dispatchable generation such as GPG will become even more critical if there are delays in building the necessary electricity transmission and other forms of long duration storage to support renewable energy projects.

Despite the introduction of synchronous condensers in South Australia, GPG remains critical in ensuring sufficient electricity supply, including system strength and long duration firming, during periods of low wind and solar generation. For example, in the period from 28 April 2023 to 2 May 2023, GPG was critical to supply adequacy due to periods of low wind and solar generation. As shown in Figure 2, on three out of five days, GPG provided over 65% of peak electricity consumption at 7pm.

Figure 2: GPG supporting energy reliability in South Australia



Source: OpenNEM

Events in Queensland and Victoria over recent years have also demonstrated the flexibility and security offered by gas pipelines and GPG:

- **Flexibility and energy security**
  On 25 May 2021, a failure of one of the generation units at Callide Power Station in Queensland caused 477,000 customers to lose power.

  In mid-June 2021, Yallourn Power Station in Victoria reduced electricity generation to approximately 20% capacity due to the threat of floodwater from the Morwell River.

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Following both these events, GPG stepped up to help provide crucial electricity generation in both Queensland and Victoria. GPG doubled its output while not increasing overall emissions. The ability of gas turbines to quickly ramp up and provide long duration dispatchable generation shows they will be a critical part of the energy system for many years to come.

- **Addressing shortfalls through the gas network**
  In mid-July 2021, the Longford gas plant in Victoria suffered a reduction in production due to technical problems, significantly reducing the amount of gas being supplied to the Victorian market. This led to AEMO issuing a notice of threat to system security.[3]

  In response to this event, it was the flexibility of APA's 7,500 kilometres of interconnected gas transmission pipelines that form an East Coast Gas Grid that enabled APA to get gas from the north to the south, helping to rapidly address these shortfalls.

  On this occasion, APA's customers were able to utilise their inventory position (known as 'Park') on the Moomba to Sydney Pipeline (MSP) to support supply to the markets through this event. Further additional capacity was available during this event should the market have required it. The recent MSP capacity upgrade has ensured additional flows from the MSP into southern markets can be accommodated should a similar issue arise.

The gas network is a flexible, affordable and safe store of energy, making it ideal to help support energy supply during extreme weather or periods of reduced supply. Locating GPG close to major demand centres also reduces exposure to electricity transmission capacity and frequency constraints often experienced by the overconcentration of renewable generation in common areas of the grid. This advantage may become critical if there are delays in building the necessary transmission investment to support renewable energy.

Gas infrastructure will play an important role for many decades to come, and therefore regulatory settings must support continued investment in our gas infrastructure. This will ensure that consumers continue to receive both reliable gas and electricity as the energy market transitions.

1.3 Maintaining investment in GPG

This section addresses questions 2, 3, and 4.

It is well documented that the economics of thermal generation (coal and GPG) are under pressure due to the lower marginal cost of wind and solar generation and the reduced flexibility of such plant. This is leading to announcements about the closure of thermal assets:

- In February 2022 Origin submitted notice to AEMO for the potential early retirement (in 2025) of Eraring Power Station. Origin stated that this decision reflected the continuing,

[3] AER, *AER gas weekly report – 20-26 June 2021* (14 July 2021) <https://www.aer.gov.au/system/files/AER%20gas%20weekly%20report%20-%2020%20%E2%80%93%2026%20June%202021.pdf>.

rapid transition of the National Electricity Market (NEM) as we move to cleaner sources of energy.[4]

- In November 2022 AGL announced that it will close one of the ageing gas-fired Torrens Island power stations due to challenging economic conditions.[5]

As increasing volumes of renewable energy come online, the pressure on thermal power station operators is expected to increase. The completion of the NSW to South Australian interconnector (Project Energy Connect) and other interconnectors, which will increase the amount of energy that can be imported between jurisdictions, will compound the problem.

In contrast to thermal power (particularly coal fired), which is expected to retire from the system and not be replaced, gas fired Open Cycle Gas Turbine (OCGT) peaking plants will become more important as coal power retires. As AEMO points out, this is because OCGT GPG will provide flexible and firm electricity supply, albeit less frequently than historically, but with greater importance to maintain reliability of the system.[6]

While governments are taking steps to incentivise the introduction of new renewable generation projects (such as through the Capacity Incentive Scheme), GPG is not being incentivised through similar mechanisms. This means that GPG operators will need to recover their costs and risk premium through high prices in the NEM. Often, this will involve bidding in capacity at the Market Price Cap (MPC), which as of 1 July 2022 is $15,500/MWh. When the NEM dispatches capacity at the MPC, all capacity is dispatched at that price, regardless of whether the capacity is underwritten or not.

In its July 2022 Consultation Paper, the Energy Security Board (ESB) recognised that the NEM's energy only design and existing MPC may not be sufficient to encourage investment in enough generation to maintain a reliable system.[7] The ESB's modelling suggested that the existing MPC is materially too low to give a high likelihood of meeting the current reliability standard.

Energy Ministers are encouraging more wind and solar through the Capacity Investment Scheme underwriting scheme. GPG however, will rely on the MPC to allow it to recover its costs. The dispatch profile of GPG is very uncertain, and many factors will impact on whether OCGT generators bid into the market, including:

- the weather
- outages at coal power stations
- the cost of gas
- delays in building electricity assets

It is unclear whether the MPC and energy only market will encourage sufficient new investment in GPG to maintain a reliable system as coal fired generation and their baseload generation

[4] Origin Energy, *Media Release, Origin Proposes to accelerate exit from coal generation,* 17 February 2022
[5] Sydney Morning Herald, AGL to close SA gas power plant in 2026 as renewables accelerate, 24 November 2022
[6] AEMO, *Gas Statement of Opportunities* (Report, March 2023) 23.
[7] Energy Security Board, *Capacity Mechanism, High-level Design Paper* (Paper, June 2022) 13.

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exits the system. Consistent with the ESB's findings, Energy Ministers should consider whether alternative arrangements are required to ensure we maintain a reliable energy system.

1.4 Developing new gas supply is critical for energy security

This section addresses questions 4, 23, 24, 39, 40 and 42.

Both the Australian Energy Market Operator (AEMO) and the Australian Competition and Consumer Commission (ACCC) have recently flagged the risk of East Coast supply shortfalls this decade.[8] The Consultation Paper recognises that at the current rates of production Australia is likely to face gas shortfalls from the medium term.[9]

Governments should be cognisant that they have a role to play in expediting approval processes to ensure that frontier basins can be established and connected to the interconnected gas grid as soon as possible. Failure to approve new sources of gas supply to replace rapidly depleting existing sources may result in the market adopting less efficient (and higher cost) options to bring gas to southern markets, such as LNG import terminals (see Section 1.6.1), introducing new energy security risks.

As an energy exporting nation with an extensive, interconnected grid that can move gas between supply fields and demand locations, we should be prioritising the utilisation and expansion of the gas transmission network (if required) together with southern storage, ahead of importing of LNG through import terminals..

Despite the risks of supply shortfalls, the Consultation Paper does not outline a strategy for bringing new supplies online. Figure 15 of the Consultation Paper notes that the supply data does not account for continued investment in developing supply and contingent (2C) resources and a consequent gap grows between gas demand and supply. We are strongly of the view that incorporating this into the Future Gas Strategy will be critical to ensuring new gas supply. This will provide the NEM with greater security and reliability and promote an orderly transition to Net Zero.

Governments should work closely with industry partners to support and fast-track the development of new gas reserves, including the Beetaloo Basin. The Beetaloo, in particular, is a natural gas resource of potentially significant scale and can help offset the very significant gas supply shortfalls that may commence later this decade.

Similar to large electricity transmission projects, however, we expect that the development of new gas resources and associated infrastructure will face social licence issues and community opposition. For this reason, we recommend that the Future Gas Strategy considers avenues to garner national support for these important projects. One of the avenues that could be considered is a policy that ensures domestic users are prioritised alongside export markets (see next section).

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[8] AEMO, *Gas Statement of Opportunities* (Report, March 2023); ACCC, *Gas Inquiry 2017-2030 Interim update*, (Report, September 2023) 9.
[9] Commonwealth Government, *Future Gas Strategy Consultation Paper* (Consultation Paper, September 2023) 21.

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1.4.1 *Domestic prioritisation of new gas reserves*

Given our abundant gas resources, Australian domestic gas markets should never face the risk of potential gas shortfalls. To support future investment in gas infrastructure, businesses and households need confidence that there will be sufficient gas to meet current and future needs.

The Australian gas industry will lose its social licence to operate, putting new investment at risk, if gas producers are seen to be neglecting domestic markets. High gas prices will also continue to put Australian jobs at risk, through their impact on both electricity and gas bills.

Given the decline of legacy gas fields, particularly in southern markets, the development of new gas fields is essential if domestic users are to avoid potential gas shortfalls later this decade. The opening of new fields, such as Beetaloo, provides a good opportunity to consider measures that will build social licence and garner support for new gas projects.

A well designed domestic priority mechanism is one of the options that could achieve these aims. As well as reducing the risk of domestic gas shortfalls, such a mechanism would place downward pressure on domestic gas prices and support Australian industry and jobs.

Importantly, it would also reduce the risk of regulatory intervention through other recent reforms, which may become redundant (such as the East Coast Gas reforms, expansion of the Australian Domestic Gas Security Mechanism, and the introduction of the Competition and Consumer (Gas Market Code) Regulations). Equally, it would reduce the risk of diverting gas from LNG exports to southern markets as suggested in AEMO's 2023 Gas Statement Of Opportunities,[10] thereby supporting Australia's existing position and reputation as a reliable energy supplier.

APA is therefore supportive of a policy framework that prioritises domestic gas requirements. Such a policy will provide long term certainty and financial incentives for domestic industry to invest in new, more efficient and lower carbon infrastructure, and in the timeframe needed to meet Australia's energy demands and interim decarbonisation targets.

While a domestic priority mechanism may not solve immediate gas supply issues on the East Coast, in the long run, it would provide clear signals for both LNG producers and domestic consumers of the supply arrangements that will apply for new investments. Importantly, new producers who are subject to such a mechanism should not bear a disproportionate obligation to supply domestically because existing producers do not have this obligation.

1.5 Gas infrastructure is very efficient and reliable

This section addresses questions 2, 4 and 16.

Gas infrastructure is very reliable and efficient at delivering energy. Because gas pipelines are underground, it is a very rare occurrence for network faults to disrupt customer supply. The fact that gas can be compressed means the gas grid holds significant inventory and can be

[10] AEMO, *Gas Statement of Opportunities* (Report, March 2023) 84 – figure 46.

relied upon to operate flexibly for customers. Consequently, even during maintenance activities, customers are rarely disrupted.

Gas pipelines are not currently subject to formal reliability standards. One of the key reasons for this is that gas reliability is very good. For example:

- Gas distribution customers experience an outage approximately once every 66 years on average[11]. This is in contrast to electricity distribution customers, who experience an outage, on average, around once or twice a year.[12]
- Gas transmission pipelines also have very good reliability with only 0.03 loss of supply events per annum per km of pipeline. This compares to 0.42 loss of supply events per annum per km for high voltage powerlines.[13]

Given gas infrastructure is so reliable, we should consider how to repurpose it for renewable gases, including hydrogen.

Furthermore, it is currently more cost efficient to deliver energy via gas infrastructure than electricity networks. For example, the ACT gas distribution network, as shown in Table 1 below, delivers energy to customers at around 60% of the cost of the electricity distribution network (2021 data).[14]

Table 1

Benchmarking ACT electricity and gas networks based on energy delivered

	Regulated Asset Base ($m)	Actual Annual Revenues ($m)	Actual Energy Delivered (GWh) (1 TJ = 0.277 GWh)	Average cost to deliver a GWh ($)
ACT Electricity distribution network	981	140	2,851	49,106
ACT Gas distribution network	377	67	2,201	30,436

If gas distribution infrastructure is eventually decommissioned, the electricity network will have to be upgraded to accommodate the avoided gas load. The build out of renewable generation will require substantial increases in electricity distribution and transmission infrastructure, with a consequential impact on household and industry electricity bills.

[11] Australian Energy Regulator (AER), *Gas Network Performance Report* (Report, 2022) 61
[12] AER, *Electricity Network Performance Report 2022* (Report, 2022) 21
[13] Australian Pipeline and Gas Association (APGA), *GPA Engineering, Pipelines v Powerlines – A Technoeconomic Analysis* (Report, 2022) 13
[14] AER, *Electricity DNSP Operational Performance Data 2022* (15 July 2022); AER, *Gas Distribution - Operational Performance Data 2022* (16 December 2022).

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The cost savings associated with electrification often overlook the significant cost of electricity network infrastructure upgrades and the cost of new generation. The cost of this new infrastructure will push up network charges for all customers across the NEM.

While we don't know exactly how much that will cost, gas infrastructure delivers energy very efficiently and the construction of new electricity assets will likely result in bill increases for customers. This means that we might not see the customer bill reductions that policy makers and advocates seem to be assuming.

1.6 On-going investment in gas infrastructure is critical to the energy transition

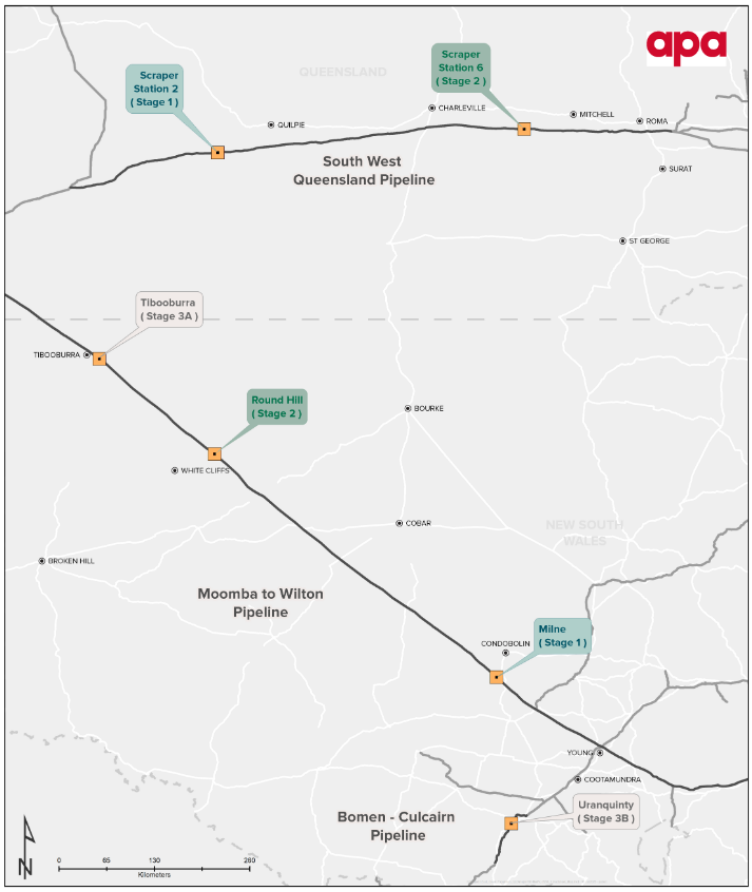
This section addresses questions 2, 4 and 16.

Gas infrastructure operators have a strong track record of delivering the necessary infrastructure to ensure customers have sufficient gas in the locations they need it.

To date, the incremental expansion of existing infrastructure has been the most efficient, timely and lowest cost solution to ensure that gas is delivered when and where it is needed. Gas retailers coordinate with producers to ensure they secure gas supplies and with pipeline operators to ensure they can transport gas from gas fields to their end customers.

Since 2021 APA has announced three expansions of the East Coast Gas Grid to efficiently provide the capacity required to transport more gas from Queensland and the Northern Territory to southern markets:

Figure 3



- In May 2021 APA announced that it would increase the capacity of the East Coast Gas Grid by 25%. On 3 July 2023 APA announced that construction of this first stage of the East Coast Gas Grid expansion, which increased capacity by 12%, had been completed.
- Stage two of the East Coast Gas Grid expansion commenced in the second quarter of 2023. This stage includes the construction of additional compressors to add a further 13% transportation capacity. Stage 2 is on schedule to be operational for Winter 2024.

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- While APA has not yet committed to further expansions, engineering and design works are underway to scope the potential next phase should it be required.

As it becomes clear that further investment in gas infrastructure is needed, market signals and bilateral contracting will help support the continued expansion of the East Coast gas network. Importantly, the most recent expansions of APA's East Coast Gas Grid are responding to increases in the need to transport gas from Queensland to meet peak demand in southern markets.

Further incremental expansion will become more challenging and subject to increased investment risk, however, as demand peaks become shorter in duration. This is expected as renewable generation displaces thermal, mainly coal, generation and requires more GPG to provide dispatchable firming. The investment risk is exacerbated by the uncertainty in domestic policy for long term gas supplies and the risk of further, adverse, regulatory intervention.

1.6.1 LNG import terminals are not an efficient option

This section addresses question 32.

The development of new LNG import terminals is likely to represent a less reliable and higher cost option compared to investment in new gas fields and infrastructure to deliver domestic gas. Long term, stable gas prices are required to support customers in Australia. Imported gas pricing is likely to be higher cost, on average, relative to domestic supplies and is subject to greater supply risks, particularly during periods of conflict.

The carbon emissions of LNG gas imported through Floating Storage and Regassification Units (FSRUs) are also around 20% higher than pipelined gas. This is due to the energy consumed during the liquification of natural gas. Should carbon pricing become mandated, this higher intensity will also mean that LNG imports will become incrementally more expensive.

It would be inconsistent with net zero 2050 aspirations for policymakers to prioritise LNG import terminals over the development of domestic infrastructure and new gas supplies, given LNG imports that displace domestic gas would add to, and not reduce, Australia's domestic carbon emissions.

Gas retailers' appetite to invest in new gas developments in eastern Australia may also be impacted should an LNG terminal be sanctioned. This is because retailers will have less of an incentive to contract long term, impacting mid-stream and pipeline infrastructure owners' confidence to invest in gas infrastructure. In turn, this will risk bringing new domestic gas supplies to market.

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1.7 The repurposing of existing gas infrastructure for renewable gases

This section relates to questions 16, 30 and 31.

Energy Ministers recognise that gas will play a crucial role in the energy transition, and that the continuing use or repurposing of gas infrastructure could therefore be important for both gas and electricity users.[15]

Gas infrastructure has an essential role to play in helping Australia achieve least cost gas decarbonisation. Repurposing natural gas pipelines to transport renewable gases, including hydrogen, has significant advantages:

- Converting existing gas networks is more cost-efficient in comparison to constructing new, dedicated hydrogen pipelines.[16]
- Gas pipeline networks are already available and socially accepted (routes, including rights of way and use).[17]
- Technologies for converting the natural gas infrastructure to hydrogen operation are already being applied.

Regardless of which renewable gas proves most effective, renewable gas providers can utilise pre-existing gas infrastructure like distribution networks, pipelines, metering equipment, and human expertise. An Oakley Greenwood report recently commissioned by the Tasmanian Government in the development of its gas strategy supports this approach.[18]

The recently published BCG Report also found that existing gas infrastructure will play an important role in supporting sectors where electrification will be too hard or expensive (peaking applications in particular). During the transition phase, preserving gas infrastructure was also considered to enable the development of low-carbon gases like green hydrogen, which will likely be needed in a net zero future, for industrial use at a minimum.[19]

Frontier Economics has also investigated the potential for gas infrastructure to decarbonise the economy. In its September 2020 report, Frontier concluded that making continued use of existing gas assets wherever possible, including for the transport of hydrogen, can help avoid the material costs of investing in new assets to deliver energy.[20]

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[15] Energy Ministers Consultation Paper, *December 2022,* p8
[16] Ibid, Amber Grid et al, *European Hydrogen Backbone* (Report, April 2022) <https://ehb.eu/files/downloads/ehb-report-220428-17h00-interactive-1.pdf>.
[17] European Union Agency for the Cooperation of Energy Regulators, *Transporting Pure Hydrogen by Repurposing Existing Gas Infrastructure: Overview of existing studies and reflections on the conditions for repurposing* (16 July 2021) 6.
[18] Oakley Greenwood, *Tasmanian Gas Strategy: Background research, analysis and suggest next steps* (Report, October 2021) p.16.
[19] Boston Consulting Group, *The role of gas infrastructure in Australia's energy transition* (Report, June 2023).
[20] Frontier Economics, *The Benefits of Gas Infrastructure to Decarbonise Australia,* (Report, 17 September 2020) 9 <https://www.energynetworks.com.au/resources/reports/2020-reports-and-publications/the-benefits-of-gas-infrastructure-to-decarbonise-australia-frontier-economics/#:~:text=1%20INTRODUCTION-,Frontier%20Economics%20has%20been%20engaged%20by%20Australian%20gas%20industry%20associations,gas%20infrastructure%20to%20decarbonise%20Australia.&text=Australia%20has%20committed%20to%20reducing,part%20of%20the%20Paris%20Agreement.>.

The cost-effectiveness of pipeline infrastructure has also been considered in the Pipelines vs Powerlines: A Technoeconomic Analysis in the Australian Context report, produced by GPA Engineering and commissioned by the Australian Pipelines & Gas Association (APGA).[21]

The report indicates that hydrogen pipelines are likely to play a central role in Australia's net zero energy market. Hydrogen pipelines, for the purpose of energy transport and storage, were found to be up to four times more cost-competitive when compared to electricity transmission infrastructure, in the context of like distance and capacity scenarios.

The ability of pipelines to store large amounts of energy is another factor supporting the repurposing of gas pipelines. The gas network is a flexible, affordable and safe store of energy, making it ideal to help support energy supply during extreme weather or periods of reduced supply. Gas turbines can quickly ramp up and provide long term dispatchable generation, which shows gas pipelines will be a critical part of the energy system for many years to come. While gas pipelines are currently used for storing natural gas, it is likely that they will be repurposed and used as a hydrogen store in the future.

1.7.1 Australian and overseas experience repurposing gas infrastructure

We note that the Consultation Paper states that 'current gas transmission infrastructure may not be suitable for gas needs in the future'.[22] This section of our submission outlines some examples, both locally in Australia and internationally, where existing gas infrastructure has been repurposed for storage and transport of renewables gases.

1.7.1.1 A step closer to Australia's first 100% hydrogen-compatible transmission pipeline

One of APA's key Pathfinder projects, the Parmelia Gas Pipeline (PGP) Conversion Project, is seeking to enable the conversion of around 43-kilometres of the PGP in WA into Australia's first 100 per cent hydrogen-ready transmission pipeline.[23] This project was partially funded by the Western Australian Government's Renewable Hydrogen Fund.

In May 2023 APA announced findings from phase two of the PGP Conversion Project which confirmed the technical feasibility of converting a 43km section of the high-pressure natural gas pipeline to carry 100% hydrogen.[24] The project will now progress to phase three, which will consider preparing the section of pipeline for hydrogen service and will include detailed safety studies and conversion plans. The detailed conversion plans will consider any modifications to ancillary equipment such as above-ground facilities and investigating supply and offtake arrangements required to meet the needs of customers.

Off the back of this research, APA has also developed a Pipeline Screening Tool that provides a high-level assessment of the hydrogen readiness of its pipeline assets, based on key pipeline material and operating characteristics. Initial assessments using the Pipeline Screening Tool indicates there is a high likelihood that around half of APA's natural gas

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[21] Australian Pipelines & Gas Association, *Pipelines vs Powerlines: A Technoeconomic Analysis in the Australian Context* (Final Report, 24 August 2021).
[22] Commonwealth, *Future Gas Strategy Consultation Paper* (Consultation Paper, September 2023) 29.
[23] APA, *APA set to unlock Australia's first hydrogen-ready transmission pipeline* (Media Release, 23 February 2021) <https://www.apa.com.au/news/media-statements/2021/apa-set-to-unlock-australias-first-hydrogen-ready-transmission-pipeline/>.
[24] APA, *Testing confirms technical feasibility of converting gas transmission pipeline* (Media Release, 19 May 2023).

pipeline assets could be used for hydrogen transportation, in 100% pure or blended form, with no, or small, changes to their current operating profile.

1.7.1.2 European experience in repurposing gas infrastructure

While Australia has only recently begun investigating opportunities for domestic renewable gas markets, other countries around the world, particularly in Europe, are further ahead. An increasing number of projects around the world are demonstrating the potential for re-use of gas infrastructure to transport renewable gases.

For example, studies carried out as part of the European Hydrogen Backbone initiative found that repurposing gas pipelines for hydrogen would equate to ~10-15 per cent of the costs involved for constructing new hydrogen pipelines (including decommissioning natural gas operation, water pressure tests, dismantling of connections etc.). The capital cost per km of repurposed hydrogen pipelines is still substantially lower, at ~33 per cent of the cost of building new hydrogen pipelines.[25]

Figure 2: Gasunie's hydrogen transmission pipeline

In the Netherlands, Gasunie, the Netherlands' gas transmission operator, has been transporting hydrogen along a modified natural gas pipeline since 2018 (see Figure 2).

This 12 km pipeline can transport more than 4,000 tons of hydrogen per year for industrial purposes. The pipeline has now been operating reliably and safely for five years.[26]

On 27 June 2023, Gasunie announced that it has taken the investment decision for the first part of its national hydrogen network. This nationwide network will cost around €1.5 billion and largely consist of existing natural gas pipelines.[27]

From 2030, the Netherlands' national hydrogen network will connect seaports with the major industrial customers as well as connections to Germany and Hamburg (see Figure 3). About 85% of the network will consist of reused natural gas pipelines, which is 75% cheaper than building new infrastructure.[28]

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[25] Amber Grid et al, *European Hydrogen Backbone* (Report, April 2022) 17-8 <https://ehb.eu/files/downloads/ehb-report-220428-17h00-interactive-1.pdf>.
[26] Gasunie, 'Hydrogen pipeline in Zeeland has been proving added value for three years' *News* (Web Page, 18 November 2021) < https://www.gasunie.nl/en/news/hydrogen-pipeline-in-zeeland-has-been-proving-added-value-for-three-years>.
[27] Gasunie, 'Dutch national hydrogen network launches in Rotterdam', 27 June 2023, < https://www.gasunie.nl/en/news/dutch-national-hydrogen-network-launches-in-rotterdam>
[28] Ibid.

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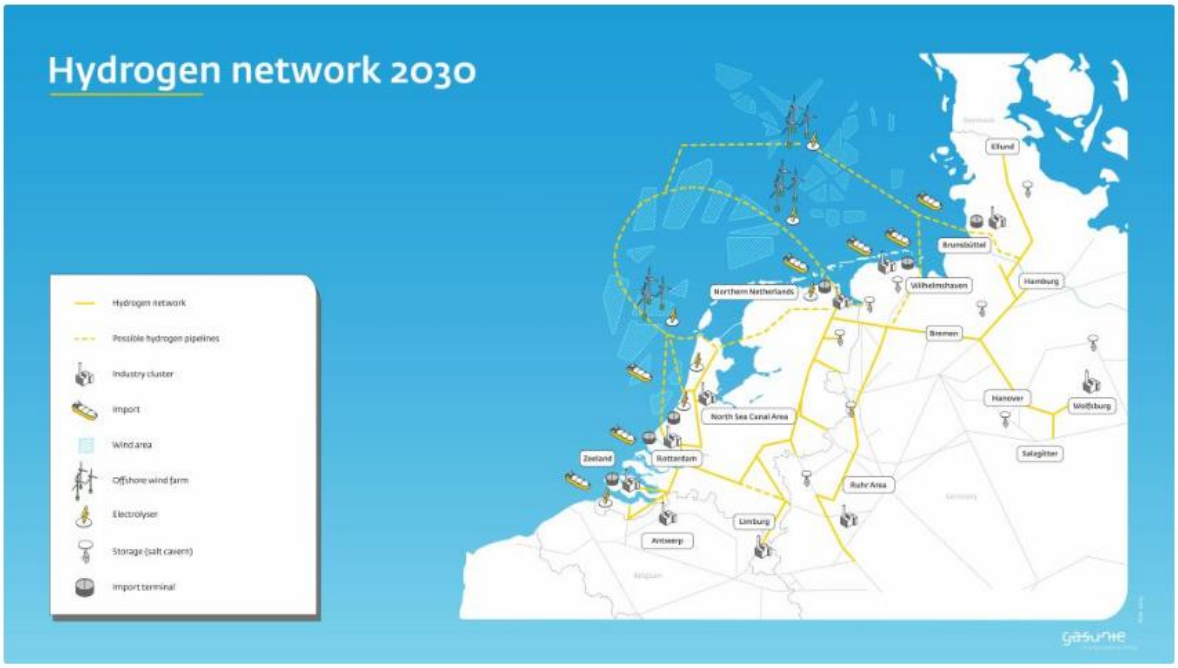
Figure 3 Planned European Hydrogen Network 2030



1.8 A technology neutral, market based approach to renewable gas scheme design

This section addresses questions 8 and 43.

We are of the view that emissions reduction ambitions can be best achieved through a market based policy that provides strong incentives across different emissions sources and abatement activities.

The Australian renewable gas industries are still in their infancy and governments should play a key role in ensuring a level playing field for all potential uses of renewable gases. The recent KPMG Report recommends that any renewable gas policy has a significantly better chance of meeting its objectives if the renewable gas scheme is 'use agnostic' and open to all potential use cases.[29] Policy decisions should therefore encourage the market to find the best opportunities for commercialisation, and not explicitly rule out any use cases while the market is developing.

We recognise that any renewable gas policy will have a focus on reducing overall emissions, and therefore targeting a renewable gas policy at particular sectors of the economy may be an appropriate place to start. However, it is unclear how the renewable gases industry will develop and the speed at which particular sectors will look to decarbonise.

In our view, any renewable gas policies should not limit opportunities to particular use cases. Instead, the market should be allowed to find the best uses for renewable gases. Widening the scope of opportunities for renewable gas is likely to stimulate domestic demand substantially more than restricting use to particular use cases.

[29] KPMG, *Policy options to support Australia's decarbonisation journey* (Report, October 2023) 44.

The BCG Report[30] found that many of Australia's distribution networks are compatible with transporting a 10-20% hydrogen blend. This means that many networks in Australia could be well-placed to demonstrate the physical and economic feasibility of low-carbon gases and support their development by blending low carbon gas into the distribution network.[31]

1.9 Accelerate renewable gas certification

This section addresses questions 8 and 43.

The KMPG Report highlights that a critical component of increasing market demand for renewable gases is ensuring that end users are able to distinguish between green gases from other emissions intensive gases (e.g., grey hydrogen and natural gas).[32]

Certificates which guarantee the provenance and emissions attributes of [renewable gases] will allow end users to make emissions reduction claims[33] making them an attractive option for consumers. Additionally, certification will aid renewable gases in being competitive against natural gas even with the price premium.[34]

1.10 Setting renewable gas targets

This section addresses questions 8 and 43.

As highlighted in the KPMG Report, targets for renewable gases 'assist industry planning and guide further policy development.'[35]

APA agrees that any renewable gas scheme should have an ambitious aspirational, long term target of, say, 10 percent. In contrast to a smaller initial target, a 10 per cent target will generate a larger demand stimulation effect and greater economies of scale. As such, we recommend an initial 10 per cent target with periodic reviews of any scheme to ensure it is meeting its objectives.

The RET provides a useful precedent for successfully delivering a renewable energy scheme. Despite many challenges experienced over its history, the RET has been a successful initiative that has accelerated the deployment of renewable generation across Australia.

It is important to remember that the RET did not achieve its ultimate objective of 33,000 GWh overnight; it took approximately 20 years to reach this goal. The initial targets were small and reviewed periodically in response to changing conditions. Similarly, a renewable gas scheme design could include interim targets with reviews of these targets taking place over the life of the scheme.

[30] Boston Consulting Group, *The role of gas infrastructure in Australia's energy transition* (Report, June 2023).
[31] Ibid.
[32] KPMG, Policy options to support Australia's decarbonisation journey (Report, October 2023) 27.
[33] Ibid.
[34] Ibid.
[35] Ibid 7.

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1.11 Carbon capture and storage's (CCS) role in decarbonising Australia

This section relates to questions 9 and 28.

CCS involves capturing, transporting and storing carbon dioxide (CO_2) by injecting the captured greenhouse gases back into the ground or another form of storage. There is a complex supply chain that is involved in this process, including (but not limited to):

- CO_2 capture process (e.g., carbon dioxide removal, point source carbon capture)
- Transportation of CO_2 to designated area
- Sequestration for permanent storage underground

According to the International Energy Agency (IEA), a scalable CCS industry can be a major supporting pillar to a successful clean energy transition.[36] The UN Intergovernmental Panel on Climate Change also recognises CCS will form a vital role to reducing global greenhouse gas emissions in line with the climate goals.[37]

CCS presents multiple opportunities for Australia's pathway to net zero by 2050 and beyond. It is an enabler to accelerate Australia's decarbonisation journey by offsetting emissions sources in hard-to-abate sectors while also achieving net-negative global emissions through engineered sequestration approaches including:

- bioenergy with CCS (any energy pathway where CO_2 is captured from a biogenic source and permanently stored)
- biochar (carbon-rich form of charcoal that can be added to soil to sequester carbon)
- direct air capture and storage (removes CO_2 directly from ambient air to be stored in deep geological forms).[38]

The Australian Government also considers CCS as a proven technology.[39] To incentivise businesses to explore CCS in their industrial processes, the Clean Energy Regulator provides funding for eligible CCS projects through the Emissions Reduction Fund.[40]

At APA, we continue to investigate innovative projects and leading industry partnerships relating to CCS and future fuels that can help Australia reach net zero by 2050.

APA was a consortium member of the Mid-West Blue Hydrogen Project that conducted a carbon capture and storage feasibility study in the Mid-West region of WA to look at blue hydrogen technology and associated CCS opportunities.[41] The feasibility study is now

[36] International Energy Agency, 'Putting CO2 to Use: Creating value from emissions' (Technology Report September 2019).
[37] Intergovernmental Panel on Climate Change, 'Mitigation of Climate Change' (Report, 4 April 2022).
[38] Climate Change Authority, 'Reduce, remove and store: the role of carbon sequestration in accelerating Australia's decarbonisation' (Insights Paper, April 2022).
[39] Australian Government, 'Reducing emissions through carbon capture, use and storage' (Web Page, Last updated 29 July 2022) <https://www.dcceew.gov.au/climate-change/emissions-reduction/carbon-capture-use-storage)>.
[40] Australian Government, 'Carbon capture and storage method' (Web Page, 31 August 2022) < https://www.cleanenergyregulator.gov.au/ERF/Choosing-a-project-type/Opportunities-for-industry/carbon-capture-and-storage-method>.
[41] APA, 'Consortium to investigate delivery of low cost hydrogen' (Media Release, 4 November 2021).

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complete and confirms that the Mid West region is suitable for blue hydrogen production and CCS.[42]

International developments have also informed our position on CCS' potential role in Australia's decarbonisation journey. There are CCS facilities that are already operating at a commercial scale or on schedule to be operating in the very near future. For example, in 2020, the Norwegian Government awarded a licence for CO_2 storage to the Northern Lights project as part of its wider CCS initiative called Longship. Longship is the Norwegian full-scale CCS project in which the Norwegian Government provides financial support, facilitation, and risk mitigation.

[42] Pilot Energy, 'APA Group, Warrego Energy, and Pilot extend mid-west consortium (Media Release, 19 September 2022).

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Appendix A – Consultation Questions

CHAPTER 1 - DEMAND	
Consumers (domestic)	
1. Do you use any international and/or domestic forecasts to inform your outlook of the gas market? We want your views on which scenarios best reflect the demand outlook. Are there any limitations or additional factors impacting the demand outlook you would like to note?	• APA uses forecasts for both domestic and international gas demand (LNG) as well as domestic gas supply data that is developed in combination with an external advisor. • Forecasting GPG demand is particularly difficult with global climate patterns (such as El Nino/La Nina), seasonal and even daily/weekly weather events (dunkelflaute) leading to significant fluctuations in GPG and therefore gas demand.
2. What role do you see gas-fired generators playing in supporting Australia's 82% renewable energy targets and beyond?	• See Section 1.2 of our Submission • Gas infrastructure will play a key role in helping Australia meet its net zero targets. • GPG will help 'unlock' renewables and ensure sufficient electricity supply during periods of low wind and solar generation • While natural gas' overall contribution to the energy mix is anticipated to decrease, gas generation will rise in peak period e.g., during winter when there is less direct sunlight and wind
3. How will the expected trends in demand from gas-fired generators impact other gas users?	• GPG demand is very difficult to forecast and increasingly driven by significant weather events and outages at coal power plants. • Peak gas demand currently occurs in winter months. Peak events in electricity markets are expected to become more common in winter, due to low solar and wind output. This will put greater pressure on winter gas supplies. • The impact on other gas users is difficult to predict. With sufficient gas support and fit-for-purpose infrastructure, GPG should be able to dispatch and support peaking demand.
4. What should government do to consider managing these impacts	• See Sections 1.3 and 1.4 of our Submission.

and to mitigate energy peaks caused by regional or seasonal variations?	• Governments should work closely with industry partners to support and fast-track the development of new gas reserves. The Beetaloo Basin, in particular, is a natural gas resource of significant scale and can help offset the very significant gas supply shortfalls that are forecast to emerge later this decade. • As outlined in Section 1.3, it is currently unclear whether there are sufficient market signals to bring enough GPG into the system. • Energy Ministers should consider whether alternative arrangements are required to ensure we bring GPG into the NEM to maintain a reliable energy system
5. How feasible, and at what scale, are alternatives to natural gas for the electricity sector? You may wish to consider renewable gas alternatives for peaking generation, for example, biomethane and low-emissions hydrogen and other forms of grid-firming technologies like batteries and pumped hydroelectricity. What barriers exist to using these alternatives?	• We agree that alternatives to natural gas need to be developed (see responses to questions 8, 42 and 43). • The Western Australia Renewable Hydrogen Target (RHT) is a good example of a scheme looking to support the development of hydrogen. • However, in the long term, natural gas will play a critical role in supporting Australia decarbonising. • The CSIRO GenCost Report indicates that the lowest system cost will be when renewable generation is supported by gas.
6. How much longer will you continue using gas as a fuel source or feedstock for your business? Do you think your consumption of gas will decline over time, and if yes, at what rate?	• APA's 15,000km of gas pipelines are our largest source of emissions. • These arise when gas in combusted in our compressor units. • Many of these compressors are in very remote locations and therefore cannot be electrified easily. • As outlined in our Climate Transition Plan, we have a target of net zero operational emissions by 2050. • We expect our consumption of gas will reduce over time, mainly through compressor efficiency and compressor electrification.

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7. Are there alternatives that your business can use instead of gas (for example electrification, hydrogen, biomethane or circular economy inputs)? What barriers exist to using these alternatives? How can the substitution of gas be accelerated?	• Yes, electrification of compressors is an alternative to gas powered compressor units. • Compressors can also run on biomethane. • The cost of electrification and biomethane are barriers to these alternatives.
8. What factor/s influence your willingness to adopt electric appliances or processes? How could governments support small businesses to decrease gas consumption?	• See Question 7. The cost of electrification is a barrier to adoption. • Government support for a market based renewable gas scheme will help drive the development of renewable gases such as hydrogen and biomethane. • Having biomethane as a viable and cost effective alternative to natural gas would help reduce commercial customers' carbon emissions.
9. What role might carbon capture, utilisation and storage (CCUS) and negative emissions technologies (NETs) (for example direct air capture and CO2 removal) play in decarbonising industrial processes that are hard to abate in your business or industry?	• See Section 1.11 • We expect CCUS to play a key role in achieving net zero. • APA was a consortium member of the Mid West Blue Hydrogen Project that confirms the Mid-West region as suitable for blue hydrogen production and CCS.
Community	
10. If your home or small business gas appliances (stove, heating, or hot water system) stop working, would you prefer to keep using gas or switch to an electric appliance?	• No response
11. If you are unsure, what would help you decide? What factors influence your willingness to switch to electric appliances?	• No response
Producers	
12. What do you see as the role of gas in Australia's net-zero transformation?	• No response
13. What action is your industry or company taking to reduce greenhouse gas emissions and does gas use have a role to play?	• No response

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14. How can Australian LNG accelerate global decarbonisation without compromising energy security or affordability?	• No response
15. What measures will increase the transparency of LNG supply chains, including their environmental, social and governance impacts?	• We do not consider that there needs to be additional reporting about LNG supply chains. • Existing reporting from AEMO, the ACCC, the AER, and other Government bodies as well as information provided to the Gas Bulletin Board provide sufficient transparency.
16. Does current gas transport and storage infrastructure support the changing role of gas in the residential and commercial sector? If inadequate, what is needed and who should provide the change?	• Yes. Refer to section 1.6 of our submission. • Gas infrastructure operators have a strong track record of delivering the necessary infrastructure to ensure customers have sufficient gas in the locations they need it. • To date, the incremental expansion of existing infrastructure has been the most efficient, timely and lowest cost solution to ensure that gas is delivered when and where it is needed. • This means that the incremental expansion of the East Coast grid is the most efficient solution to transport more gas from Queensland and the Northern Territory to residential and commercial customers in southern markets.
Consumers (international)	
17. What role will LNG – and Australian LNG in particular – play in your economy's energy transition?	• We expect Australian LNG to support the decarbonisation of many economies across the world. • Similar to its role in the NEM, as coal power stations retire across the world, LNG will help support the reliability of energy systems dominated by renewables.
18. What is your economy's current LNG demand and how do you predict this will change through to 2035 and beyond to 2050?	• No response
19. What options should the Australian Government consider to ensure international investment in Australian LNG projects remains competitive?	• No response
20. What value do you place on low or net zero emissions LNG production?	• No response

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CHAPTER 2 - SUPPLY	
Producers	
21. What is the role of offshore acreage releases in the context of consumer demand and emissions targets? What factors should the Australian Government consider when releasing acreage?	• No response
22. How could the offshore petroleum regime be improved to meet the objectives of the strategy?	• No response
23. What are the major barriers and opportunities for new supply? How can the Australian Government prioritise, mitigate or manage these?	• See Section 1.4 of our Submission. • Government policies looking to restrict or reduce natural gas use are increasing uncertainty for investors in gas assets. • Policy support in areas such as acreage releases, allocation of exploration licences, support for environmental approvals and land access, will help mitigate some of these barriers.
24. What are some of the opportunities for gas production in Australia in the medium (to 2035) and long term (to 2050)? How could these necessary developments support decarbonisation consistent with achieving emissions reductions goals?	• See Section 1.4 of our Submission. • The Beetaloo Basin, is a natural gas resource of potentially significant scale and can help offset the very significant gas supply shortfalls that may commence later this decade. • Governments should work closely with industry partners to support and fast-track the development of new gas reserves, including the Beetaloo Basin. • Given GPG emits approximately half the carbon emissions of coal, ensuring there are adequate gas supplies will avoid the extension of coal power stations.
Community	
25. How can the Australian Government better communicate and provide more transparency to local communities regarding gas projects?	• Unless the Australian Government is a partner in a project, we do not see the Australian Government having a role in communicating and providing transparency to local communities. • Project proponents should be responsible for communications and developing social licence in local communities. • However, we do see a role for Government in supporting a more genuine debate about the importance of gas in supporting the energy system during the transition.

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26. What opportunities exist to improve engagement and consultation processes with industry?	• We see a role for the Commonwealth Government taking a national leadership approach on the future of gas with industry and state governments. • We see an opportunity for the Commonwealth to work with states to align on strategic objectives, the need for gas to support domestic industry, and the reality that both natural gas and renewable gases are essential for Australia's decarbonisation and keeping Australian industries internationally competitive.
27. How can all levels of governments better support the industry to engage with First Nations people and community groups?	• Project proponents should be responsible for engagement with First Nations people and community groups. • APA recently launched its inaugural Reconciliation Action Plan which aims to support our journey in building better relationships with First Nations peoples in order to strengthen communities through responsible energy – this is a key focus of APA's sustainability strategy.
Producers	
28. How can Australia support the potential for cost-effective, safe and verifiable CCS projects, including for the gas sector, other industries and our region?	• Scaling CCS operations in Australia in timeframes that can contribute to net zero means there should be a portfolio of considered policy approaches which reach every aspect of the CCS value chain. There are specialised, diverse and often Government-funded technologies needed to efficiently operate CCS facilities. • Given the nascent state of CCS in Australia, government support and incentives are needed to scale CCS to its full potential. Support can be seen in different forms, including government auctions, large-scale project partnerships, and major grants for eligible CCS projects.
Community	
29. How can the Australian Government better communicate and provide more transparency to local communities regarding CCS projects?	• Unless the Australian Government is a partner in a project, we do not see the Australian Government having a role in communicating and providing transparency to local communities. • Project proponents should be responsible for communications and developing social licence in local communities.
Distributors and LNG import terminal project proponents	

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30. How fit for purpose is Australia's gas transmission and distribution network?	• See response to Question 16
31. What changes should be made to the transmission and distribution network to prepare for the changing profile of gas demand in Australia? What risks and opportunities would this entail?	• See Section 1.7 of our Submission. • In the long term, the extent of any changes to the transmission and distribution networks will depend on the type of gases that need to be transported. • Many commercial and industrial users will continue to rely on gaseous fuels. • Both transmission and distribution networks are capable of transporting biomethane without modification. • The extent to which assets are capable of carrying hydrogen will depend on the nature of the assets.
32. Could the construction of LNG import terminals contribute to improving energy security in Australia?	• See Section 1.6.1 of our Submission. • The development of new LNG import terminals is likely to represent an inefficient, higher cost option compared to investment in infrastructure to deliver domestic gas. • Gas retailers' appetite to invest in new gas developments in eastern Australia may also be impacted should an LNG terminal be sanctioned. This is because retailers will have less of an incentive to contract long term, impacting mid-stream and pipeline infrastructure owners' confidence to invest in gas infrastructure. In turn, this will risk bringing new domestic gas supplies to market.
33. Under what conditions would LNG import terminals be commercially viable in Australia?	• No response
Producers and LNG facilities	
34. Are you able to attract and retain the workforce and skills you need? How will these shift as we transition to net zero emissions?	• No response
35. What are your long-term business and investment plans beyond 2035? How might these affect local economies, employment and communities?	• No response
36. Describe the projects or best practice examples of industry engagement with the local	• No response

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community, as well as the benefits these projects bring to the people and regional economy.	
Community	
37. How has the oil and gas industry impacted the local economy and employment opportunities in your region?	• No response
38. What actions will assist workforce retention, upskilling and mobility in your community as the economy transitions to net zero emissions?	• No response
Consumers (domestic)	
39. What are the risks to Australia's domestic gas security in the medium (to 2035) to long term (to 2050) for your industry and how can these be addressed?	• See responses to Questions 23 and 24
40. What do you see as the biggest risk to the ongoing affordability of Australia's domestic gas supply? For example, what are risks to affordability in the wholesale or retail market?	• See Section 1.4 of our Submission • Failure to bring online new gas supplies is the biggest risk to the ongoing affordability of domestic gas supplies.
41. What reforms can be made at a Commonwealth, state, territory, or industry level to allow gas supply to be more responsive to domestic demand signals?	• Extremely lengthy approval processes mean that gas supplies take many years to response to demand signals. • Expediting approval processes will make the industry more responsive and bring future gas supplies online.
42. What actions are available to lower gas costs, including substitution and new supply, to provide certainty to consumers? How would these actions further the Australian Government's decarbonisation goals?	• See Section 1.4 of our Submission • Bringing new gas supplies online will place downward pressure on gas costs. • In the long term, developing a renewable gases industry will help drive down costs and further the Australian Government's decarbonisation goals.
43. What opportunities exist in your industry to decarbonise supply chains?	• The development of renewable gases is expected to support the decarbonisation of gas supply chains. • As outlined in Sections 1.8 to 1.10 of our submission, a market based policy similar to the Renewable Energy Target will best support the development of renewable gas industries.

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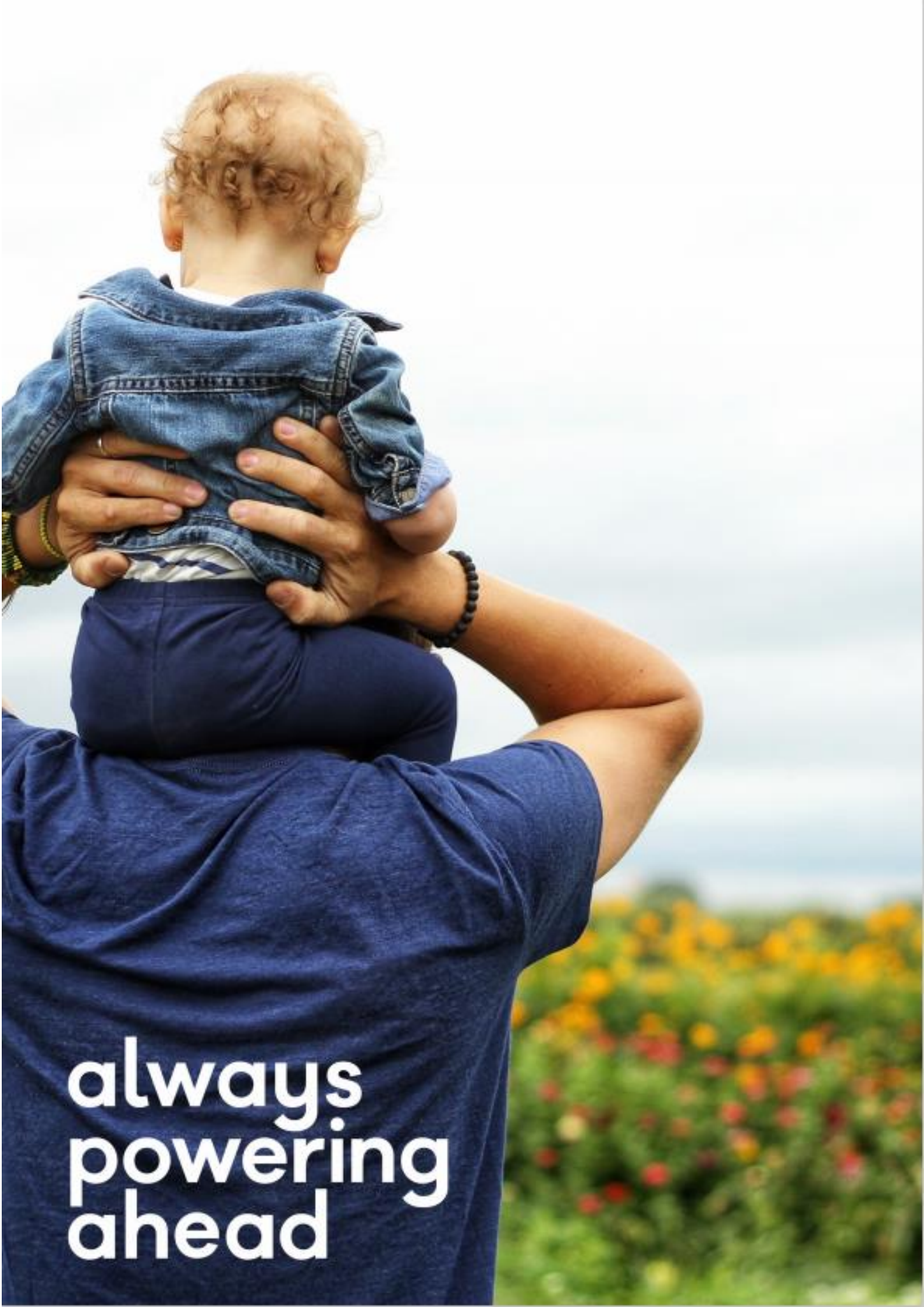
	• Recent changes to the National Energy Objectives and subsequent changes to the National Gas Rules expenditure criteria are also expected to support projects which help reduce the emissions from gas infrastructure.
44. Do you use any forecasts of gas supply to inform your outlook of the gas market? If so, what are they? You may also wish to consider whether these forecast scenarios consider the technical and commercial uncertainties associated with gas reserves and resources. Which scenarios do you consider best reflect the supply outlook?	• See our Response to Question 1.
45. Are there any limitations or caveats associated with these scenarios? How do you address these limitations?	• No response


always
powering
ahead