Attachment 6.2

KPMG Expert Panel – Future of Gas Report

Final Plan 2023/24 – 2027/28

July 2022

Future of Gas

What are the plausible scenarios for Victoria's 2030-2050 energy system and what role does gas play in each?

Development of Future Scenarios Co-Design Summary Report

October 2021
kpmg.com.au

Purpose

The Future of Gas Scenario report summarises the four plausible scenarios developed to support and inform future regulatory plans for 2023 to 2028

This report captures the methodology and outputs of a co-design process established to develop a series of future plausible scenarios for the future of the gas network in Victoria from 2030 to 2050. The work forms part of a broader framework of activities being undertaken by AGN, Ausnet Services, and MGN to inform future regulatory plans for the period of July 2023 to June 2028. Other activities being undertaken within the framework by AGN, Ausnet Services, and MGN include customer choice modelling and a program of customer and stakeholder engagement activities.

This report includes detailed information about the role of Expert Panel members and AGN, Ausnet Services, and MGN in the development of the future scenarios.

This report should be read in conjunction with materials being prepared by AGN, Ausnet Services, and MGN as part of their regulatory resets which can be found at https://gasmatters.agig.com.au/

Introduction

Context

Over the next 30 years, the energy system will undergo a complete transformation, however the ultimate mix of technologies and fuels is uncertain.

The Australian energy sector is undergoing rapid transformation driven by the forces of decarbonisation, decentralisation, digitalisation, and democratisation. While many of these forces have been present in the electricity sector for some time, they are now influencing the gas sector with increasing speed and impact.

There is now increasing awareness that if left unaddressed, these forces could significantly reduce the relevance of gas in the future energy mix. The cost of this future uncertainty could include the fluctuation of energy prices for consumers and the early cessation of gas delivery to homes through the decommissioning of stranded assets. However, if these forces are addressed, Australian gas distribution networks could continue to provide safe, affordable, reliable, and low or even zero-emissions energy to consumers into the future.

Organisations across the energy landscape are grappling with the disruption and flux associated with the energy transition. For Australian gas distribution networks to seize on future opportunities, understanding and adapting to the high degree of uncertainty is necessary. Scenario modelling has been seen as a critical step to ensure decisions taken today are resilient to a range of potential future outcomes.

The Future of Gas Co-design work has built on the emerging suite of scenario modelling literature produced by government and energy industry leaders, including Infrastructure Victoria, AEMO, and the CSIRO. Where AEMO and the CSIRO have broad, whole of energy system focus, this Future of Gas Co-design work applies a specific lens on the scenarios for gas distribution networks. That is, while other recent scenario work has tended to be framed by alternatives regarding decarbonisation and decentralisation, this current scenario work focused on the extent of electrification and growth in the hydrogen economy.

Executive Summary

In the next decade, gas distribution networks face unprecedented operating uncertainty as the decarbonisation imperative disrupts the stability and operating models of fossil fuel participants across the value chain. AGN, MGN and AusNet commenced a program of customer and stakeholder engagement as part of the planning and inputs for their 2023-28 Access Arrangements (AA) in Victoria.

With the support of KPMG, AGN, MGN and AusNet convened a panel of independent, industry leaders, to co-design four novel, plausible and unique scenarios that depict the future of gas in Australia between 2030 and 2050. The expert participants were selected to ensure a diverse range of energy industry perspectives were captured. The participants included individuals with scientific, engineering, public advocacy, academic, and commercial experience, and backgrounds. The scenario development phase of the engagement program leveraged the independence and experience of the Expert Panel across four workshops, to define the four future energy system scenarios and the role gas networks play within each scenario. These scenarios will be underpinned by customer choice modelling in the subsequent phases of the project.

The customer choice modelling undertaken on each Future of Gas scenario will seek to highlight and inform the range of potential future outcomes, and required investment decisions that may exist for AGN, MGN and AusNet ahead of the 2023-28 Victorian AA reset. Further, it will also seek to understand the near-term pathways and signals that may appear as gas distribution networks respond to the energy transition and the resulting disruption and operating uncertainty.

The Future of Gas scenario narratives specifically attempt to qualitatively address the plausible role of the gas distribution networks across each potential future. This includes where policy decisions and social licence forces may remove or constrain future options, and alternatively where the advancement of future fuel technologies may create opportunity.

The scenarios developed through the Future of Gas Co-Design process provide a meaningful contribution to knowledge in the sector. Where other reports have tended to examine decarbonisation and decentralisation as scenario framing axes, the Future of Gas considers the specifics of the Victorian energy sector and the high heat load that is present in the morning and the evenings when Solar PV is at lower

- **Outcomes Following This Report** provides a short summary of future work being undertaken by AGN, Ausnet Services, and MGN

Engagement Approach and Principles

A co-design approach with a preeminent panel of industry leaders was adopted to leverage collective industry knowledge and expertise.

AGN, MGN, and AusNet elected to leverage a co-design methodology, with clear engagement principles to develop four plausible scenarios for the Future of Gas co-design work. The co-design approach was selected to leverage the independence, depth of experience and authority of each Expert Panel member, and to ensure that all scenarios considered the contextual environment across political, economic, social, technological, environmental, and legal drivers.

The engagement principles, shown in Table 1, were selected to foster an inclusive and purposeful environment for the Expert Panel.

Table 1 Engagement principles for the co-design workshops

Genuine & Committed	We will bring our expert views to the table to co-create future scenarios leveraging these insights and ideas
Integrated	Clear evidence that Expert Panel responses have been documented and responded to through the sessions
Open Exploration	We will explore plausible alternative futures rather than forecasting throughout the process
Clear, Accurate & Timely Communication	Information provided will be timely and enhance the quality of discussion and focus on key issues
Accessible & Inclusive	Multiple engagement mediums will be utilised to ensure all expert panel members are heard and have a learner mindset to new ideas
Measurable	We will seek feedback from the Expert Panel on the co-design process throughout the project and identify ways to improve our approach
Transparent	The process and objectives of each workshop are clear so that all Expert Panel understand how outputs are developed

Engagement occurred across an introductory session in addition to four, three-hour workshops, where the Expert Panel explored key industry trends and drivers,

Expert Panel Participants

The Scenario Planning Expert Co-Design Panel was comprised of nine individuals from across the energy industry

The nine expert panel members were selected based on their experience, reputation and to ensure a diverse range of independent views were represented across the energy landscape. The experts each brought unique experience and skills, and ensured a broad representation of all facets of the electricity and gas industry were captured in each scenario.

Table 2 Expert panellist profiles

Expert Panellist	Experience and Profile
Anna Freeman, Director, Energy Generation Clean Energy Council	Anna is the Policy Director of Energy Generation and Hydrogen at the Clean Energy Council, and a member of the NSW Energy Sector Board. Anna has experience working in public affairs as a communications manager, as well as in climate change, sustainability, and urban planning.
Alison Reeve, Deputy Program Director, Energy Fellow Grattan Institute	Alison is the Climate Change and Energy Deputy Program Director at the Grattan Institute and has two decades of experience in climate change, clean energy policy, and technology. She led the development of Australia's National Hydrogen Strategy in 2019, as well as the Commonwealth policy for offshore wind, energy innovation, energy efficiency, and structural adjustment.
Lynne Gallagher, Chief Executive Officer, Energy Consumers Australia	Lynne is an Economist/Econometrician by qualification and has substantial experience in policy reform processes, including working with the Council of Australian Governments. Prior to her appointment as ECA's Director of Research, Lynne was Executive Director of Industry Development at Energy Networks Australia.
Matt Clemow, Group Manager Gas Operations, AEMO	Matt is an experienced gas industry professional and is responsible for AEMO's gas operations in eastern Australia, including Victorian gas transmission, the wholesale gas markets, and gas supply adequacy for power generation.
Mark Grenning, Director, Energy Users Association Australia	Mark has been a long-term Director and past Chairman of the EUAA. He is a member of the AER's Consumer Challenge Panel and lectures in the Master of Energy Systems course at the University of Melbourne.
Dr Patrick Hartley, Leader of CSIRO Hydrogen Industry Mission	Dr. Patrick Hartley is the leader of CSIRO's Hydrogen Industry Mission. In this role, he is responsible for developing the strategy, structure, operating model, and partnerships which underpin a major new national research initiative to enable the scaleup of Australia's domestic and export hydrogen industries.

Non-Participant Attendees

In addition to the Expert Panel, the Australian Energy Regulator and project team members observed the workshop.

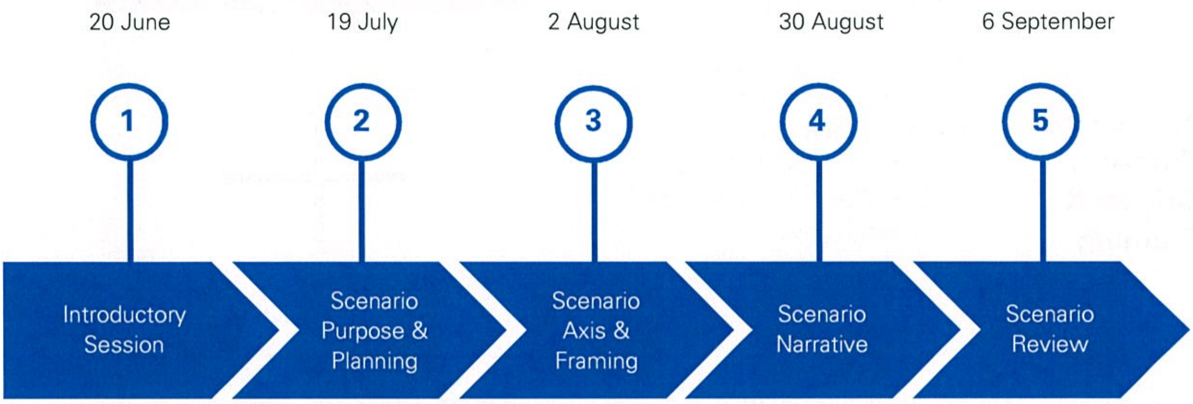
Non-participant attendees varied across each workshop and included:

- An independent observer from the Australian Energy Regulator (AER)
- AGN, Ausnet Services, and MGN project team attendees
- Facilitators from KPMG

Workshop Design and Approach

Online workshops utilised a range of platforms and engagement techniques to develop the end-to-end scenario narratives and drivers.

Workshops throughout the Scenario Development phase were conducted using Microsoft Teams and utilised a range of online digital tools, such as Mentimeter and Mural, to enhance the level of engagement and contribution from the expert panellists.



A single 1-hour introductory session and four, three-hour scenario development co-design workshops were held. The format of each workshop was tailored to drive deep discussion amongst the Expert Panellists and iteratively develop and define the four unique scenarios that highlight plausible divergence of outcomes for the future of gas distribution networks. All workshops were held virtually using a combination of engagement technologies to capture inputs and insights.

Table 3 Outlines the objective and outputs from each engagement. Activities throughout the workshops were designed to allow all panellists to have equal input into the co-design scenario development process and discussion.

Plausible Scenario Methodology

Plausible scenarios are consistent and challenging narrative descriptions of situations in the future, based on a selection of key future factors and their interdependencies.

The creation of plausible scenarios was a necessary requirement for the Future of Gas Co-design work. Plausible scenarios were determined to be outcomes that could occur based on current knowledge. They must be credible, challenging, coherent and relevant. They should be summarised in a narrative that describes divergent pathways and futures, as shown in Figure 1.

The Expert Panel understood that the role of gas could vary significantly in the future. In that context, creating plausible scenarios would be beneficial as it enables: alignment in thinking across the industry; identification of the critical infrastructure and technology for investment; creates insight to enable risk mitigation from unexpected or unintended futures; and highlights a broader and more innovative view about future growth opportunities and risks.

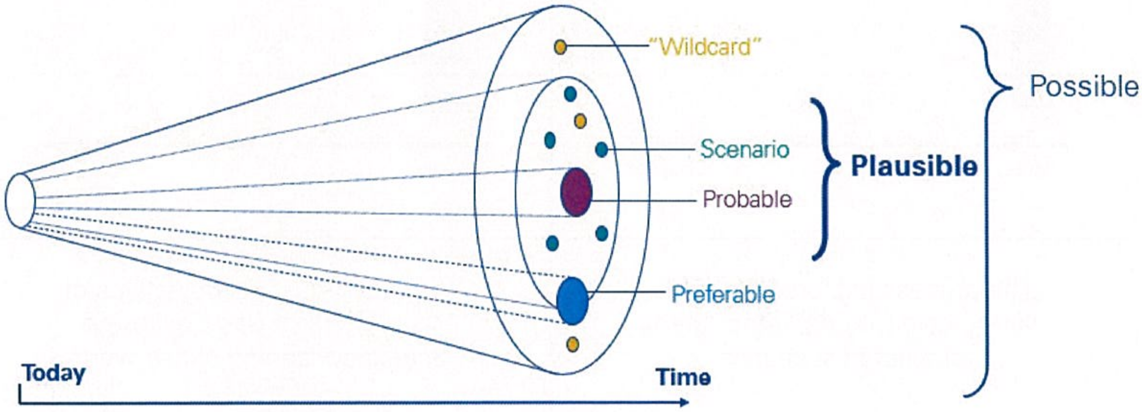


Figure 2 Approach to determine plausible futures

Scenario Outcomes

Co-Designed Scenarios

The extent of the electrification of residential heat and the scale of a hydrogen economy characterised the four scenarios

The four Future of Gas scenarios were created to represent a range of outcomes, characterised by the extent of electrification of heat and the growth of a hydrogen economy in Australia. The developed scenarios are:

- **Electric Dreams**, where electrification of heat is prevalent, and hydrogen has limited growth in applications globally and domestically.
- **Dual Fuel**, where domestic electrification of heat is prevalent, and an integrated global supply chain for hydrogen is established with use in certain domestic industrial and residential applications.
- **Muddling Through**, where electrification of heat is moderate, and hydrogen has moderate growth in applications domestically.
- **Hydrogen Hero**, where electrification of heat is low, and an integrated global supply chain for hydrogen is established, with wide use domestically.

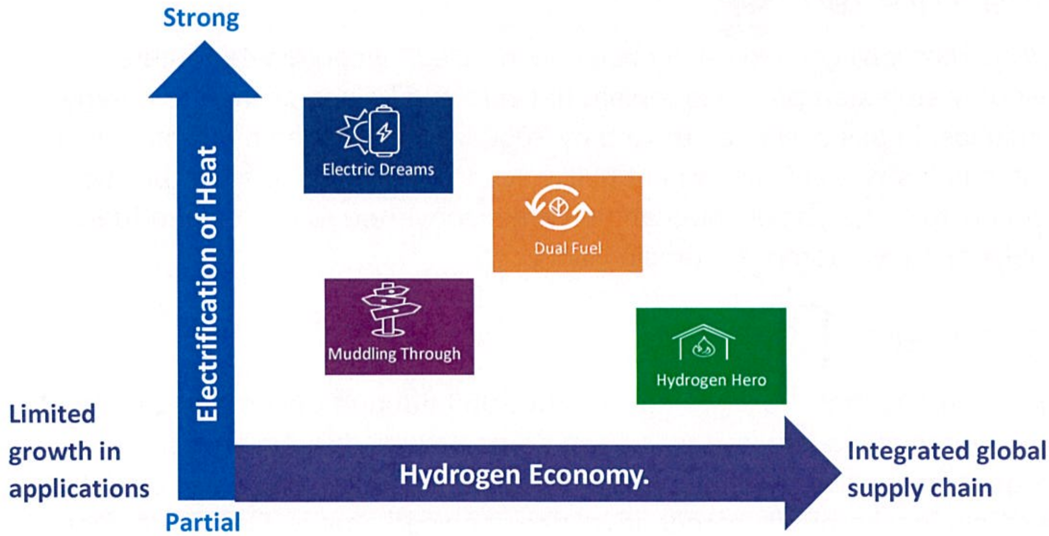


Figure 4 Relative placement of each scenario across Electrification of Heat and Hydrogen Economy drivers

Scenario Narratives

Electric Dreams

The *Electric Dreams* scenario is characterised by deep electrification underpinned by strong market driven growth of renewables, investment in system flexibility and efficiency, and policy support for Net Zero by 2050. Accelerated electrification of a wide range of applications leads to a rapid rise in electricity demand, which outstrips renewable supply and briefly prolongs the reliance on fossil fuel generation. This is largely replaced with renewables and grid firming infrastructure at an orderly and increasing pace over the next decade. Gas distribution networks become increasingly stranded as consumers electrify through the late 2030s.

In this scenario, the expansion of renewable energy zones and new domestic and international interconnectors enable higher deployment of renewable generation, which in turn inhibits the scale of a global hydrogen supply chain. Intermittent generators are balanced by pumped hydro, renewable capacity overbuild and both transmission and distribution connected battery storage, as well as limited gas peakers.

The combination of climate conscious residential consumers and government policies (including subsidies for electrical appliances and gas connection moratoria), drives electrification of home heating, cooking, and light transport into the 2030s. The need for firming and grid stability drives growth in demand flexibility enabled by new technology, demand response, competition, and smart distributed energy resources. Large users electrify low heat processes and hydrogen production is not widespread, nor exported. Rather, it is produced on location for a limited number of high heat applications, including ammonia production, steel manufacturing, as a chemical feedstock, and for long haul transport.

Natural gas prices rise in the medium term as supply declines driven by the phase out of gas development and rising carbon prices, while demand declines gradually. Electricity prices increase and become more volatile in the near term due to a high level of electricity network investment, system stability costs, and renewable intermittency. Hydrogen costs prohibit scaled industrial competitiveness of the fuel beyond unavoidable uses.

Dual Fuel

The *Dual Fuel* scenario is characterised by the fusion of extensive domestic electrification and the development of a material export industry for hydrogen in the medium term. Domestic hydrogen is utilised for certain industrial applications and in select residential locations. Net zero is achieved by 2050 due to focused market and policy action, and the orderly retirement of fossil fuel use. Gas distribution networks are largely stranded by 2050, however a subset service 100% hydrogen customers.

Growth in low cost solar and wind generation is supported by early investment in grid stability, pumped hydro, and large-scale batteries. In the 2030s, as domestic hydrogen supply becomes available, some gas connected consumers reject full electrification of domestic heat which creates demand for hydrogen use in certain, gas enabled applications, such as cooking, space heating and hot water. Australia captures a significant share of global hydrogen demand through decentralised, purpose-built hydrogen production, storage, and export facilities.

End users have a greater range of fuel type and appliance options. Hydrogen is used to support industrial applications and heavy transport. Some residential consumers prefer smart electrification of light vehicles and home appliances. However, a small subset of commercial and residential areas adopt 100% hydrogen in the near term, thanks to successful hydrogen blending pilots.

Domestic hydrogen and electricity markets converge, placing downward pressure on prices due to combined infrastructure and scaled deployment by 2040. However, natural gas prices increase driven by falling supply and carbon prices, which are partially offset by falling demand. This in turn accelerates further conversion to electricity and hydrogen towards the middle of the century.

Hydrogen blending (up to 10%) in gas distribution networks occurs at a moderate scale, however ultimately only certain locations convert to 100% hydrogen, leaving most assets stranded. A small subset of gas distribution businesses reorganise to supply hydrogen to a limited number of locations.

Hydrogen Hero

In *Hydrogen Hero*, Australia reaches net zero by 2050 through the orderly growth of a significant hydrogen industry for export and domestic use through widespread renewable generation. Hydrogen and electricity markets become linked in the 2030s to provide stable, economically competitive, decarbonised energy. Gas distribution networks are fully utilised to deliver hydrogen to home, commercial and industrial applications.

In this scenario, policy, and market action in the 2020s drives investment to build out hydrogen export hubs, renewable energy zones, and associated infrastructure. Renewable generation and storage capacity is expanded to supply constant electricity for end uses and to enable continuous hydrogen production. The electricity grid is stabilised by hydrogen ready gas peakers. While electrolysers are primarily located near domestic demand and export facilities. Some existing gas transmission networks are utilised for hydrogen, together with purpose-built transmission pipelines connecting large-scale hydrogen supply with industrial hubs and storage facilities.

Consumers have ultimate choice between fuels across a broad range of applications including industrial processes, fuel cells for heavy transport, domestic heating, energy storage, and grid firming generation. Electric light vehicle sales grow rapidly in the next decade, while hydrogen fuel cell light vehicles enter the market more slowly. Governments subsidise the uptake of hydrogen in the home which leads to greater availability and affordability of hydrogen-based appliances. Small scale electrolysers are used to convert and store excess distributed solar PV generation for interconnected suburbs and homes.

Targeted government and market interventions result in a booming hydrogen industry and a low hydrogen price in the 2030s. Natural gas prices rise as supply declines at a faster pace than domestic demand driven by an increasing price on carbon and international demand, which in turn results in accelerated conversion to hydrogen. Electricity prices are driven down by large scale renewable build out, offset by rising demand from electrolysis and electricity infrastructure investments.

Ongoing investment in gas distribution networks enables conversion to 100% hydrogen and the continued utilisation of assets.

Detailed Comparison of Scenario Modelling Assumptions

The modelling drivers will inform the quantitative assumptions determined through the customer choice modelling phase and focus on economics, technology, and the role of the networks.

Table 4 provides the detailed list of modelling drivers. Notably, the Expert Panel determined that the pace of decarbonisation to 2030 would not vary across each scenario. Further, the domestic electricity price and the future price of hydrogen vary considerably across scenarios. While the East Coast domestic natural gas production relative to demand was determined to be low in all scenario except Muddling Through.

Table 4 Detailed comparison of modelling assumptions across the four scenarios

Category	Scenario Driver	Electric Dreams	Dual Fuel	Muddling Through	Hydrogen Hero
Economic	Wholesale domestic electricity price	Low	Low-Medium	Medium	Low
	Wholesale domestic natural gas price	High	High	Medium	High
	Wholesale domestic hydrogen price	Medium	Low-Medium	High	Low
	Delivered electricity price	Medium/High	Medium	High	Medium
End Use Technology (Demand)	Electricity network demand	High	High	Medium	High
	Natural gas demand	Low	Low	High	Low

Detailed Comparison of Scenario Framing Assumptions

The framing drivers inform the differentiation of scenario narratives with a focus on the energy market dynamics, policy, and social drivers.

Table 5 details the framing drivers that were defined, ranked, and used to differentiate each scenario. The Expert Panel determined that the consumer preference for gas, including hydrogen would be highest in the Hydrogen Hero scenario. While the extent of moratorium on new natural gas connections was deemed a high risk for gas distribution networks in the Electric Dreams scenario, and a medium risk for all others.

Table 5 Detailed comparison of framing assumptions across the four scenarios

Category	Scenario Driver	Electric Dreams	Dual Fuel	Muddling Through	Hydrogen Hero
Economic	Extent of electricity infrastructure investment	High	High	Medium-High	Medium-High
	Appliance Energy efficiency	High	Medium-High	Medium	High
End Use Tech (Demand)	EV Uptake (ex. Hydrogen Fuel Cell)	High	High	Medium	Medium
	Fuel Cell Uptake (hydrogen)	Medium	Medium	Low	High
	Electricity network peak demand	High	Medium	Medium-High	Low
	Convergence of electricity and hydrogen markets / systems (prices become linked)	Medium	High	Low	High

Outcomes Following this Report

Customer Choice Modelling

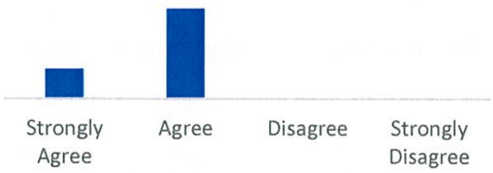
An independent economic modelling expert will prepare a customer choice model across each scenario, with specific business inputs and constraints provided by AGN, MGN and AusNet

The scenarios will inform the evolution of the costs of self-supply, network electricity, and network gas (including hydrogen) within the customer choice models. The subsequent impacts from political, economic, social, technology, environmental and legal decisions within each scenario will also be captured.

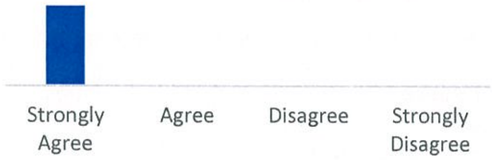
The planned structure of the models is as follows:

1. In each period, each customer makes a choice on their mix of energy supply based on price where assumptions are derived from:
   - Logit model with customer characteristics and "stickiness"
   - Customer types based on local government areas (LGA's)
2. In each period, a building block model (one each for gas and electricity) based on past connect/disconnect decisions drives network total costs
   - "gross" component reflecting maintenance capital expenditure and hydrogen spend
   - "per connection" component reflecting new connections
3. Network price is a function of (t) allowed revenue divided by (t-1) demand, which drives the pathway of customer demand
4. If the NPV of revenue (customer demand (t) times network price (t)) is less than NPV of costs, the depreciation profile will be adjusted until equality is reached

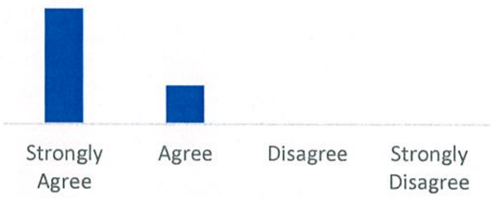
The engagement mediums utilised (e.g. Mentimeter and Mural) were appropriate for the purposes of each of the workshops.



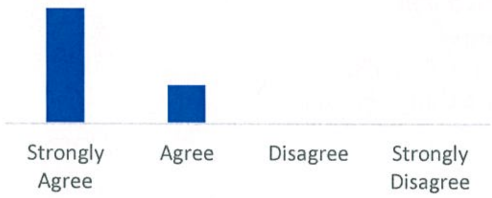
My feedback was sought throughout the co-design process and any suggestions were identified and addressed adequately.



The process and objectives for each of the workshops were clear and agreed outputs were developed and delivered.



The outcomes and objectives of this Future of Gas Co-Design Scenario Planning phase were achieved.



I was well informed for each of the workshop objectives and expected outcomes.

The facilitator was able to provide an unobtrusive, objective guidance.