1 April 2022

Ken Morrison
Chair, ASBEC Net Zero Buildings Task Group
Chief Executive – Property Council of Australia

Via: https://www.surveymonkey.com/r/decarbonisationofbuildingoperationsdiscussionpaper

Dear Mr Morrison,

Energy Networks Australia's response to ASBEC's Rapid and Least Cost Decarbonisation of Building Operations – Discussion Paper

Energy Networks Australia welcomes the opportunity to provide a response to the ASBEC's Discussion Paper published on 14 February 2022.

Energy Networks Australia is the national industry body representing Australia's electricity transmission and distribution and gas distribution networks. Our members provide more than 16 million electricity and gas connections to almost every home and business across Australia.

Both electricity and gas networks are decarbonising. Electricity networks are facilitating the continued build out of renewable generation, while ensuring safe and reliable supply. The focus to date of decarbonisation has been on the electricity sector, but gas networks are on their own decarbonisation journey. Customers tell us that they are seeking a clean energy future and are engaged in achieving emission reductions from gas use. New renewable fuels, such as hydrogen and biomethane, have the potential to become mainstream and complementary energy solutions that will use existing energy infrastructure. Our gas networks are leading the development of renewable gas projects and blending renewable hydrogen in the Adelaide and Sydney gas distribution networks, with further projects under development for Victoria, Western Australia and Queensland.

Energy Networks Australia is supportive of the housing sector's transition to net zero emissions. We support a technology neutral approach to energy efficiency and agree that cost-effective improvements in energy efficiency of homes will reduce customer bills and emissions at the same time.

Scenarios, as proposed by ASBEC, are a useful tool to better understand potential futures and to assist in the development of policies. However, they are always based on a range of assumptions, which are uncertain by themselves. As the Australian Treasury points out:

» *Long-term scenarios necessarily involve the exercise of judgement and simplifying technical assumptions. This underscores the importance of viewing the scenarios as one possible picture of the future based on expected structural pressures and existing policy settings. In other words, this report presents* ***a world that could be, rather than will be****. In doing so, it helps all* *members of society including businesses, households and governments to prepare for future challenges, take advantage of future opportunities and decide to modify existing strategies*. [Emphasis added]

- » Adapted from the Australian Treasury's 2021 Intergenerational report https://treasury.gov.au/sites/default/files/2021-06/p2021_182464.pdf, page xvii.

As such, the scenarios reflect a range of options based on a range of simplifications. While these scenarios can influence policy decisions, their limitations and level of uncertainty should be recognised. In our responses below, we outline some of the important issues to consider in scenario modelling.

Gas networks are decarbonising

Australia's gas distribution networks are leading the development of renewable gas demonstration. Both renewable hydrogen and biomethane projects are under development. Of particular interest are the following projects:

- » Hydrogen Park, SA: Renewable hydrogen is produced using a 1.25MW electrolyser with water and renewable electricity. The renewable hydrogen is blended with natural gas at volumes of up to 5 per cent and supplied to nearby homes via the existing gas network. This project is already demonstrating that renewable gas can be provided to customers. (source: https://www.agig.com.au/hydrogen-park-south-australia)
- » Western Sydney Green Gas Project: Hydrogen is carbon neutral and a 500kW electrolyser installed as part of the Western Sydney Green Gas Project will produce renewable hydrogen which will then be blending into Jemena's gas network and delivered to approximately 250 homes. The project will contribute to the NSW Government's Stage 1, Net Zero Plan, to cut emissions by 35 per cent by 2030 compared to 2005 levels. (source: https://jemena.com.au/about/innovation/power-to-gas-trial)
- » Malabar Biomethane Project: This project located in Sydney aims to produce renewable biogas from wastewater. This biogas will be upgraded to meet the specifications of natural gas allowing it to be injected and blended into the natural gas distribution system. The project is currently under construction with a planned operation date in early 2022 when renewable biomethane will be injected into Jemena's natural gas network. At the same time, GreenPower is developing a pilot certification scheme to verify that this biomethane is a renewable gas (source: https://jemena.com.au/about/innovation/malabar-biomethane-project)

These projects are demonstrating a pathway to deliver renewable gas to homes and businesses without emissions.

The Discussion paper recognises the opportunity for renewable gases. The scenario modelling should adequately represent both the electrification and renewable gas opportunities including consideration of their time to commercial maturity.

Below are our key messages in response to the Discussion paper.

Key Messages

1. Energy Networks Australia is supportive of the housing sector's transition to net zero emissions, and we support a technology neutral approach that values actual emissions reductions at time of use and location as the most effective way to achieve this.
2. Both the electricity and gas supply sectors are on a decarbonisation journey in line with Australia's 2050 emission target objectives.
3. Energy Networks Australia is supportive of the high-level description of the scenarios but seeks clarification on the time horizon of those scenarios.
4. Time of use factors should be used instead of daily or yearly averages for emission intensity, impact on wholesale prices and efficiency of electrical appliances.
5. Cost benefit analysis across the energy system for electrification have been shown to be negative. Adjusting this to individual homes creates a positive benefit for households but that benefit is subsidised by the rest of society (eg through higher networks costs for everyone).
6. Independent research by RACE 2030 on improving energy efficiency of homes noted a range of energy efficiency upgrades totalling over $58,000.

We have provided responses to your questions below and through the online portal. Should you have any queries please contact ENA's Head of Renewable Gas, Dr Dennis Van Puyvelde, dvanpuyvelde@energynetworks.com.au.

Yours sincerely,

Andrew Dillon
Chief Executive Officer

Attachment 1: Response to focus questions

1. Are there significant trends in the built environment that will impact on future energy/emissions scenarios? (e.g., online retail, sharing economy, circular economy, aging population)

The Discussion paper provides a good overview of significant trends. It does not provide clarity on whether the factors used in the scenario modelling will consider time of use impacts. The use of average factors, for say emission intensity, can suggest electrification of gas services results in lower emissions, while using the emission factor at time of use may demonstrate ongoing gas use will be lower emissions.

The assumptions used for the scenarios should be clear on whether to use Time of use factors and be agreed by an advisory group.

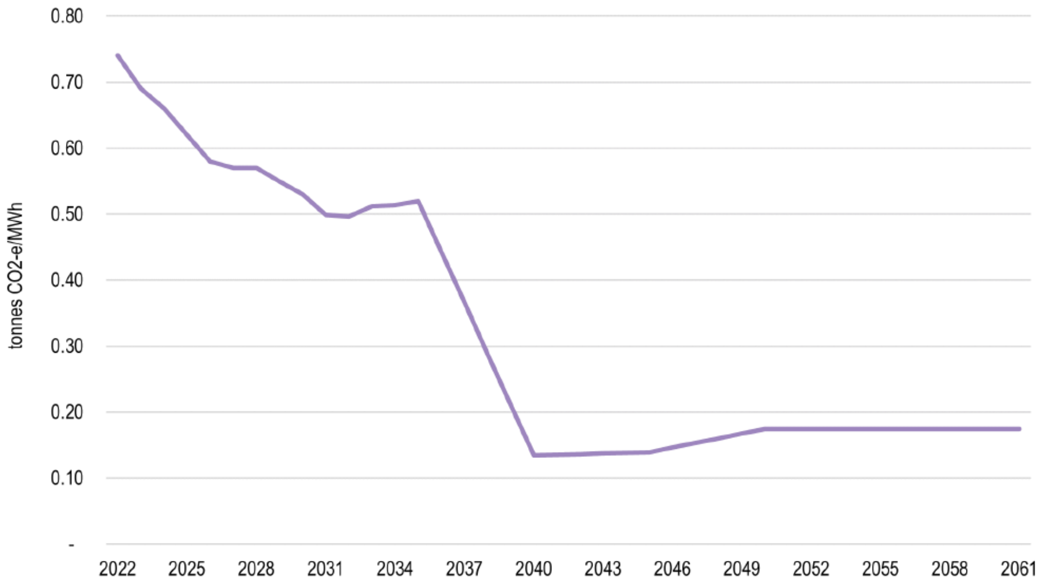
Emission intensity

A cost benefit analysis report by ACIL Allen for the NSW BASIX scheme noted that the NSW electricity grid has over time become greener, and that it will continue to do so. Figure 2.15[1] of the ACIL Allen report (Figure 1 below) illustrates the change in emission intensity out to the 2060's. This reflects growing renewable generation in the NSW electricity grid and has been used to estimate to estimate the emission savings.

Due to the variable nature of renewable generation, the emission intensity does not only change year on year, but also changes throughout the day and between seasons. Using a single yearly average means that estimated emissions savings from electrical appliances replacing gas appliances are overstated.

[1] Figure A-2 of the ACIL Allen report shows the emission intensity chart used in the BASIX assessment. While the emission intensity used by ACIL Allen and by BASIX are different, they both reflect a declining emission intensity over time.

Figure 2.15 Electricity emissions factors over time



Source: ACIL Allen and DISER 2020, Australia's emissions projections, December.

Figure 1: Emission intensity (Source: ACIL Allen (2021), Proposed requirements for BASIX in 2022: Cost Benefit Analysis)

Emission intensity at time of use is responsible for the volume of emissions produced, rather than the yearly average of emission intensity of the grid. This is particularly true when replacing gas appliances with electrical ones as the time of usage of gas appliances corresponds to peak emission intensity of the electricity grid.

Figure 2 shows data from electricity generation in NSW by time of use throughout the day and by different seasons. The peak demand periods for gas use for heating and hot water are in the morning between 7 and 9 am and in the evenings between 5 and 9 pm. The data shows that the emission intensity of the grid is higher in winter and during the morning and evening peak times compared to during summer and the middle of the day.

While increasing overall renewable generation can bring down the average emission intensity the daily and seasonal difference will still occur as a reflection of the nature of intermittent renewable generation, especially solar.

Using a yearly average of emission intensity to determine emissions savings from switching from gas to electricity does not account for the actual emissions at time of use and overestimates the projected emission savings. This creates a bias to electrification. Hence the calculated emission savings by ACIL Allen using the yearly average will be much higher than the actual savings using the emission intensity of the grid when electricity is being consumed.

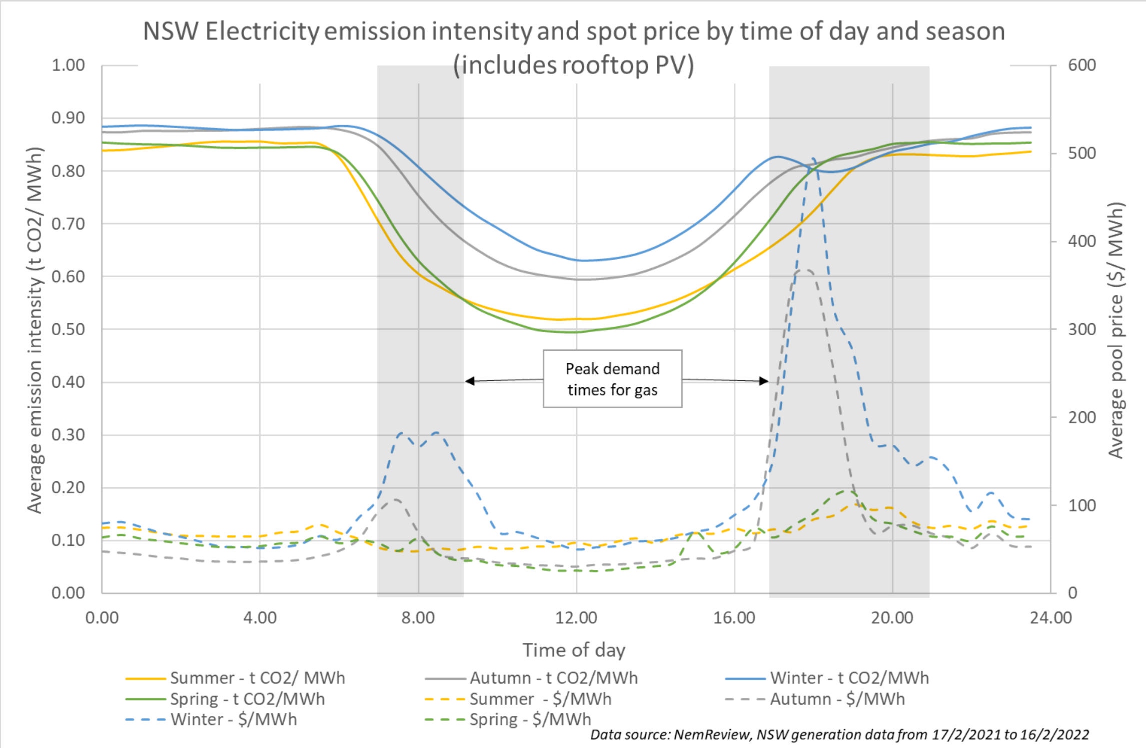


Figure 2: NSW electricity emission intensity and spot price (Source: NemReview data, ENA analysis)

ASBEC should ensure that the scenarios it develops to compare electrification and renewable gas options account for this time of use.

Electricity Wholesale Price leading to higher bills

Figure 2 also illustrates the electricity wholesale price that also increases during winter and the morning and evening peaks. So switching from gas to electricity will increase the overall wholesale price of electricity (simply by adding more load at those higher prices) and over time will result in higher retail prices paid for by all customers. Essentially, this is a cross-subsidy from all electricity consumers to support some customers making a switch from gas. This switching, and the resultant increases in electricity bills, is not considered when average prices are assumed but is a consequence from the electrification of gas use during peak demand times. ASBEC should carefully consider how this can be incorporated in its scenario modelling.

Renewable gas is more expensive than natural gas at the moment but opportunities exist for it to become commercially competitive as renewable electricity has. For example, additional revenue stream from biomethane production by being able to sell the digestate and the avoidance of landfill fees will make it more cost competitive. Similarly, the deployment and scaling up of hydrogen will see its production cost decline rapidly.

Heat pump efficiency is overstated

Efficiency of heat pumps in heating modes are often overstated and refer to their maximum efficiency, not their actual efficiency which depends on the ambient and set temperature of the heat pump, its age and how well it has been maintained. The Discussion paper refers to heat pumps as having 500 % efficiency. Figure 3 demonstrates how the performance of a heat pump can change. An efficiency of 500 per cent is achievable when the outside temperature is 20°C and the set temperature is 15°C. But in that instance, the heat pump is cooling, not heating. As the temperature declines to say, 5°C and the set temperature of the home increases to 21°C, the efficiency drops to around 350%. Heating is used on colder days so using the maximum efficiency of heat pumps overestimates their benefits. This in turn can overestimate the potential emission and cost savings compared to gas heating.

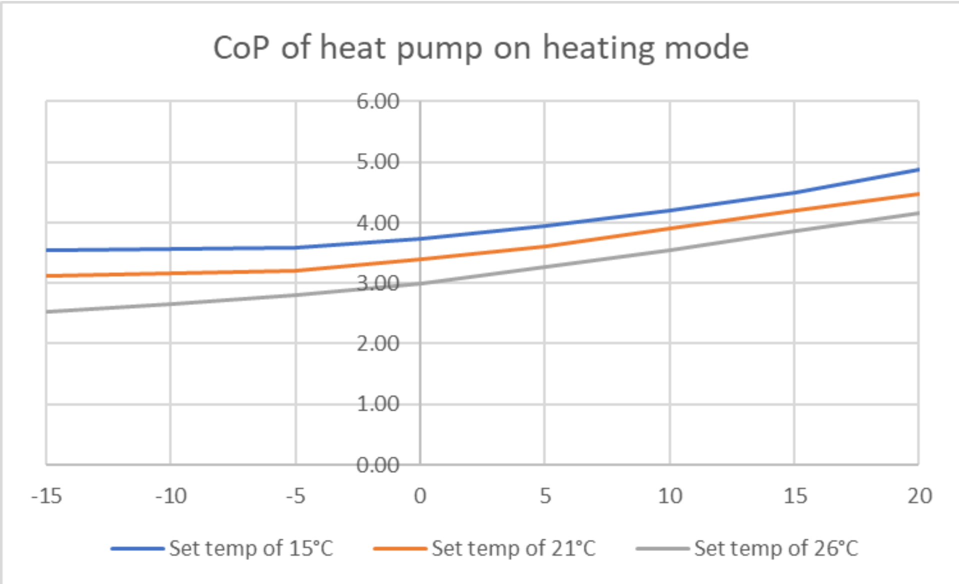


Figure 3: Coefficient of performance of an air source heat pump (source: Heat Pump Data – Mitsubishi, model: PLA-M71EA-A capacity 8 KW; ENA analysis)

ASBEC should consider the impact of time of use on the efficiency of heat pumps in its electrification scenario, and the resulting impact on emissions and energy bills.

2. In developing future scenarios for decarbonisation, what energy systems or technologies in residential buildings are going to play a key role in reducing emissions ?

Scenarios are a useful tool to better understand potential futures and to assist in the development of policies based on those options. However, they are always based on a range of assumptions, which are uncertain by themselves. As the Australian Treasury points out:

» *Long-term scenarios necessarily involve the exercise of judgement and simplifying technical assumptions. This underscores the importance of viewing the scenarios as one possible picture of the future based on expected* *structural pressures and existing policy settings. In other words, this report presents **a world that could be, rather than will be**. In doing so, it helps all members of society including businesses, households and governments to prepare for future challenges, take advantage of future opportunities and decide to modify existing strategies.*

» Adapted from the Australian Treasury's 2021 Intergenerational report https://treasury.gov.au/sites/default/files/2021-06/p2021_182464.pdf, page xvii.

As such, the scenarios reflect a range of options based on a range of simplifications. While these scenarios can influence policy decisions, their limitations and level of uncertainty should be recognised.

ASBEC is proposing to complete three scenarios:

- Electrification with renewable electricity: transitioning to fully electric buildings powered by renewables.
- Renewable electricity/renewable gas: renewable electricity is dominant with natural gas displaced with either biogas or green hydrogen.
- Renewable electricity/blended gas/carbon offsets: renewable electricity is dominant in the grid, some natural gas is displaced with renewable gas and credible offsets are used to achieve net zero.

The timeline for the scenarios is unclear from the discussion paper. There is some uncertainty about the time horizon that will be used for these scenarios. The Discussion paper refers to 2050 in some parts while in others it seems to focus on a hydrogen blend of 10 to 20 per cent, which is an interim step to full decarbonisation using gas network. As has been seen in the modelling work for the Victorian Gas Substitution Roadmap, selecting an unachievable level of emission reductions before new technology is commercially ready leads to a predetermined outcome. In the Victorian case, an emissions reduction target from gas use by 2030 was set at 50 per cent. This could only be achieved by electrification or renewable gas options. At present, no renewable gas options are commercially available[2] and hydrogen appliances are not yet commercially available either. As such, the only available option in 2030, according to the Victorian modelling, is an electrification option. Some have interpreted this as the start of the deathspiral of gas networks[3], whereas a more constructive policy discussion would be around facilitating the transition to renewable gas and bringing the cost curve forward through mechanisms such as a renewable gas target.

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[2] Note that some renewable hydrogen is being blended at up to 5 per cent volume in the gas distribution networks in Adelaide and Sydney.
[3] https://thefifthestate.com.au/energy-lead/energy/victorian-roadmap-may-see-gas-use-fall-to-less-than-half-within-eight-years/

One of the main simplifications often used is to average out values such as prices, emission intensities or efficiency of appliances. These simplifications often produce misleading results.

The Discussion Paper presents good overview of potential technologies. Energy efficiency of the home is also important and can reduced energy consumption for both gas and electric heating.

The cost of the energy efficiency upgrades for the higher standards is often underestimated.

> *ACIL Allen found that an average house in Western Sydney will cost and additional $7,152 to build. (pg 6, Proposed Changes to BASIX)*

Independent research by RACE 2030 on improving energy efficiency of homes provided four packages of energy efficiency upgrades to homes. One of the upgrades focussed on improving insulation, while the others focussed on efficiency appliances and the inclusion of rooftop PV. Combinations of different options were used to determine potential cost savings from energy efficiency upgrades.

Upgrade	Description	Cost estimate
Upgrade 1	Insulation and window treatment (7 windows @$700)	$ 21,383
Upgrade 2	Ceiling fans, reverse cycle (1 unit @$2000), and double glazing (@$500)	$ 7,540
Upgrade 3	Efficient appliances, LEDs, showerheads and clothesline	$ 8,250
Upgrade 4	Solar panels, battery (@$7,500), hot water heat pumps, induction	$ 21,229
All upgrades		**$ 58,402**

Figure 4: Energy efficiency upgrades (Source: RACE 2030 (2021): Pathways to scale: retrofitting one million+ homes)

The total of all the energy efficiency upgrades totals over $58,000. This is nearly 8 times higher than the cost estimate used by ACIL Allen in their scenario modelling. While energy efficiency improvements to new homes (especially insulation) are easier and cheaper compared to retrofitting, it appears that the costs of the proposed changes to BASIX are underestimated.

ASBEC should consider the timing of their scenarios and clearly articulate whether this will create unfavourable conditions for emerging technologies. Energy efficiency should also be included as a general measure across all scenarios, but realistic cost estimates should be adopted.

We have also provided a number of proposed changes to the advantages, challenges and consequences of the three scenarios in Attachment 2.

3. In developing future scenarios for decarbonisation, what energy systems or technologies in commercial buildings are going to play a key role in reducing emissions ?

As per response to question 2.

4. What are the most important costs and benefits that should be taken into account when analysing each of the scenarios ?

A number of cost benefit analysis of decarbonisation of buildings have been completed in the last 12 months, including the National Construction Code Regulatory Impact Statement and the BASIX Cost Benefit Analysis to comply with the new

The intention of the proposed changes to BASIX are to bring it in line with the national plan, as outlined in the National Construction Code (NCC). The aim of this plan is to make cost effective increases in energy efficiency requirements for residential buildings from 2022. The proposed changes to the NCC were found by its consultant not to be cost effective meaning that the increased benefit from the energy efficiency improvements resulted in a higher cost to society, compared to the value of the benefits to society.

Similarly, the cost benefit analysis completed by ACIL Allen for the proposed changes to BASIX showed that these were not cost effective.

> *The cost-benefit analysis found that both Options A and B produced a benefit-to-cost ratio (BCR) of less than one at the statewide level. A BCR of less than one means that the option in not cost beneficial and results in a net cost (pg 7, Proposed Changes to BASIX)*

Option A reflects higher increases in energy efficiency standards compared to Option B. The reported BCR's for the options considered are 0.16 and 0.36, which means that for each dollar spent, the benefit is between $0.16 and $0.36. These negative BCR's should be sufficient to not proceed with either of the proposed options.

Furthermore, the Cost Benefit Analysis also estimated the BCR for individual households, using retail energy costs rather than wholesale energy costs. The analysis found that the BCR for individual households under Option B was 0.8 while the more energy efficient option, with lower energy consumption compared to Option B, produced a BCR of 1.9.

This positive benefit is partly due to extra savings from adopting higher residential energy costs and notes that others consumer may need to cross subsidise this benefit:

> *Other energy users may need to pay more in energy bills to compensate for the bill savings from households in new homes that meet higher standards, as energy retailers need to recover the fixed network costs and other overhead costs. (pg 8, Proposed Changes to BASIX)*

Adopting the proposed NCC or BASIX changes is not cost effective and will lead to higher societal costs compared to the calculated benefits. Households gaining financial benefits from building to the higher Option A will be cross subsidised by all

NSW households who will not gain from the energy efficiency benefits. It is unclear whether this unintentional wealth transfer is an acceptable consequence of the proposed BASIX changes.

ASBEC should be clear about the conditions is places on determining the costs for each scenario. To determine the least cost will require a wholistic assessment of appliance upgrade options, and home efficiency or modifications required (for example, repair needed when replacing ducted gas heating with individual room heat pumps) and ongoing energy prices of the different options.

5. What are the risks and consequences of each scenario that should be highlighted in analysis for policy makers to be aware of ?

As noted in our response to Question 1, there are a range of options to reduce the costs of renewable gases and to bring forward its commercial competitiveness. Figure 5 outlines a range of policy options to support the development of renewable gases.

For renewable and decarbonised gases, comprising both hydrogen and bio and renewable methane:

- Continue supporting demonstration projects.
- Encouraging market development via renewable and decarbonised gas targets, certification schemes and incentives.
- Enter into "reverse auctions" or "gas purchase agreements" for renewable and decarbonised gas to encourage its take up in the market, similar to actions undertaken via the Victorian Renewable Energy Target and local council actions.
- Enable gas networks to offer renewable and decarbonised gas opportunities in new residential developments, which will fast-track the development of 100 per cent renewable gas and ensure gas costs remain affordable for all gas users.
- Continue to decarbonise electricity generation through supporting renewable electricity generation.
- Encourage technical regulators to work collaboratively with industry in developing safety cases for demonstration projects, similar to the process adopted by the Health and Safety Executive in the UK, which is an enabling regulator that works with industry to ensure renewable gas projects can be safely deployed.

Hydrogen focussed policies.

- Support blending projects to gain technical and regulatory experience, customer acceptance and a pathway to commercial opportunities for hydrogen.
- Support the development of renewable hydrogen to support decarbonisation of industrial processes.
- Support local appliance manufacturers to provide accredited hydrogen appliances.
- Enabling opportunities for network businesses to deliver hydrogen to new residential developments.

Bio and renewable methane focussed policies.

- Identify the resource potential of biomethane, either from local biomass resources, or from interstate resources that can be shipped using existing transmission pipelines.
- Facilitate collaboration with gas networks, technology vendors, and resource providers to develop commercially viable biomethane projects.
- Support policies to recognise the value of circular economy benefits.

Figure 5: Policy options to support the development of renewable gases.

Attachment 2: Responses to scenarios

Scenario 1: Electrification (Proposed changes in track changes)

Advantages	Challenges	Consequences
• Many residential and commercial buildings are already fully electric - but some jurisdictions have greater exposure to gas. • Electrical technologies that are well-established, proven, and that offer low technical risk, are available now to meet all building operational requirements • Renewable electricity is readily available • Electricity is clean at point of use • The energy efficiency of PV panels, heat pumps and other electrical end-uses, is expected to continue to increase over time • The cost of PV installations has fallen dramatically over the last decade and is projected to fall further in future • Utility-scale renewables continue to set lower and lower price records • This strategy is applicable for most building types, residential and non-residential, existing and new	• Pace of decarbonisation of the electricity grid • 100% renewable electricity options exist today but may not be selected by building owners • Capacity of the electricity grid – generation, transmission and distribution, will be tested during periods of peak demand and reliability could suffer if this is not managed well • Capacity challenges could be amplified through the transition to electric vehicles • An electrification pathway also needs to manage the decommissioning of gas networks • More extensive electrical demand management may be required to limit peak loads • At the building level, electrification of existing buildings could require upgrades to wiring or switchboard capacity • The time required to retrofit every building currently supplied with natural gas could delay net zero • Some larger PV retrofits require roof strengthening	• Significant consequences for gas infrastructure and how it can be decommissioned over time • Millions of gas appliances to be replaced with an electric equivalent • Significant impact on businesses supporting gas systems, manufacturers, suppliers and installers of gas boilers and heaters • There may be social equity implications that justify government intervention • Building regulations and many other policy settings would need rapid change to avoid locking-in gas or other fossil fuels • A managed transition of existing buildings to fully electric demands careful management • Some buildings will be challenged spatially in accommodating technologies such as heat pumps

• Renewable electricity generation avoids the combustion losses, and potentially the distribution losses (when generated onsite), associated with gaseous fuels • Electrification strategies may be enhanced with increasing uptake of electric vehicles	• At the electrical system level, electrification could require upgrades to local distribution substations, or other network capacity upgrades • Situations of existing energy poverty may be amplified where costs of transition; new appliances and rewiring, accumulate • Consumer fuel choice preferences need to be addressed • The purchase cost of electrical appliances is generally higher than gas appliances	

Scenario 2: Renewable electricity + renewable gas (Proposed changes in track changes)

Advantages	Challenges	Consequences
• Gas transmission and distribution systems can provide energy storage • Gas end uses are able to remain on the gas system and not add to electrical loads • Opportunity to utilise/repurpose existing gas distribution infrastructure • Gas option retained for consumers with a preference for this solution • Potential to increase renewable electricity generation assets by	• Changing the gas supply system to any significant degree (> 10% - 20%) will require modification of gas end use appliances and associated costs • Parts of gas networks may require upgrade to be compatible with 100% renewable gases • Developing a local capability of hydrogen appliances • Gas appliances have lower energy efficiency than electric equivalents – relative cost effectiveness would depend on renewable	• To achieve zero emissions, millions of gas appliances require modification or change out • There may be social equity implications that justify government intervention • Risk of stranded investments if 100% renewable gas supply cannot be achieved and maintained or is not cost competitive with renewable electricity

producing renewable hydrogen • Renewable gas (hydrogen) appliances are expected to cost no more than current gas appliances once manufactured at scale.	gas pricing and time of use of electrical alternatives, which is uncertain • The availability of feedstocks for biogases may limit the feasibility of this approach and/or reduce its cost effectiveness • Transitioning gas networks to 100% renewable gases ~~would take time and~~requires a plan to reduce uncertainties for users ~~create uncertainties for users~~ regarding the timing of appliance/end-use upgrades • There may be higher value applications for hydrogen and biogases	

Scenario 3: Renewable electricity + gas blend + offsets (Proposed changes in track changes)

Advantages	Challenges	Consequences
• No modification of building end use equipment is required • Existing energy infrastructure remains in use • Electricity and gas consumption can be balanced optimally recognising the storage capacity in the existing gas infrastructure	• Potential stranding of fossil fuel assets as investors seek lower carbon portfolios • Offsets that are credible (effective capture, permanent/reliable, biodiverse), are likely to become increasingly expensive with rising demand • Consumers may choose to move to electrification anyway leaving those	• International investors could preference investment in other countries if continued use of fossil fuel is judged an environmental risk • Risk of higher energy/carbon prices impacting on Australia's competitiveness • As other countries electrify, choice and

	remaining to pay higher gas/carbon prices	availability of natural gas appliances could decline • The social equity consequences of this scenario are less clear and may depend where the costs associated with offsets are ultimately carried