18 April 2018

Michelle Crocker

Assistant Secretary Energy Productivity Branch

Department of the Environment and Energy

Via email: NEPPSecretariat@environment.gov.au

Energy Networks Australia response to Low Energy Homes modelling

Dear Ms Crocker

Energy Networks Australia welcomes the opportunity to provide this submission in response to the Trajectory for Low Energy Homes: Stage 2 Draft Report (the Report).

We represent Australia's energy grid that powers our economy with more than 900,000 km of electricity transmission and distribution lines and almost 90,000 km of gas distribution mains. Our members provide energy to almost every household and business in Australia.

Our gas distribution businesses manage five million connections to Australian households and businesses. The gas supplied through these networks provides an average of 44 per cent of the annual energy consumption in homes.

This submission highlights the current and future role of gas networks in supporting the decarbonisation of the stationary energy sector, balancing the energy trilemma of environmental impacts, cost and security, and our views on the results of the Report and recommendations for additional work. In Australia our current fossil fuel energy supplies are 70% of our emissions challenge, but gas and renewables can be part of the solution as we move from coal and oil to cleaner technologies.

Industry's preferred carbon and energy policies are built on the following principles:

- Australia contributing fairly to the global reductions of greenhouse gas emissions and pursuing targets with a technology neutral approach;
- Ensuring security across the energy system by considering renewables, electricity and gas as a single energy system;
- Avoiding unnecessary regulation or placing unwarranted restrictions on the development of industry; and
- Allowing markets to work effectively to reduce costs to consumers and increase economic benefits.

Energy Networks Australia's position, as relevant to the Report:

- Energy Networks Australia supports the integration of energy and climate policy in order to deliver Australia's emission reduction goals, while maintaining a secure, reliable supply of electricity.

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- Energy Networks Australia supports research, development and demonstration of a diverse range of low emission technologies. Support of low emission technologies should be technology neutral.
- Commercially available technologies, such as heat pumps or rooftop PV panels should compete on their own merit in the market place without additional incentives.
- Collaborative, nation-wide policies are imperative; disparate state policies (such as state based renewable energy targets) can undermine lowest cost outcomes for customers.
- Various initiatives such as the National Energy Productivity Plan (NEPP), the National Energy Guarantee (NEG), AEMO's Integrated System Plan, the AEMC's Reliability Frameworks Review, consideration of renewable energy zones and others must be co-ordinated and aligned.
- Energy Networks Australia supports measures that increase competition. It is important that the NEPP facilitates rather than precludes options that could deliver more affordable energy, such as new network investment.
- The NEPP should facilitate a wide range of options to reduce emissions and increase reliability. Distributed energy resources (DER) in distribution is key. Demand management should be designed with responsiveness and flexibility in order to provide a range of services, such as meeting the reliability requirement, or firming generation to satisfy dispatchability.
- Gas supplies 44 per cent of energy to households in Australia. The NEPP should consider the role of low carbon gas in the form of biogas and hydrogen, in addition to options for electrifying some applications, without being prescriptive about technologies.
- While gas is already a clean fuel, the gas industry is investing in research and development for decarbonising the gas networks, continuing to provide customers with a fuel of choice.

The following pages provide further detail to support the above summarised points.

Please do not hesitate to contact Dr Dennis Van Puyvelde – Head of Gas on 02 6272 1548 or dvanpuyvelde@energynetworks.com.au if you would like further information.

Yours sincerely,

Andrew Dillon
Chief Executive Officer

Response to questions

1. Are the Stage 2 Draft Report results consistent with your experience and why?

Zero Net Energy Assumption

The Report is based on the assumption that the energy flow to the Class 1 or Class 2 homes reaches net zero. This assumption appears misleading as the methodology is based on reducing energy consumption in the home by adopting energy efficiency measures and then offsetting the total energy through the use of solar PV panels.

This potentially leads to two unintended consequences.

Firstly, offsetting the energy consumed through solar panels does not account for the intermittency of solar PV and the net zero energy is enabled through the use of the network. While this can be absorbed by the network at low levels of renewables, as the total renewables component increases, additional augmentation and investment will be required in the electricity network to manage this intermittency. The information box published in the BP Technology Outlook 2018 explains the mismatch between the demand of energy and the time of which solar energy is generated. The additional costs for managing this intermittency will impact on customer bills and will affect the simple payback reported in the Report.

Secondly, the approach of using solar PV to offset electricity demand leads to a technology specific solution for appliances, which disadvantages gas appliances. The report does not adequately articulate how the approach is biased towards electrified homes.

Energy Networks Australia recommends that an additional table outlining energy options after upgrades are included in the Report and that this includes options for both gas and electrical appliances. The requirement of net zero energy homes is misleading as the homes still consume energy in the form of rooftop solar PV. If the intention is to minimise emissions, then a broader range of renewable options should be considered such as rooftop PV, rooftop PV with batteries, natural gas, renewable gas (including hydrogen and biogas) or a combination of those energy sources.

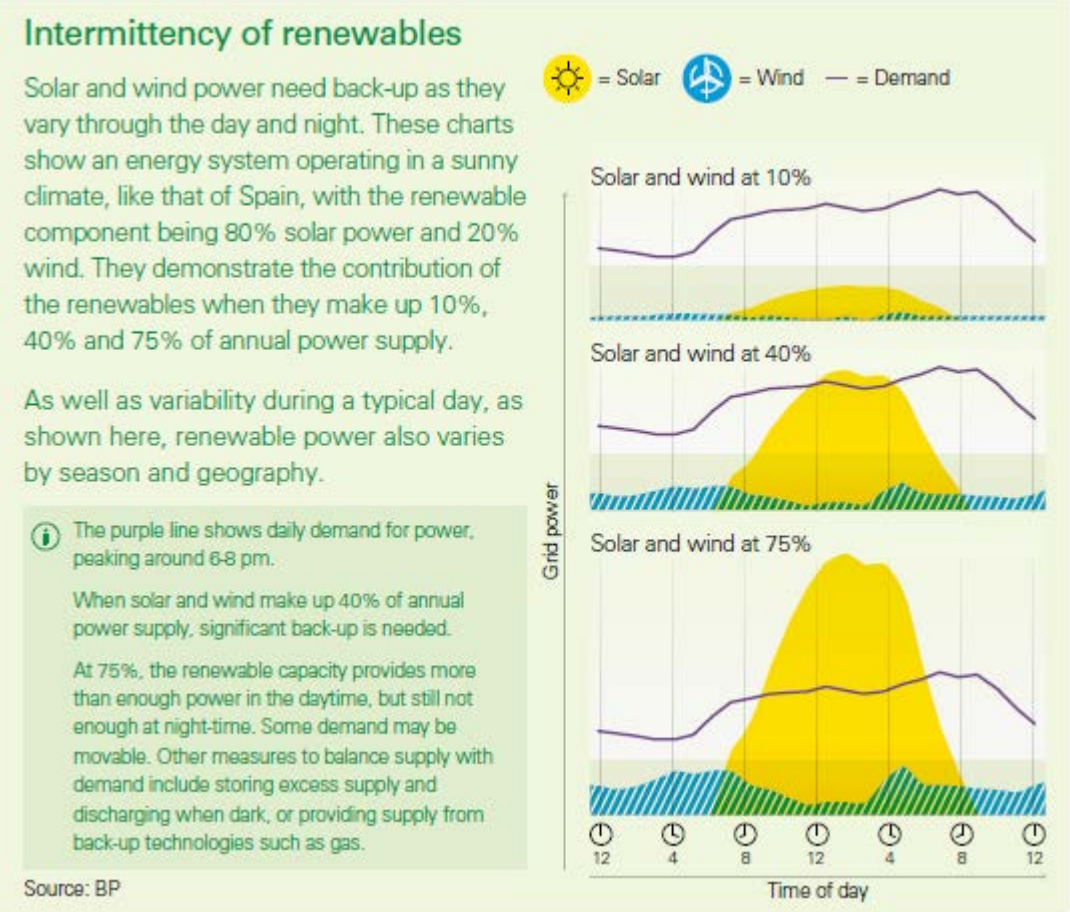

Figure 1: Intermittency of renewables and peak energy demand (Source: BP[1]).

Technology specific upgrades

The Report proposes a limited selection of upgrades for heating and cooling, and water heating appliances. The Report discounts new gas appliance using the following justification:

> *Given the limited scope to increase gas heating/ gas hot water heating efficiency, the possibility of introducing a reverse cycle system/ a heat pump was considered [pp18/19].*

This limitation creates biased results in the Report towards electrified homes.

Unfortunately this does not consider more efficient "condensing" gas heating appliances that are able to achieve thermal efficiencies of 95% compared to the base case assumption in the report of 80%.

The major reason that gas is a fuel of choice is that it provides ambience in space heating and cooking and performs well for heating and hot water. It is

[1] BP (2018), BP Technology Outlook 2018

the preferred fuel in the southern regions of Australia and is more cost effective.

Gas provides households with choice, energy at lower cost and lower emissions compared with the grid. An additional 100,000 connections to the gas network are made annually, with a high level of penetration in new residential estates.

Placing additional and unrealistic requirements on the thermal efficiency of gas appliance may reduce customer choice and indirectly lead to an electrified house solution. For hot water in particular, this may create poor carbon emission outcomes. Hot water heat pumps are generally only suitable in warm environments. For colder climates, some heat pumps come with defrost and booster elements, but this essentially reduces any carbon benefit from paying a premium for heat pumps compared with gas appliances. Heat pumps have also been known to be noisy (as the compressor is on for a long time during the day) and more unreliable than gas appliances.

Energy Networks Australia supports government policies that are technology neutral and provide households with energy choice. Any amendments to the Draft should consider unintended consequences such as increased carbon emissions due to inadvertent fuel switching from gas to a higher intensive emissions source.

Payback methodology

The results presented in the Report are based on a simple payback methodology, although the actual calculation is not detailed in the report, but is assumed to include the capital cost of the appliances, the installation costs and the operating costs over the appliances life.

This simple payback does not include upgrades to infrastructure that may be required to manage the increase in electricity demand and the increase in intermittency of rooftop solar PV.

More detailed studies in the UK by KPMG[2] suggest:

> *That evolving gas and electricity networks to help decarbonise the economy could save consumers in Great Britain as much as £214 billion by 2050, compared with full, or near-full electrification (as proposed in the AECOM Report).*
>
> *This would see an incremental cost to the consumer up to 2050 of £4,500 to £5,000 as opposed to £12,000 to £14,000 under a full or near-full electrification scenario.*

This indicates that the simple payback is a misleading measure that does not account for wider system costs that ultimately affect customer bills.

[2] KPMG (2016), 2050 Energy Scenarios – The UK Gas Networks role in a 2050 whole energy system

Other options such as, interconnection, investments involving the orchestration of distributed energy resources (DER) in distribution, and other demand management can play an enabling role in enhancing wholesale competition, firming up supply and meeting the reliability requirements.

The role of DER and demand management and the impacts on distribution networks must also be carefully considered. A better understanding of how the various forms of DER entering into and interacting with distribution networks is being accounted for and included in assessing system reliability requirements appears essential. The capability and contractual obligations on DER and demand management must also be visible to network service providers to allow proper planning around maintenance and network investment decisions.

Energy Networks Australia is undertaking significant work in the DER and interconnection space and our members are willing to assist in any further examination of these issues. This will provide a more realistic assessment of costs compared to the simple payback methodology used in the Report.

Heat pump technology

The Report indicates that heat pumps are the best solution for hot water and space heating for new build Class 1 homes across in all regions of Australia. As mentioned above, this results seems to be driven by the simplified assumptions adopted in the report such as a simple payback methodology and limiting appliance upgrades to electrical appliances only.

The Coefficient of Performance (CoP) of the heat pumps used in the Report appear high and do not account for the reduction in CoP in colder conditions.

The data of the E3 Program indicates that CoP reduces as the ambient temperature reduces and approximates 2 at temperatures between 0 and 2 degrees Celsius. The CoP's used in the Report range between 3.31 to 4.81 for hot water heat pumps and between 3.92 and 5.22 for reverse cycle air conditioners, which are significantly higher than the actual performance of those appliances during colder months, when those appliance will need to provide additional heating. Using incorrect CoP leads to inaccurate calculations of the energy required for the home and may bias the results.

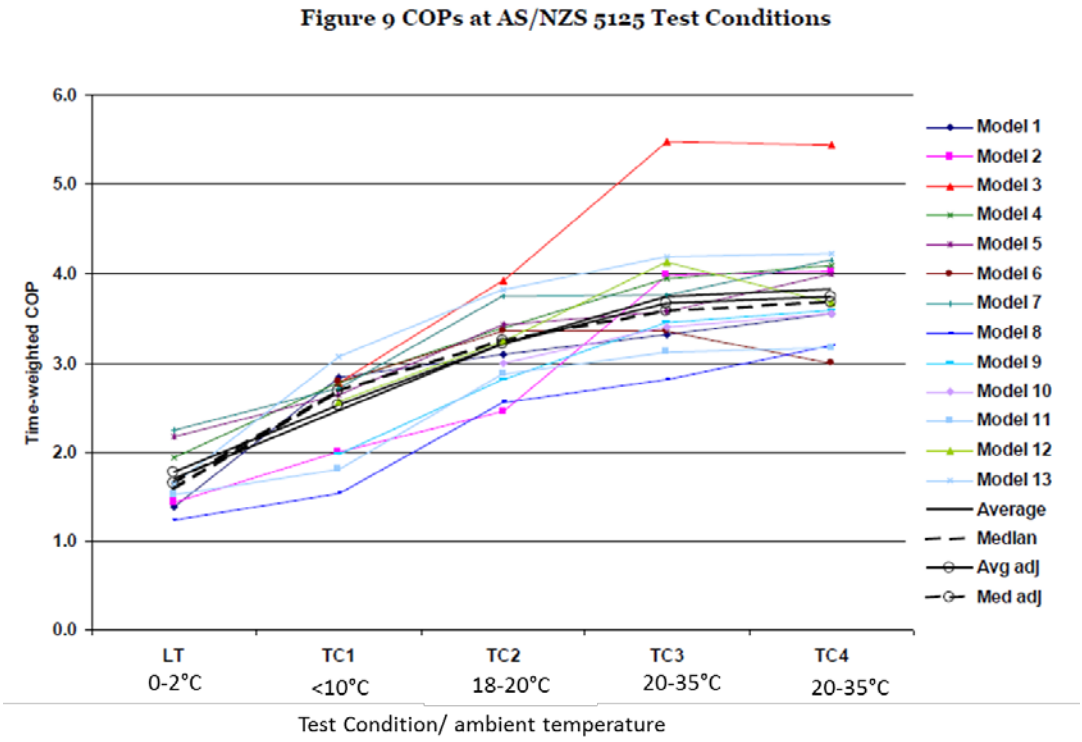

Figure 2: Ambient temperature effect on heat pump coefficient of performance (Source: Equipment Energy Efficiency Program[3])

The energy required for reverse cycle air conditioning and how water heat pumps will increase during colder months and will also increase at night time when there rooftop solar PV is not generating. This will lead to additional peak energy demand to be supplied by the grid, requiring additional grid augmentation and strengthening. As mentioned above, this has not been considered in the simplified pay back calculation leading to a biased result favouring heat pump technology.

Overall, installing heat pump hot water units in areas with low average temperatures is not recommended. Energy Matters[4] notes that the average ambient yearly temperature for heat pumps should be equal to or greater than 19°C. This is because the efficiency of heat pumps reduces as ambient temperatures get cooler. It is indeed a dilemma that heat pumps work better at transferring heat into a home when it is hot outside. Data from the Bureau of Meteorology indicates that the ambient average temperature in most of southern Australia is below 18 degrees. This indicates that heat pump technology for hot water works best in Australia's subtropical, tropical and arid regions.

[3] Equipment Energy Efficiency Program (2012), Product Profile: Heat Pump Water Heaters
[4] https://www.energymatters.com.au/solar-hot-water/solar-heat-pumps/

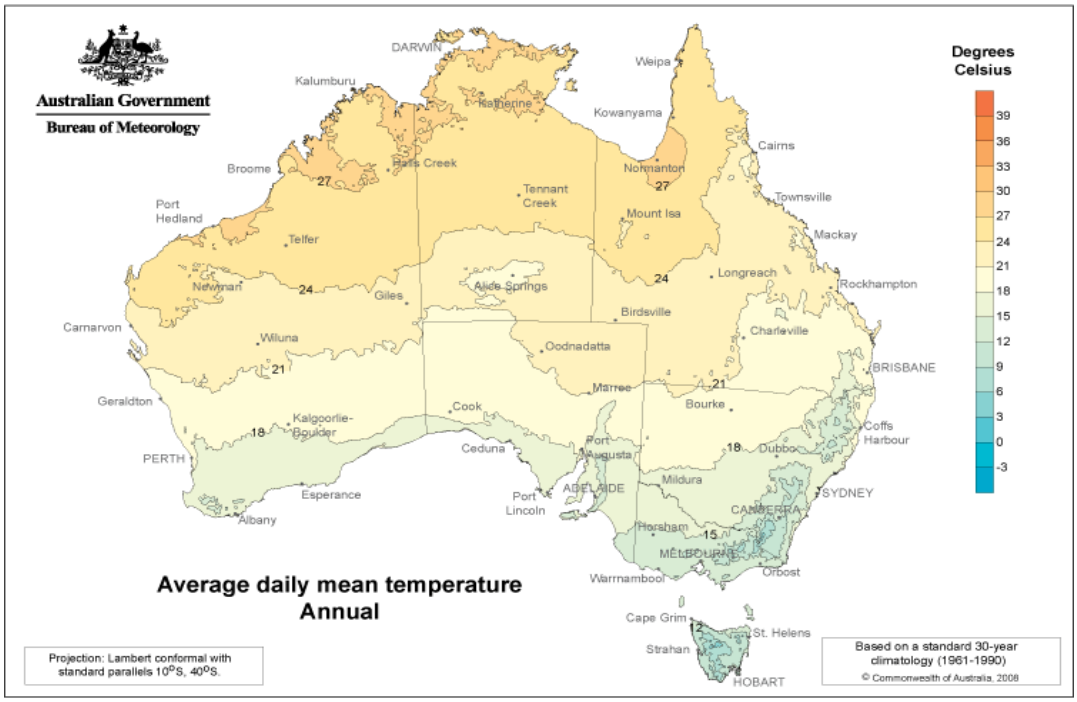

Figure 3: Average daily mean temperature across Australia (Source Bureau of Meteorology).

In colder and more humid climates, the outside coils of the heat pump may ice-up and this requires additional electrical heating before the unit can be operational. This additional electricity is generally not included in efficiency estimates. The performance of a heat pump reduces when it is most needed, i.e. in cold weather.

Energy Networks Australia recommends that the energy scenarios are recalculated by adopting realistic – rather than theoretical - performance metrics of heat pumps for hot water and space heating, and by considering the broader system costs required to manage the intermittent nature of rooftop solar PV.

2. What additional opportunities should be considered or modelled to support future economic analysis and why?

The focus of Australian energy policy to date has been on decarbonising the electricity sector. The broader challenge of decarbonising the economy presents opportunities for transport and the use of gas in the home or by industry.

The chart below illustrates the energy consumption challenge in Victoria. The following key observations are made:

1. The total decarbonisation challenge (of the energy sector) is the top black line. This fluctuates between 1,500 and 2,500 PJ per day, the variation largely a reflection of gas used during winter.

2. The grey line reflects the energy use in transport fuels. It is likely that some of this will be decarbonised using electricity and this will increase the demand of the electricity network.
3. The focus to date has been on decarbonising the electricity sector. This only represents between 1/3rd and 1/5th the total challenge.
4. There has been limited focus on decarbonising the gas sector, which provides up to twice the energy during winter compared with the electricity sector.
5. Electrifying transport and gas energy usage will require augmentation and construction of new electricity infrastructure. This will need to meet the seasonal total energy demand, requiring a large amount of infrastructure to meet the winter peaks which is essentially unused during summer months.
6. The gas network already provides this seasonal energy load and industry is leading work to decarbonise gas in the networks through hydrogen and/or biogas. This transition will repurpose existing infrastructure and continue to provide energy to households at a lower cost compared with a 100 per cent electrification scenario.

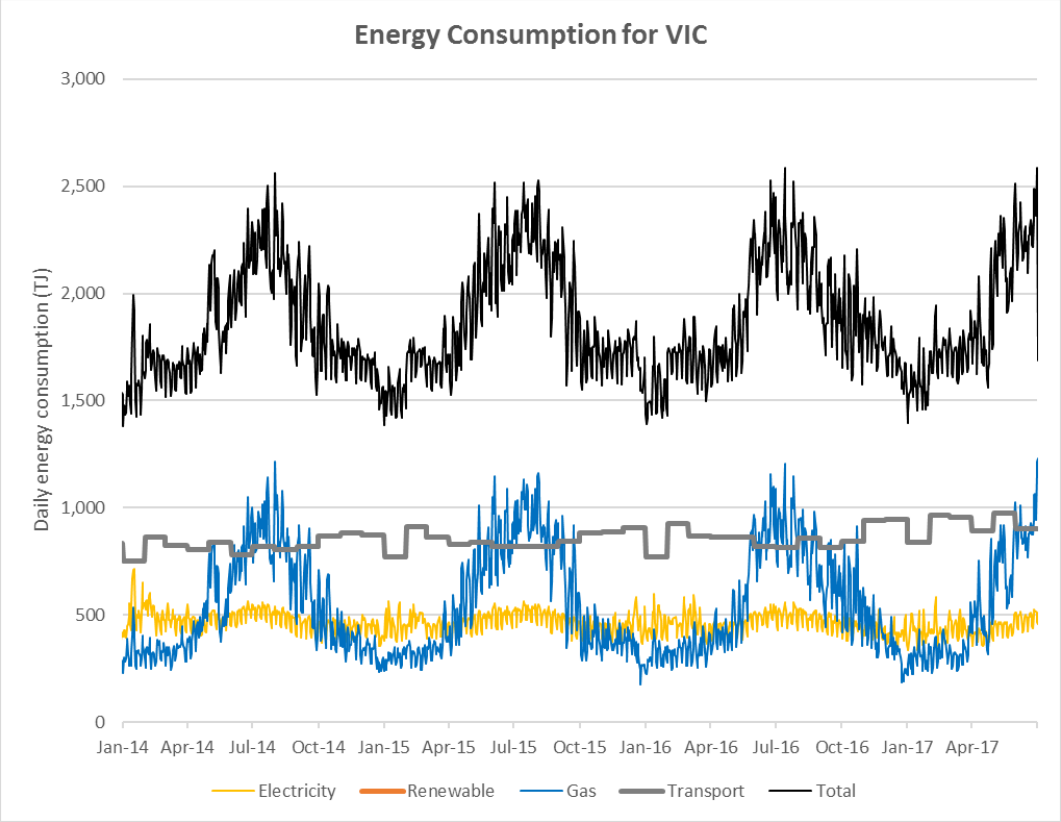

Figure 4: Energy consumption in the Victoria[5].

[5] Source: Energy Networks Australia analysis based on AEMO data and Australian Petroleum Statistics.

Energy Networks Australia recommends that energy efficiency modelling of homes should be considered within context of the broader decarbonisation challenge.

3. What additional opportunities should be considered or modelled specifically for apartment buildings and why?

No response provided.

4. What policies and initiatives would be required to facilitate the transition for new and existing dwellings and how might they be implemented?

For Australia to meet its obligations under the Paris Agreement, electricity, transport and the direct use of gas sectors will need to be decarbonised. A major challenge is that gas provides about 44 per cent of energy to Australia's households; with nearly half of Australia's homes connected to the gas network.

Electrification may be an option to consider, however, this would require major infrastructure investment. A further challenge is that gas is a seasonal fuel and in winter, provides more than double the energy to homes compared with electricity. Put simply, if electricity is to replace gas, the electricity network will require three times as much energy in transmission as it utilises now. This projected augmentation does not account for the growth in electric vehicles that will require additional electricity network upgrades. Repurposing the gas networks through the use of decarbonised fuels (e.g. hydrogen and biogas) represents a much more cost effective approach to decarbonising energy.

Australia's gas networks comprise different materials for the distribution of gas including cast iron and steel pipes, polyethylene and nylon pipes. The businesses are completing mains replacement programs on an economic basis to replace the low pressure iron pipes with high pressure polyethylene or nylon pipes. Most of these programs are nearing completion. The added benefit of this is that the new networks are capable of transporting hydrogen in the future.

Switching to hydrogen or biogas in gas networks will result in zero emissions from using these hydrogen and or biogas appliances in the home. This will assist Australia reach its long term carbon emission targets.

More information is available from www.energynetworks.com.au/gas-vision-2050/

Energy Networks Australia suggests that any Government policy proposals will interact with all the on-going National Electricity Market (NEM) Reviews and current regulatory processes in a coherent and non-contradictory way. For example,

- The Energy Security Board National Energy Guarantee;
- The National Energy Productivity Plan;
- The out-workings of the Australian Energy Market Operator's (AEMO) Integrated System Plan consultation;
- The AEMC's Reliability Frameworks Review and its Frequency Control Frameworks Review;
- Other related work stemming from the Independent Review into the Future Security of the National Electricity Market (Finkel) Final Report (June 2017) recommendations the ESB has carriage of, in either implementing or considering (e.g. Strategic Reserves and Day Ahead Markets); and
- That the reliability component of the Guarantee should be able to coexist with existing jurisdictional reliability standards.

There may also be benefit in combining or streamlining some of these activities to ensure consistent outcomes and reduce the volume of material participants are being asked to respond to.

5. What timeframes would be required to facilitate the transition for new and existing dwellings?

Electrifying the gas network would require increased investment to duplicate the network with electricity networks and supporting infrastructure. This additional investment would lead to inefficient use of existing infrastructure and increased bills for customers. It would be more economically efficient to re-purpose the existing gas networks to continue to deliver energy to homes for cooking, space heating and hot water, especially in a colder regions in southern Australia.

Australia's gas network includes gas storage facilities such as at those located at Iona, Victoria[6] that allow daily and seasonal fluctuations in gas demand to be met. The gas storage facilities can store more than 150 days of average gas demand. Unlike electricity, gas transmission and distribution networks themselves also store energy that can be on over a period of time. In effect, gas infrastructure facilities provide a national energy storage service for electricity generation from gas and for the direct use of gas in the home. Gas Vision 2050 reports that this storage infrastructure has the same energy storage potential as 6 billion PowerWall batteries – enough for 250 for each Australian. Repurposing gas networks can also provide additional services for electricity networks as they have a potential for storing huge amounts of renewable energy in the form of hydrogen.

[6] Core Energy Group (2015), *Gas Storage Facilities – Eastern and South Eastern Australia,* accessed from: https://www.aemo.com.au/-/media/Files/Gas/National_Planning_and_Forecasting/GSOO/2015/Core--Gas-Storage-Facilities.ashx

The expected lifespan of this infrastructure is between 60 to 80 years and value of this national gas distribution network is almost $9 billion[7]. The economic role of gas will remain dependent on its competitive position as a fuel of choice, competing on price, sustainability, security and amenity. While there has been upward pressure on wholesale gas prices due to the internationalization of Australia's gas market, it is important to recognize the delivered cost to customers reflects other elements of the cost structure. Historically, gas distribution network costs can represent about 50 per cent of the delivered cost to residential customers[8], compared with the wholesale cost proportion of about 20 per cent. However, in many jurisdictions, these network costs are falling and the decrease in network costs have substantially offset increasing wholesale costs.[9]

Energy Networks Australia recommends that the timeframes for policy implementation should align with the broader range of policies related to decarbonising Australia, as mentioned above. Policies should consider implications across the whole system to optimise existing and new investments required in the energy sector – which has long lived assets.

[7] Australian Energy Regulator (2015), *State of the Energy Market* 2015, accessed from http://www.aer.gov.au/publications/state-of-the-energy-market-reports
[8] OakleyGreenwood (2015), *Gas Price Trends Review - December 2015.*
[9] Australian Gas Networks (2017), *Victoria and Albury Access Arrangement for the five year period commencing on 1 January 2018,* https://www.australiangasnetworks.com.au/our-business/about-us/media-releases/household-gas-bills-to-drop-by-$15