1 April 2021

Arlette Bruzzaniti
Study Manage
Fugitive emission reduction in the Victorian gas sector
Advisian
Via: FEStudy@advisian.com

Dear Arlette,

Energy Networks Australia welcomes the development of a Victorian Gas Plan

Energy Networks Australia welcomes the opportunity to provide input during the consultation period on fugitive emission reductions for the Victorian gas sector.

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.

To date, the focus 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 businesses are leading the development of renewable gas projects and are beginning blending renewable hydrogen in the Adelaide and Sydney gas distribution networks.

Key Points

1. Fugitive emissions from the natural gas supply chain represent a small amount of total emissions and are mostly focussed on natural gas production.
2. Gas network businesses are already completing work to minimise leakage from networks through iron mains replacement programs. These are expected to be completed by the mid 2020's.
3. Leaks arising from accidental strikes or regular maintenance are minimised as much as possible.
4. Conversion to renewable gas in networks will further reduce fugitive emissions associated with networks.
5. Reaching net-zero emissions can be done at 41 per cent of the cost of electrification by using renewable gas in gas networks.

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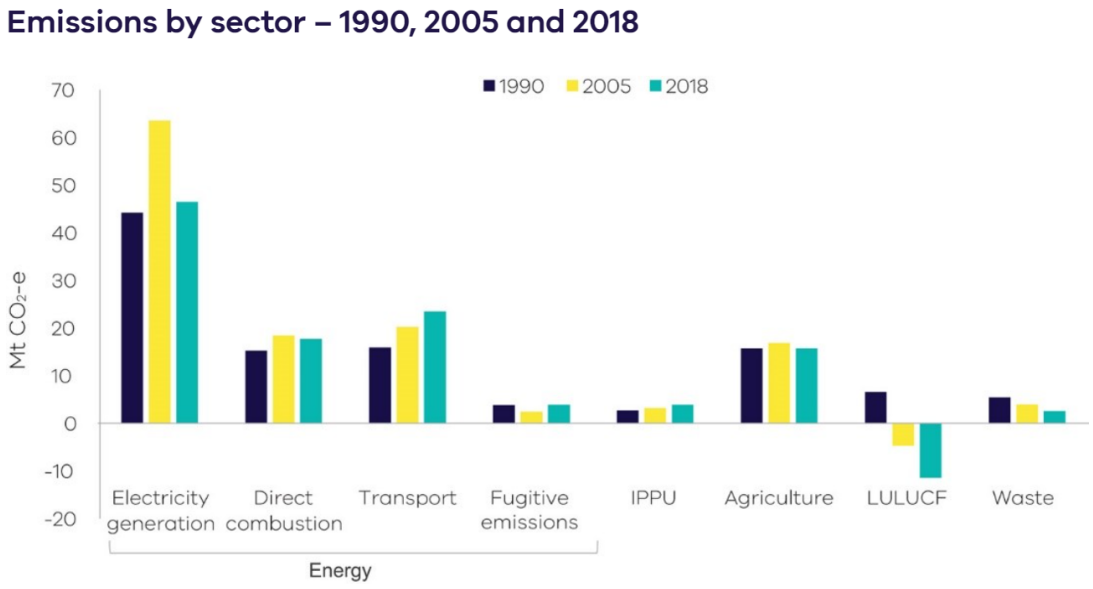
Fugitive emissions in Victoria.

Greenhouse gas emissions for Victoria are shown in Figure 1. This shows that fugitive emissions contributed 3.9 Mt of CO_2-e to Victorian's total greenhouse gas emissions or 3.7 per cent of its total. These fugitive emissions have been estimated in line with the UNFCCC definition, which is broader in remit than the fugitive emissions under consideration for this project – namely venting, flaring and leaks.

At the national level, fugitive emissions in 2018 were roughly equal for solid fuels and liquid and gaseous fuels. The breakdown by fuels within Victoria has not been provided, but this shows that the actual emissions from the oil and gas sector are less than 3.7% of the total. The majority of fugitive emissions from gas arise from gas production at onshore and offshore gas fields. Most of Victoria's gas is produced in Commonwealth waters in the offshore Gippsland basins and as such are not covered by Victorian legislation.



Source: Australian Greenhouse Emissions Information System (Department of Industry, Science, Energy and Resources 2020b)

Figure 1: Victorian greenhouse gas emissions (source: https://www.climatechange.vic.gov.au/information-and-resources/greenhouse-gas-emissions-in-victoria)

Fugitive emissions from the gas sector include:

- Upstream – emissions associated with the production of natural gas;
- Midstream – emissions associated with the delivery of natural gas through pipelines and gas distribution networks; and
- Downstream – emissions associated with the end use of natural gas.

In our submission, we will focus on fugitive emissions from gas distribution networks.

Methane or fugitive emissions.

Fugitive emissions from the natural gas sector include both carbon dioxide and methane. Carbon dioxide is separated from producer gas to meet the gas specifications for gas pipelines and networks. This CO_2 is commonly vented although it can be captured and stored in the subsurface such as being undertaken at the Gorgon CO_2 re-injection project and other similar CCS projects around the world. This is one practical example of reducing fugitive emissions from the natural gas sector.

A major component of fugitive emissions is the direct release of methane. Methane is considered to be a more potent greenhouse gas compared to carbon dioxide. Global warming models use a 100-year average of global warming potential (GWP) of different gases. Methane is considered to be 28 times as potent a greenhouse gas over this 100-year horizon, although it usually doesn't last more than a decade as methane once vented.

> *CH_4 emitted today lasts about a decade on average, which is much less time than CO_2. But CH_4 also absorbs much more energy than CO_2. The net effect of the shorter lifetime and higher energy absorption is reflected in the GWP. The CH_4 GWP also accounts for some indirect effects, such as the fact that CH_4 is a precursor to ozone, and ozone is itself a GHG.*[1]

In total, methane emissions contribute around 16 per cent to global warming. Global methane emissions are around 500 million tonnes per year.

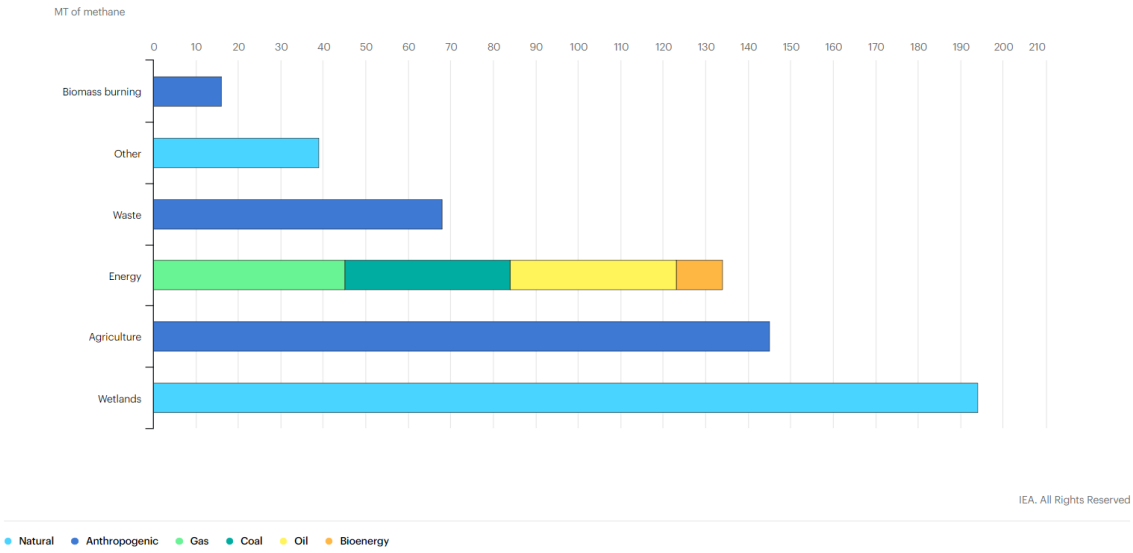


Figure 2: Global methane emissions by source (Source: IEA, Sources of methane emissions, IEA, Paris https://www.iea.org/data-and-statistics/charts/sources-of-methane-emissions-2)

[1] United States Environmental Protection Agency, https://www.epa.gov/ghgemissions/understanding-global-warming-potentials

The largest source of anthropogenic methane emissions is agriculture, responsible for around a quarter of the total, closely followed by the energy sector, which includes emissions from coal, oil, natural gas and biofuels. Out of the global total, fugitive emissions from gas represent 8 per cent of global methane emissions.

The global focus on methane reductions covers all fugitive emissions of methane. The Global Methane Initiative has working groups to reduce fugitive emissions from oil and gas, coal, and agriculture. As shown in Figure 3, there are many opportunities to reduce methane emissions at different price points. For oil and gas, these emission reduction opportunities mainly occur in the upstream sector where larger volumes of fugitive emissions can be handled.

Table 1: Global Percentage Reduction from Projected Baseline, 2030

Cost per $MTCO_2E$	$0	$15	$30	$45	$60	Baseline ($MMTCO_2E$)	Global Abatement Potential (at any cost)
Agriculture	0%	3%	10%	13%	15%	384	28%
Coal Mining	10%	56%	59%	59%	59%	784	60%
Municipal Solid Waste	12%	26%	31%	32%	32%	959	61%
Oil and Gas	35%	42%	44%	45%	47%	2,113	58%
Wastewater	1%	3%	5%	7%	8%	609	36%

Source: *Global Mitigation of Non-CO_2 Greenhouse Gases: 1990 – 2020* (EPA Report 430-R-06-005)

Figure 3: Methane emission reductions at different price points (Source: Global Methane Initiative)

The report highlights that even with all available technologies and at any cost, that fugitive emissions cannot be fully eliminated due to the diverse nature of the sources of emissions. For example, it is extremely difficult to eliminate emissions from livestock or from accidental releases when pipelines are struck.

Fugitive emissions from gas distribution networks.

Sources of fugitive emissions from gas distribution networks can be categorised as follows.

Category	Description	Emission reductions action taken by networks
Energy emissions	Heating is required as natural gas is transferred from the high-	This is outside the scope of the current consultation process.

Category	Description	Emission reductions action taken by networks
from hot water baths	pressure transmission pipelines to the distribution network. This heating is provided by gas and produces CO_2 emissions.	
Accidental leaks from third party strikes	Sometimes the gas network is damaged from third party operators looking to install new infrastructure (e.g. NBN cabling) or conduct maintenance on existing infrastructure.	Safety precautions such as warning tape or tracing wire are added to gas networks pipes during construction. Dial before you dig is provided with geospatial information of gas networks. This hotline aims to reduce accidental strikes on assets. Network respond to reported asset strikes within a designated time.
Leaks from replacing network pipes	The joints of old cast iron pipes are prone to leakage with the use of natural gas. The pipes themselves are not prove to leakage.	Networks are undertaking iron mains replacement programs. This will replace the old cast iron network to modern plastic pipelines and reduce the leakage from the old assets. For Victoria, these replacement programs are expected to be completed in the middle of this decade. If a leakage pathway from a network is observed, this can be minimized through pressure monitoring of the network. When new mains and joints are installed, they are pressure tested to ensure they do not leak prior to operation. Replacing these older pipes will reduce leakage from networks.
Leaks from maintenance	Pipes and networks need to be vented prior to undertaking any	Network conduct these maintenance operations in line

Category	Description	Emission reductions action taken by networks
	regular maintenance. These are controlled releases that result in a small amount of methane gas being released to the atmosphere. Venting the methane is a safety requirement. Includes connection and disconnecting gas to properties	with Australian Standards and/or state based technical standards. The primary objective is to ensure that maintenance and repairs can be carried out safely.
Meter leaks	Gas meter sets (including the regulator) may form leaks as they age. When customers report gas leaks, network businesses attend to these call outs to repair the leaks.	Network businesses have a minimum response time to reports of leaks within a designated time, depending on the type of reported leak. While there are 1,000's of reported leaks from meter sets in Victoria per year, the total amount of methane released through all of these leaks is very small. Meter sets are periodically replaced by network businesses. This minimises the amount of leakage from meter sets.

Gas businesses report their fugitive emissions using Method 1 of the Greenhouse Accounts Factors Handbook[2]. This includes all the emission sources described above.

- For transmission pipelines, fugitive emissions are estimated by multiplying a factor by the length of the pipeline network.
- For distribution networks, this is slightly different as it is based on a proportion of the total volume of gas moved through the network. This is based on a factor referred to as "Unaccounted for Gas", which is the difference between the measured quantity of gas entering the gas distribution system from various supply points and the gas delivered to customers.[3] Networks are already

[2] https://www.industry.gov.au/data-and-publications/national-greenhouse-accounts-factors-2020
[3] https://www.esc.vic.gov.au/electricity-and-gas/tariffs-and-benchmarks/unaccounted-gas-benchmarks

incentives to minimise these UAFG as there is a requirement to purchase a similar volume of gas.

Gas distribution businesses are already actively reducing methane emissions from their network – mainly through ensuring safe operation of the network but still reducing methane leakage. The UAFG factor should be periodically reviewed to reflect the progress of the iron mains replacement program. The Essential Services Commissions undertakes reviews of UAFG benchmarks[4] for Victorian gas distributors and calculated new benchmarks as part of the reviews.

Decarbonising gas is underway.

Australia has committed to the Paris Agreement on climate change. This requires reaching maximum emissions as soon as possible combined with reaching net zero emissions in the second half of the century. Each State and Territory has further set targets of reaching net-zero emissions by 2050 or earlier.

Gas Vision 2050 – Delivering a Clean Energy Future[5] is the gas industry's plan to decarbonise the sector in line with Australia's commitment to the Paris Agreement.

Decarbonising gas networks will adopt a range of transformational technologies including hydrogen, biomethane and carbon capture and storage. All of these technologies will be complementary to the range of technologies to decarbonise the electricity sector.

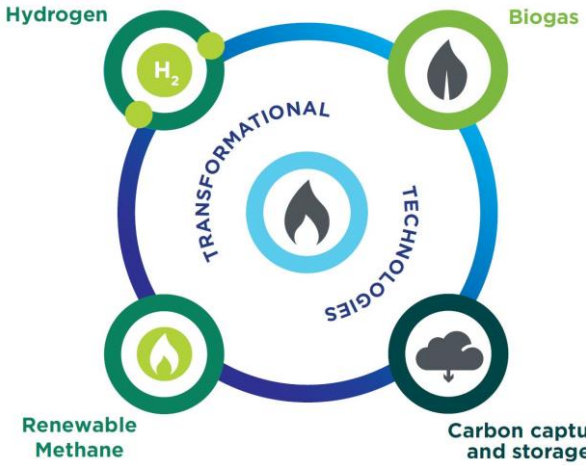


Figure 4: A range of options are available to decarbonise gas networks (Source: Gas Vision 2050)

Maintaining both gas and electricity networks, that both deliver decarbonised energy, provides more options for customers and improves energy reliability and security while also providing customers with choice.

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[4] https://www.esc.vic.gov.au/electricity-and-gas/tariffs-and-benchmarks/unaccounted-gas-benchmarks
[5] www.energynetworks.com.au/projects/gas-vision-2050

The move towards hydrogen or biomethane would also reduce fugitive emissions.

» Replacing natural gas with hydrogen avoids the fugitive emissions from natural gas, especially the large-scale source of fugitive emissions from the production of natural gas. There are some concerns that hydrogen is an indirect greenhouse gas that prolongs the intensity of other greenhouse gases, such as methane. The impact will depend on the total amount of hydrogen leakage across the supply chain. Regardless, the impact of hydrogen leakage will be much smaller than the current impact of fugitive emissions from the natural gas supply chain.
  – *The researchers have calculated that a global hydrogen economy with a leakage rate of 1% of the produced hydrogen would produce a climate impact of 0.6% of the fossil fuel system it replaces. If the leakage rate was 10%, then the climate impact would be 6% of that of the fossil fuel system*[6].

» Biomethane is chemically similar to methane and it is vented, it would act as a greenhouse gas, just like methane does. However, biomethane production is often localised and avoids the upstream fugitive emissions associated with conventional oil and gas production. Through its localised nature, it would also avoid some of the fugitive emissions associated with the transport of gas from where it is produced to the customer.

Continued use of gas infrastructure achieves net-zero emissions at lower cost.

Economic analysis completed as part of *Gas Vision 2050 – Delivering a Clean Energy Future* showed that decarbonising gas can be done at half the cost compared to direct electrification of the gas load. This reflects the opportunity to repurpose existing gas infrastructure because electrification may impose system-wide costs for grid reinforcement on customer bills. The modelling showed that whole system costs would be lower when gas infrastructure is utilised (instead of replaced with electrical equivalent) to decarbonise the energy sector.

For Victoria, decarbonising using green hydrogen was shown to only cost 41 per cent compared to the scenario where the end use of gas was electrified. This is the lowest for any region in Australia and reflects the high level of gas used in Victoria.

The cost stack (Figure 6) illustrates that very large investments would be required in electricity generation and storage for electrification compared to that required for green hydrogen.

[6] Environmental impacts of hydrogen-based energy systems (2006), source: https://ec.europa.eu/environment/integration/research/newsalert/pdf/39na1_en.pdf

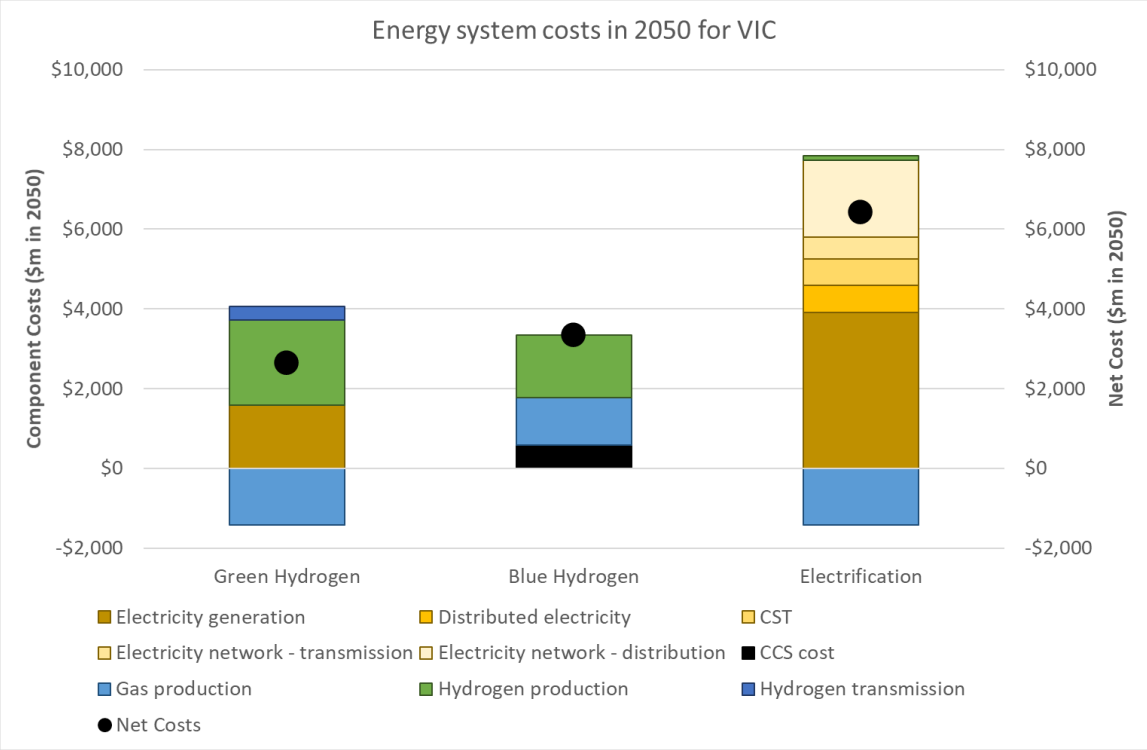

Figure 6: Costs of decarbonisation scenarios for Victoria (Source: Gas Vision 2050: Delivering a Clean Energy Future)

This demonstrates the benefits and opportunities of utilising gas infrastructure to decarbonise and help Victoria reach its 2050 zero emission target. The analysis is consistent with many other international studies assessing the benefits of gas infrastructure to decarbonise the economy.

Gas networks leading the way.

Gas network businesses are already progressing the demonstration and blending of renewable gas in networks. Over 2 MW of electrolysers is operating or under construction in Australia to produce renewable hydrogen. Early in 2021, renewable hydrogen blending will commence in Adelaide and in by mid-year, blending will commence in the Sydney gas network. Further to this, a project is also under construction in Sydney to blend biomethane into the local gas network in 2022.

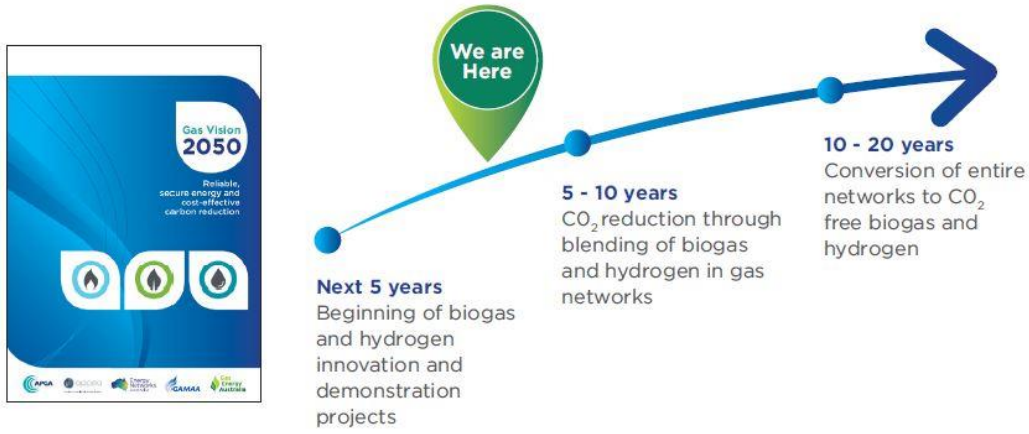

Figure 7: Renewable gas pathway (Source: Gas Vision 2050: Delivering a Clean Energy Future)

The Role of Gas Infrastructure.

Our submission demonstrates that gas networks are already implementing best world practice to minimise leakage events from gas networks. There are some unavoidable leakages are a result of accidents, through controlled leaks for ensuring safe working conditions to conduct maintenance and leakage from old meter sets.

As we move towards our Gas Vision 2050, the fugitive emissions from gas networks will significantly reduce through a combination of transporting a fuel that has a lower global warming intensity compared to natural gas, or through avoiding the major source of fugitive emissions, which is when natural gas is produced.

If you have any questions or would like a to discuss this further, please do not hesitate to contact our Head of Gas - Dr Van Puyvelde on dvanpuyvelde@energynetworks.com.au.

Yours sincerely,

Andrew Dillon
Chief Executive Officer

Response to questions

Question	Energy Networks Australia Response
1. What do you consider to be the main sources of fugitive emissions from the Victorian gas sector. Describe each source and contribution % to fugitive emissions.	» The main source of fugitive emissions from the oil and gas sector in Victoria is from the gas producing fields located in Commonwealth waters. » Normal operation of gas distribution and transmission pipelines are not a major contributor to fugitive emissions. When these pipes are installed, they are pressure tested before going into service which demonstrates that there is no leakage. » Leakage may occur from networks as a result of: – A third-party strike – Failure of valves – Routine maintenance – Meter leaks
2. Are you aware of any fugitive emissions reduction programs not already in progress which could potentially be implemented in Victoria? Please describe each program, who you know of that is implementing this program and the approximate reduction in fugitive emissions that could be achieved.	Many responses are already being undertaken by industry such as: » Replacing ol cast iron mains with modern plastic pipes that are less prone to leakage » Reporting location of networks to dial before you dig » Responding to report of strikes on assets within a set timeframe Blending renewable gas into network will further reduce fugitive emissions.
3. Can you identify the key barriers for owners/ operators that would prevent them from implementing fugitive emissions reduction initiatives or programs?	Gas distribution businesses are already minimising fugitive emissions from networks.
4. What types of support would overcome these barriers? (eg research and	The main opportunity for reduction of fugitive emissions from distribution network is to replace the natural gas with renewable gas.

Question	Energy Networks Australia Response
development, advisory services, grants/loans, incentive programs, new regulation or policies)	This will avoid upstream fugitive emissions associated with natural gas and also lower the emission intensity due to venting or leaks from meter sets. Blending renewable gas into networks is being demonstrated currently. Once the network is fully converted to modern plastic materials, it will be suitable for transporting hydrogen. Scaling up hydrogen production will require suitable technology development (through R&D) and financial incentives (e.g. grants) to address the cost differential between hydrogen and natural gas.
5. Do you consider that the reduction of fugitive emissions can be accelerated, and if so, what are some of the key issues that might need to be addressed in achieving such acceleration (eg potential impacts upon networks tariffs and affordability)?	As above.