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6 August 2021

Victorian Gas Substitution Roadmap
Department of Environment, Land, Water and Planning

Re: Victorian Gas Substitution Roadmap submission

1. Chemistry Australia welcomes the opportunity to provide this feedback to the Victorian Government Gas Substitution Roadmap Consultation Paper.

2. **Chemistry Australia recommends that any planning or other outcomes from the Roadmap:**
    a. **Be done on a sector-by-sector basis, recognising the unique contributions currently provided by the chemicals sector, and the opportunity for future opportunities in jobs and investment**
    b. **Be done on a net benefit basis, recognising the opportunities for energy efficiency and emissions reductions, new jobs and investment, and the risks of unintended consequences.**
    c. **Differentiate the uses of gas as:**
        i. **An energy source for industrial processes**
        ii. **A feedstock source for the production of goods critical to the economy, and**
        iii. **A source of power generation that enables grid certainty and stability**
    d. **Focus on gas being provided to industrial customers at globally competitive prices that match plant capital re-investment cycles. Ongoing and nationally coordinated market reforms are critical to ensure this is achieved, so industrial viability, jobs, skills, and scale are not lost to the Victorian economy.**
    e. **Be done as part of a nationally coordinated plan of action**
    f. **Be done in consultation with industry, recognising their need for capital investment planning purposes, and opportunities for further growth and investment**
    g. **Be done over a suitable period of time that delivers the greatest certainty for business and employment with realistic and predictable considerations for the introduction of new energy sources or technologies and / or the retirement of current ones**
    h. **Where the substitution of natural gas is considered, Government must ensure the obligations of the National Energy Objectives are met.**

Background

3. Chemistry Australia is the peak national body representing the chemistry industry. The industry is committed to playing its role in nationally and globally coordinated actions that address climate change and improve energy sustainability.

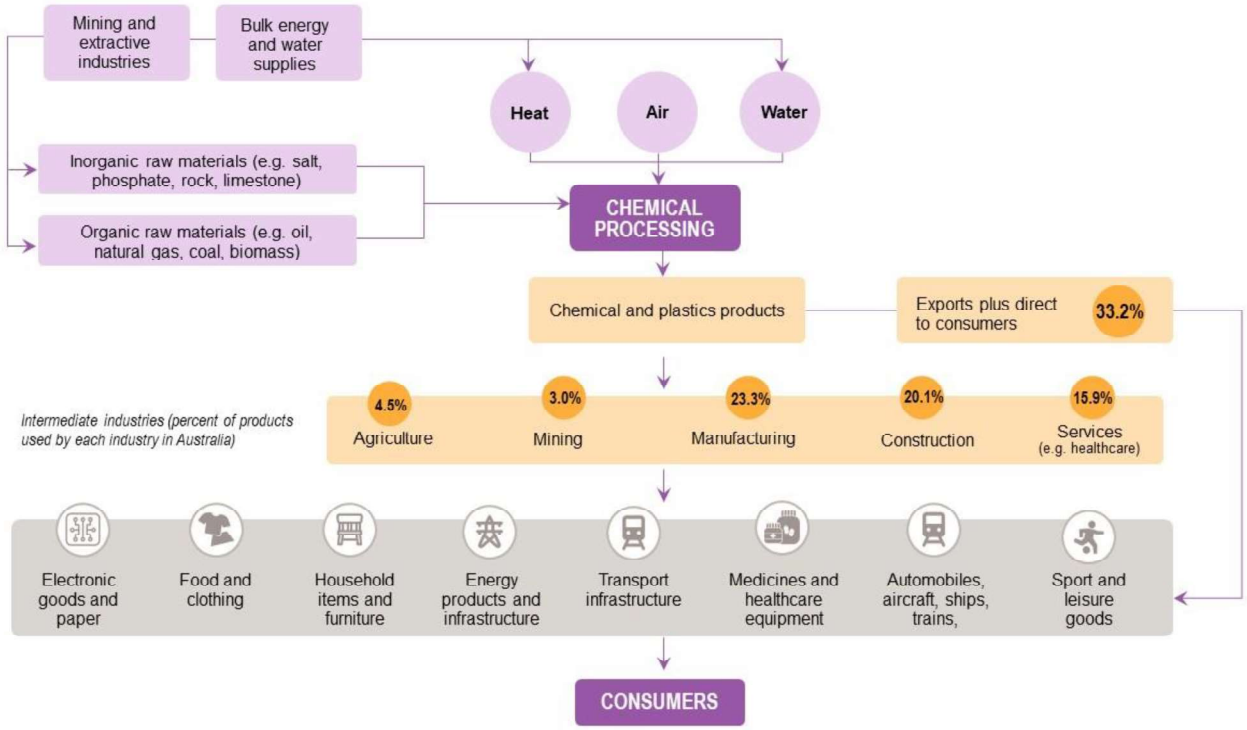
4. The chemistry industry is unique in consuming gas in both of its forms, which will be discussed later:
    a. Its energy value as methane for process heat, power, steam generation and the like, and
    b. Its non-substitutable feedstock value, principally as ethane in the Victorian context, for high value-added polymer production.

5. This submission will focus on industrial gas consumption in these two categories, rather than residential and commercial consumption. Chemistry Australia also recognises the importance of gas fired electricity generation for the safe and reliable supply of 24/7/365 power for industry. This submission will not specifically address this aspect. The submission by the Energy Users Association of Australia has valuable insights into this area.

6. The sector consumers approximately 3% of Australia's gas compared with the large volumes exported as energy. The industry also delivers the largest value-add of any sector. For each PJ it processes, it contributes $286M to GDP and underpins 1,600 FTE jobs, greater than gas-powered generation or LNG exports[1].

7. The industry abates more than twice its global emissions through the products and services it provides households and services[2]. Chemistry Australia members products such as insulation materials, marine coatings, fertilisers, and lightweight, recyclable packaging contribute to Australia's Paris Agreement targets as some of the top climate response solutions enabled by the chemical industry.

8. The chemistry industry is the third largest manufacturing sector in Australia and supplies inputs to 108 of Australia's 114 industries as seen in the following figure[3].



[1] *"Chemical industry economic contribution analysis"* Acil Allen Consulting, August 2019.
[2] "*Innovations for greenhouse gas reductions",* International Council of Chemical Associations, 2009.
[3] *"Chemical industry economic contribution analysis"* Acil Allen Consulting, August 2019.

9. Notably these include: Agriculture; Mining; Manufacturing, including fresh food production; Construction, and Services. These are critical to the Victorian economy as the manufacturing and innovation hub of the country, and to the State's sovereign capability and economic resilience.

10. Nationally, the industry directly employs more than 61,500 people (FTE) and supports approximately 212,000 FTE jobs across the economy. The industry directly contributes $11 billion to gross domestic[4] product (or $38 billion including indirect contributions).

Chemistry industry gas-based manufacturing contribution to Victoria

11. Victoria is the major state for the chemical industry in Australia. It is estimated that Victoria's chemical industry spent $6,907 million on goods and services in producing chemicals and plastics for other industries and exports in 2017-18. Of this, it is estimated that $4,839 million was spent on locally produced goods and services comprising:
    - $538 million on gas
    - $1,080 million on wholesale and retail trade and transport
    - $724 million on professional and other business services
    - $565 million on electricity
    - $412 million on basic chemicals and polymer products
    - $187 million on health care and public safety
    - $1,333 million other inputs and services.

    A local spend of $4,839 million by the Victorian chemical industry contributed between an additional $4,720 million to $7,539 million to the state's economy, which is between 1.10 and 1.75 per cent of Victoria's GSP in 2017-18. This is in addition to the direct contribution of 0.70 per cent.

    In total, it is estimated that between 28,236 and 45,164 FTE jobs were indirectly supported by chemical industry activities in the Victorian economy in 2017-18.

12. These, and other key statistics can be summarised as:
    a. directly employs 19,550 direct jobs and supports a further 45,160 underpins for total of **64,710 FTE jobs**
    b. has over **1,700 businesses**, and
    c. directly contributes $3,001M and indirectly $7,539M for a total of **$10,541M to Gross State Product**[5], or 2.5%.
    d. Contributes **$1,949M in exports**

[4] *ibid*
[5] *ibid*

Factors critical to the Gas Substitution Roadmap

13. Gas as an energy source for industrial processes:

It is important to distinguish between the energy sources required by industry, and the ability for companies to adopt alternatives:

- Large scale, high heat applications cannot be readily electrified and will likely continue to need to be met by the capability of gaseous energy. Current applications, technologies and the regulatory requirements of factors such as Major Hazard Facility Licences will need to be considered as part of any change.

- Lower heat applications may be amenable to electrification. These are highly dependent on a range of factors, including: heat profile and suitability; process suitability and product quality, cost and ROI over the life of the plant.

Insights from one Chemistry Australia member are important to note here:

"Whilst [we have] invested in a range of significant business improvement initiatives in the last 10 years (e.g. growth expansion, natural gas fired cogeneration and improved yield and efficiency projects) it is currently facing significant headwinds. The key issues primarily relate to long term natural gas and ethane supply availability at an internationally competitive price. This can only be achieved through local gas".

- In terms of hydrogen as a substitutable alternative, Chemistry Australia has appended its 2019 submission to a Commonwealth inquiry on the introduction of hydrogen to gas pipelines to provide inputs and insights.

14. Gas as a feedstock

Key industries rely on gas as an industrial chemical feedstock into their process. Whilst methane is a feedstock into ammonia for fertilisers and explosives, hydrogen peroxide and methanol, these are not currently used as such in Victoria.

The principal gas feedstock in Victoria is ethane. Ethane is produced alongside natural gas only in certain locations. Ethane is used as the feedstock for the manufacture of high value-added polymers (polyethylenes) and other products. **Ethane as a feedstock is non-substitutable.** Manufacturing facilities producing polyethylene cannot consume methane, hydrogen or other feedstock gases.

In terms of gas volumes, Chemistry Australia notes the schematic on p.17 that indicates an estimated 1% of Victorian gas is used as an industrial feedstock. This is incorrect and requires amendment, given the feedstock volumes consumed equate to approximately 5% of consumption.

15. New circular economy opportunity

A new opportunity arising from ethane feedstock consumption for manufacturing polymers is the ability to further strengthen the capability to meet Australia's plastics recycling targets by the introduction of advanced recycling technologies. The following position by Chemistry Australia member, Qenos, provides an oversight relevant to the Roadmap.

"Qenos is Australia's only manufacturer of Polyethylene, a material that represents around half the volume of plastic consumed in Australia each year.

The company has a significant manufacturing asset base at its plants in Melbourne and Sydney, strong engineering capability and broad access to Australian manufacturers through its 60% market share position. This means that Qenos is uniquely positioned to develop an advanced chemical recycling capability to supply Australian manufacturers with highly sought after food grade plastics with recycled content.

There are many different technologies for the advanced recycling of waste plastics, each producing a unique mix of gasses, liquids and solids. In a circular process where new virgin plastic is manufactured from waste plastic, the derived oil is upgraded into feedstock suitable for cracking into the olefins used to make virgin plastics. The less circular alternative is to send the oil to a refinery which will typically convert over 95% into fuel, with only a small proportion of gas available as feedstock for plastics production

Qenos' aim is to build a truly circular capability that converts over 100kt of plastic waste into feedstock for the creation of new plastic at high yield, without targeting the non-circular refinery linked fuel stream. Target plastics are those that are unsuitable for mechanical recycling and that currently end up in landfill (e.g. soft plastics such as plastic wrap, food and consumables packaging).

Qenos is currently assessing the business case for its investment in advanced chemical recycling. Our study is underway and will define a wide network of collaboration including waste plastic feedstock partners, technology partners, local manufacturers of plastic packaging and their customers."

16. Gas as a source of power generation

Any transition to alternative forms of power generation will require planning in consultation with major industrial users. In particular, manufacturing sites with 24/7/365 operations requiring consistent power profiles will require their needs to be met. Early July 2021 should be a reminder of the critical reliance Victoria has on gas due to an extended period of low wind power generation, cold weather and coal generation issues.

17. Substitution by Hydrogen

Hydrogen likely offers a potential alternative pathway for current methane industrial process heat assuming it is commercially viable and meets the full range of safety, quality and other obligations set out under the National Gas Objectives of gas provision that meets the long-term needs of consumers.

However, any meaningful blend of hydrogen into the natural gas stream would also require significant capital upgrades necessitating government support. Industry will find it challenging to handle gradually ramping up hydrogen due to the change in heat value and other factors requiring plant modifications, investment and their ROI. Preference would be a small number of step changes, in close consultation with impacted industries in time-frames that match the planning, equipment upgrades, commissioning and other critical factors.

The introduction of Hydrogen to the existing gas pipeline and other infrastructure will require close work with industry operating major hazard facilities currently operating with methane and ethane. Chemistry Australia's submission to a 2019 Federal Government investigation into this issue is provided here for reference and consideration.

Yours sincerely,

Peter Bury

Director – Strategy, Energy and Research
Company Secretary

2 June 2019

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Re: Hydrogen in gas networks

Chemistry Australia appreciates the opportunity to provide the following information regarding the current considerations for including 10% hydrogen in Australian gas networks. We trust it assists with an informed and evidence-based consideration of benefits, impacts and other factors.

Chemistry Australia is the peak national body representing the chemistry industry. Chemistry Australia members include chemicals manufacturers, importers and distributors, logistics and supply chain partners, raw material suppliers, plastics fabricators and compounders, recyclers, service providers to the sector and the chemistry and chemical engineering schools of leading Australian universities.

The chemistry industry is one of the largest manufacturing sectors in Australia. Our industry employs more than 60,000 people, with every job creating five more in related supply chains. The industry contributes $10.8 billion to gross domestic product.

The chemistry industry consumes 10% of the domestic economy's gas supply for chemical feedstock purposes as well as additional volumes for heat, energy other process needs.

Chemistry Australia advocates and reiterates the obligations on all parties on the National Gas Objective: "to promote efficient investment in, and efficient operation and use of, natural gas services for the long term interests of consumers of natural gas with respect to price, quality, safety, reliability, and security of supply of natural gas."

Chemistry Australia would be pleased to be part of this working group and other relevant aspects of hydrogen related work in the future. Please let me know if you require any additional information or clarification.

Yours sincerely,

Peter Bury
Director – Strategy, Energy and Research.

The general questions you sought information on were:

1. Does your plant take natural gas from the distribution or transmission networks? If so which?
2. If there was a blend of 10% hydrogen in the natural gas network how would it generally affect your process plant in terms of process quality?
3. If there was a blend of 10% hydrogen in the natural gas network, would you generally forecast issues and a need to invest in upgrades to the existing plant, for example to change flow meters, instruments, valves, compressors, burner heads, pipework or pressure vessels?
4. Do you have any lessons learnt to share on hydrogen? For example on hydrogen safety in regards to 10% of hydrogen in the gas network?

Chemistry Australia sent manufacturing members a survey with these and other questions to assist our response. We received six responses from both feedstock users as well as process heat and energy users located in different states.

The responses are helpful in better understanding issues from this selection of companies. However, they should not be relied on as comprehensive and detailed analysis of the whole of industry. More complete engagement and consultation will be required to provide an accurate picture.

Collated responses to initial questions

1. Does your plant take natural gas from the distribution or transmission networks? If so which?

Responding companies reported both. This was depended on whether they were feedstock users and so more likely to use transmission pipelines, or process users which was more likely distribution pipelines. The other variable was the location of the plants and their proximity, and access, to transmission or distribution pipelines.

2. If there was a blend of 10% hydrogen in the natural gas network how would it generally affect your process plant in terms of process quality?

- The principles, and requirements, of energy balance are important to understand and take note of for any changes in chemical plant operation.
    - Hydrogen has less energy per volume than methane and so the plant needs to be re-balanced to take this into account
    - Changes in gas composition will therefore impact aspects such as productivity, efficiency, overall energy consumption, plant outputs and cost
- In some cases, energy balance problems in some areas of plant can negatively affect plant efficiency
- If concentration of the hydrogen Is not stable, then analysis of the plant feed is required as concentration changes will impact plant and process
- Minor effects, such as increased pressure drop through valves and pipework, speed increase, and capacity concerns on the natural gas compressors would have to be examined
- For some feedstock users, 10-15% hydrogen is estimated to be a limit in terms of plant efficiency. Beyond that level, there would be significant cost and efficiency barriers to be considered.

3. If there was a blend of 10% hydrogen in the natural gas network, would you generally forecast issues and a need to invest in upgrades to the existing plant, for example to change flow meters, instruments, valves, compressors, burner heads, pipework or pressure vessels?

- The operation of burners, flue gas and burner management systems will need to be checked due the different burning characteristics

- A catalyst vessel and heat exchanger in the natural gas system, for example, operate above 200 deg C and are likely to require replacement to avoid high temperature hydrogen attack
- Some plants already use plant/ process off-gas hydrogen as an energy fuel source. In some reported cases. Hydrogen in excess of 10% by volume could be tolerated, with upper limits yet to be defined.
- Steam generation boilers would need to be revalidated for higher hydrogen content natural gas. This includes tuning of boiler management systems to manage air-fuel ratios and account for the different heat curves. This would come at cost.
- Some specific pieces of plant may be only rated for the current natural gas composition.
    - Changes in natural gas composition may therefore impact safety, performance, rating, metal embrittlement, warranty and other considerations would need to be worked through with the manufacturers of the plant and equipment
- Other specific items such as site flares may have pilot flares designed to run on current natural gas. Aspects such as flame stability would need to be re-evaluated, tested and verified for changes in gas composition.
- Any Hazardous Area Classification for gas reticulated piping may need to be reviewed and may be required to undergo re-zoning classification.
- Instrumentation in or near hydrogen containing streams requires a high temperature protection rating and may need to be changes. Effectively a complete review would be required.

4. Do you have any lessons learnt to share on hydrogen? For example, on hydrogen safety in regards to 10% of hydrogen in the gas network?

- Chemical plants can be complex operations, often producing a variety of **by-products at significant commercial scale** in addition to their principle output type. In one instance, a significant amount of the economy's commercial CO2 is produced as a by-product, and in use by a number of key downstream industries. Changes in feedstock will have an impact on CO2 outputs and therefore may impact on the down-stream customer base relying on its volume, price and proximity. Alternative arrangements, with attendant costs may be required if hydrogen substitution for methane occurs.

- **Major Hazard Facility licencing considerations.**

  Most major chemical plants are required to hold Major Hazard Facility (MHF) licences from state governments. These are complex and onerous undertakings, periodically reviewed for re-issue. They take into account a broad range of factors and variables. It will be important to understand any impact of hydrogen in gas networks has on MHF licencing provision, complexity and cost.

- **Emergency services response considerations**

  All chemical plants have detailed procedures and arrangements in place with emergency services. Changing the composition of natural gas will also have readiness, response and recovery considerations for these agencies and these arrangements.

  Hydrogen has unique physical properties, which need to be fully understood and respected from an operational and personnel safety perspective. This includes its light weight, its upward dispersion and a very wide flammability range of some 4-75%.

  The industry is well-established with experience, expertise, capability and a significant safety and process safety focus and pedigree to deal with these characteristics. However, any changes need to be factored into all aspects of incident planning, response and recovery.

- **Metal embrittlement** was another factor identified for consideration within all facets of plant pipeline, vessel and other equipment. An operational temperature threshold was recognised for at least one of the plants. More work would be need on this aspect.

Additional considerations:

5. **Supply and price of gas**

Chemistry Australia has a priority policy advocacy program on gas in place due to the significant challenges of companies no longer able to access sufficient gas at affordable price on the East Coast, following the licencing of export LNG plants in Queensland.

In Chemistry Australia's view, a market for gas does not yet exist, rather a series of historical point to point contracts for the supply and transportation of gas. The current arrangements mean that fundamental market characteristics of depth, liquidity, transparency and competitiveness do not exist.

The impacts of linking a 700PJ East Coast domestic 'market' with a 1400PJ export energy market have been independently forecast to have a major impact on domestic users, particularly manufacturing and specifically the chemistry sector. Deloitte Access Economics forecast the damage to manufacturing at $118bn in lost output and 15,000 jobs between 2014 and 2021 in NPV terms. These factors have the follow-on impacts of issues including reduced profits due to increased inputs costs, and therefore less investment flexibility.

It follows then that introducing hydrogen into natural gas networks creates yet a further issue that requires plant and process engineering, business model and customer, cost and investment consideration.

Several major questions need to be fully understood in this context:

1. How will the introduction of less energy dense hydrogen into natural gas networks impact the price and supply for consumers?

2. Who is undertaking this work and how are they engaging with industrial consumers to make an informed decision?

3. What is the time-frame for this determination and how does it align with the technical work on a 10% blend threshold.

The current gas crisis has required an unprecedented response from the COAG Energy Council, including ACCC and AMEC reviews and the creation of the Gas Market Taskforce to investigate a number of aspects of market operation.

This includes investigating the operation, transparency and behaviours of the gas pipeline sector. A number of major reforms have been agreed and implanted as a result. It will be important to understand how introducing hydrogen into gas networks has a bearing on the outcomes of reforms already implemented, currently under investigation, or aspects yet to be investigated.

An example of pipeline related issues can be seen in the 30 May 2019 'State of the east coast gas industry' address by the Australian Competition and Consumer Chair, Rod Sims, noting:

"In late March, AEMO released its 2019 GSOO for eastern and south-eastern Australia, warning about potential looming shortages in the east coast. The GSOO forecasts that gas shortages in the southern states could arise as soon as around 2024 in the absence of major pipeline infrastructure upgrades to allow more gas to flow from Queensland, or new sources of supply emerging."

6. Consumer protection under the National Gas Law

Industrial consumers have protections under the current National Gas Law (NGL), including the National Gas Objective. Will any changes to the composition of natural gas also impact those protections? This is a material issue for the technical considerations of 10% hydrogen in natural gas pipelines, as the NGL provides boundaries that suppliers need to work within, and inform consumers of, where changes occur.

7. Other technical

Is the proposal for 10% gas in pipelines by volume or mass? We have assumed here volume and the respective reduction in volumetric energy delivered.

8. Report from the USA

One of our responding members noted a United States Department of Energy publication:" Blending Hydrogen in natural Gas Pipeline Networks: A Review of Key Issues."

Australian authorities may find this contains useful considerations for the current technical review. Chemistry Australia has not reviewed the document and does not warrant or otherwise endorse its findings, and recognises the differences between the economies, climate, process and other factors that may derive different outcomes in Australia.

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