Department of Environment, Land, Water and Planning
8 Nicholson St,
East Melbourne, VIC 3002

Victoria's Gas Substitution Roadmap - Consultation Paper Response

Bright Sparks is grateful for the opportunity to make a submission in response to the Gas Substitution Roadmap Consultation Paper (**Consultation Paper**).

Bright Sparks is a community for engaged, motivated and passionate young people working in clean energy across Australia. Our members are the future generation of leaders to inherit Australia's fuel infrastructure. We already actively work for retailers, generators, government bodies, start-ups, advisory organisations, academic groups and NGOs or think tanks and play a role in developing, operating and reforming the energy industry in our day-to-day. We bring creativity, vision and accountability to the work we do and the Consultation Paper process.

Bright Sparks supports the need for long-term strategic design and vision for the Gas Substitution Roadmap (**Roadmap**). We understand that there is enormous economic opportunity through the transition away from natural gas and towards cleaner alternatives. We support the proposed deep dive investigations proposed in the Consultation Paper, particularly the scenario analysis of the different pathways forward. When conducting this analysis and weighing relative benefits, we encourage the Department to consider the following principles that we believe are key to the Roadmap and the energy transition more broadly.

Principles

We believe an effective Roadmap should:

- Set firm targets with measurable outcomes(e.g. % reduction in natural gas use)
- Be consistent with the emissions objectives set out in the Victorian Climate Change Strategy
- Achieve the emissions objectives at least cost to consumers
- Maintain equity and ensure a just transition for consumers, workers and industry

The elephant in the room: the fate of the natural gas network

While the Roadmap is right to consider all end-uses of natural gas as well as all types of gas users, the reality is that the vast majority of natural gas consumption in Victoria is for low temperature heat, and the vast majority of consumers are homes and small businesses. We estimate at least 61% of total gas consumption is for low temperature heat (all of residential and small business consumption in the VGPR), but it is more likely well over 70% given that some portion of large commercial and industrial use should also be included.

To decarbonise low temperature heat, two main options have dominated discussion among engineers, economists, and policy experts: direct electrification, and green hydrogen. These pathways have dramatically different consequences for the gas network. In the direct electrification pathway, consumers gradually leave the gas network and it becomes too expensive to be supported by users that remain. In the green hydrogen pathway, the gas network lives on and is transformed to carry pure hydrogen. We believe this gives rise to the most important and controversial questions that the Roadmap must answer:

1. Which of the two options is best placed to reduce emissions at lowest cost to small consumers, over the next 20 to 30 years, taking a fair view of all costs and risks? Put another way, is it best to go all-electric or do we continue our current "dual-fuel" energy system but with hydrogen instead of natural gas?
2. If the answer to the above is direct electrification, what does this mean for the existing natural gas transmission and distribution networks?

Research has indicated that small users likely pay greater than 90% of gas network distribution costs, so the future commercial viability of the gas network hinges on how they decide to heat their homes and businesses. On the other hand, if the Roadmap and corresponding government policies support a sub-optimal path forward, these same consumers will be saddled with the costs and consequences for decades to come. Our view is that direct electrification is likely to be the best pathway forward - this is supported by whole-of-economy decarbonisation research and more recently by AEMO's scenarios and assumptions for the 2022 Integrated System Plan, where three out of six scenarios assume significant electrification of low temperature heat. If this is indeed the case, the Roadmap must not tiptoe around the elephant in the room but must instead address and plan for the decline of the natural gas network.

Any questions about our submission should be addressed to bright.sparksAU@gmail.com. We welcome any opportunities for further engagement and look forward to the release of the Roadmap later this year.

Kind regards

Bright Sparks

Summary of analysis

The following heatmap is our summarised assessment of the suitability and viability of the proposed pathways for each of the four major uses of natural gas. Green means we believe a particular pathway is highly suitable to a particular end-use application, yellow means we believe it has some potential, and red means we think the pathway is not worth considering for a particular end-use.

	Low temperature heat	High temperature heat	Electricity peaking generation	Chemical feedstock
Energy/process efficiency				
Electrification (with complementary policies)			Specifically the replacement of GPG with varying durations of storage	
Green hydrogen				
Biogas/biomethane				
Emerging tech (e.g. solar thermal)	Could be particularly valuable in regional areas and for resilience / self-sufficiency			

Timeline analysis

The following table presents our view on the focus each pathway deserves in the short, medium and long term.

Pathway	Application	Short term application	Medium term application	Long term application
Energy / Process Efficiency	Low temperature heat	Increasing efficiency of low temperature processes will always be beneficial.		
	High temperature heat	Increasing efficiency of high temperature processes will always be beneficial.		
	Electricity peaking generation	Increasing efficiency of existing GPG is beneficial but will have limited impact since these technologies are inherently unsuitable for a long-term transition to zero emissions.		
	Chemical feedstock	Increasing efficiency of feedstock utilisation is useful. However, alternative feedstocks should be sought wherever possible.		

Pathway	Application	Short term application	Medium term application	Long term application
Electrification (with complimentary policies)	Low temperature heat	Electrification is viable for low temperature heat right now and into the future, but care must be taken to ensure that any resulting increase in electricity demand is met by increasing zero-emissions supply. Given that a key driver of the Roadmap is the need to lower emissions, it is critical to ensure that electrification does not simply prop up coal generation.		
	High temperature heat	Electrify processes where possible, particularly on the lower end of high temperature heat. Focus on low hanging fruit (e.g. minimal upgrades to network infrastructure, with technology appropriate temperatures).	Adopt alternative technologies that are more suitable for challenging applications (e.g. very high temperature), but financial support may be required.	
	Electricity peaking generation	For short and medium durations, batteries are already economically feasible and are more flexible than GPG. For long durations, a variety of technologies exist including pumped hydro, long duration batteries (flow, iron-air, etc), compressed air, flywheels, etc. If the technology is unfamiliar then it is all the more important to pilot the technology early.		
	Chemical feedstock	Not applicable. Except for specific technologies (e.g. redox conversion of CO2 and water/hydrogen to methane) chemical feedstocks will not be replaceable by electricity.		

Pathway	Application	Short term application	Medium term application	Long term application
Green hydrogen	Low temperature heat	In the short term, focus on hydrogen blending into the gas network to limit infrastructure costs.	Pure hydrogen has potential for low grade heat applications, but direct electrification will likely be cheaper. For now, one pathway forward is to hedge bets by making sure natural gas appliances can be easily converted to use hydrogen (e.g. see UK policies for hydrogen ready appliances)	Hydrogen has potential for low grade heating in the long term, if the hydrogen supply chain becomes more mature.
	High temperature heat	Hydrogen has potential for high grade heat applications, but there is "lower hanging fruit" in the short and medium term such as biogas and electrification.		Hydrogen has potential for high grade heating in the long term, once the hydrogen supply chain is more mature. It can be useful for applications where electrification is challenging (e.g. very high temperature processes).
	Electricity peaking generation	Hydrogen may have some niche applications due to its high energy storage capacity (e.g. peaking for multiple days) but is likely to be out-competed by other storage options in terms of cost and efficiency.		
	Chemical feedstock	Where hydrogen derived from natural gas is used directly as a chemical feedstock, substituting with green hydrogen should be done as soon as possible. Where natural gas is being used as a chemical feedstock, in the medium to long term it may be possible to change the chemical process to use green hydrogen instead, particularly when it is the hydrogen in the methane that is of value to the chemical process.		

Pathway	Application	Short term application	Medium term application	Long term application
Biogas / biomethane	Low temperature heat	In the short term, blending biogas into the gas network is a reasonable way to reduce emissions.	In the long term it would be best reserved for the applications that need it most e.g. as a chemical feedstock. This is based on the assumption that biogas will mainly be produced from organic waste and therefore will be relatively scarce.	
	High temperature heat	In the short term, blending biogas into the gas network is a reasonable way to reduce emissions.	In the long term it would be best reserved for the applications that need it most e.g. as a chemical feedstock. This is based on the assumption that biogas will mainly be produced from organic waste and therefore will be relatively scarce.	
	Electricity peaking generation	In the short term, blending biogas into the gas network is a reasonable way to reduce emissions.	In the long term it would be best reserved for the applications that need it most e.g. as a chemical feedstock. Also, maintaining biogas fuelled peakers risks sunk cost.	
	Chemical feedstock	In the short term, blending biogas into the gas network is a reasonable way to reduce emissions and in the long term chemical feedstock is arguably the most critical application for biogas because of the lack of substitutes.		

A note on emerging technologies

We have excluded emerging technologies from the table above as we have a general view on emerging technologies that applies to all end-use applications. While emerging technologies deserve some early investment (e.g. R&D, pilot projects), we do not believe they can be relied on as a cornerstone of the Roadmap due to their uncertain nature.

We also make the following points regarding specific emerging technologies:

- Carbon Capture and Storage (CCS) - there is as yet no well-functioning large scale plant in Australia. So far, CCS has mainly served as a distraction to the important work that needs to be done in the energy transition, and we are concerned that the false promise of large-scale CCS is likely to be a net harm to any serious attempt to decarbonise natural gas.
- Concentrated solar thermal - we believe this could useful to provide high temperature heat, where land is available could possibly be installed behind the meter, but key barriers are low awareness and cost
- Pyrolysis of waste - has potential to replace fossil natural gas in chemical feedstock applications
- Geothermal - suitability of regional Victorian sites for geothermal deserves further investigation and research

Further pathway analysis

Pathway	Benefits	Risks	Opportunities	Barriers	Role for Victorian Government
Energy efficiency	• Lower costs for consumers, reduced CO2 emissions, higher quality of life with health outcomes	• Too slow of an uptake to meet emissions targets • Over-reliance on energy efficiency of natural gas appliances can lead to further sunk costs		• Cost, particularly for low income households	• Government should push for building standards in line with a clean energy transition • Government to reform current energy efficiency offerings
Electrification (with complementary policies)	• Economic benefits associated higher investment in renewable energy (coupled with reuse of materials could result in lower environmental damage from extraction) • Reducing CO2 emissions - clear pathway to decarbonising electricity • Reduce costs for consumers when replacing old gas appliances with efficient electric appliances • Provides additional demand and therefore confidence to	• Infrastructure blockades or delayed infrastructure upgrades • Cost overruns on renewable energy projects as a result of supply constraints and geopolitics • Possibility that additional demand leads to the marginal generation being brown coal	• Community owned renewable energy projects • Possibility to meet additional electricity load with behind-the-meter options e.g. household solar and storage, community batteries, etc. • Additional storage will help reduce issues related to intermittent generation	• Inadequate network capacity • Inadequate household connection capacity • Consumer preferences for gas appliances • Sunk costs of the gas network and supply chain, and associated lobbying from vested interests	• Government to continue to set firm targets for zero-emissions generation and address market failures

	renewable energy developers, making it easier to meet the VRET				
Pathway	Benefits	Risks	Opportunities	Barriers	Role for Victorian Government
(Green) Hydrogen	• Resiliency - diversifies the energy mix • Ability to act as flexible load and long-term storage for the electricity system • Possibility that the existing gas distribution network could be used to take pure hydrogen, thereby making use of sunk costs	• Green hydrogen is in early stages - may not scale in time to meet emissions targets • Very expensive in the short term, uncertain cost declines in the long term • Round-trip efficiency low compared to using renewable electricity directly	• Possibility for Victoria to use domestic expertise to scale an export industry. • Transition and retraining opportunity for existing oil and gas workforce	• Access to water • Lack of workforce with technical knowledge of handling hydrogen • Unlikely that the existing gas transmission network can take pure hydrogen with only minor modifications - will likely require an entire replacement of transmission assets	• Provide stable regulations and standards for the emerging hydrogen industry, and give green hydrogen opportunity and a level playing field to compete with direct electrification • Disallow or discourage domestic use of blue hydrogen i.e. hydrogen with CCS
Biogas / biomethane	• Produces methane that can be used for difficult -to-transition applications • Readily dispatchable as per international examples	• Low scalability • May be consumed heavily behind-the-meter and may not be available for external use.	• Currently heavily underutilised in Victoria • Can be used for odour management (e.g. wastewater treatment plants) • A suitable candidate for high-temperature heat and chemical feedstock applications	• Difficult to scale from waste only. Meeting large-scale heating demand would require new sources of biogas e.g. from virgin crops, which comes with a whole host of issues	

Key issue 1 - Maintaining electricity reliability with new sources of demand

What policies are needed to ensure that the electricity network can reliably serve new sources of demand from hydrogen production, electric vehicles and electrification of gas demand?

Hydrogen:

Hydrogen should only be generated with renewable energy which is not grid connected or during the expected electricity demand troughs where it can be confirmed that the marginal generator is zero-emissions i.e. curtailed renewables. This may mitigate some of the effects of increasing solar feed ins on the network. If hydrogen generators can be used to soak up excess distributed solar generation, then it can be a boon for the network.

Electric Vehicles:

As the current ICE vehicle fleet transitions into electric there will be increased demand especially overnight. There is potential for electric vehicles themselves to be used as short-term battery power when there are enough in circulation. Ensuring that local transformers are upgraded with a low voltage option to maintain a voltage differential between the grid and the solar inverter for efficient distribution of distributed energy sources.

Electrification of Gas Demand:

Electrifying gas consumption runs the risk of the additional electricity load supporting existing thermal generation such as coal and gas. This not only risks emissions increasing but could also provide financial support for existing coal generation and delay their retirement. Electrifying gas demand requires whole-of-system thinking and complementary policies to manage these risks. For example, we support the incentives to install battery storage for households that already have rooftop solar, thereby reducing the additional load on the grid. We would also support policy that provides certainty around the exit of thermal generation, including a least-cost reverse auction for coal plants, paired with policy that incentivises grid-scale renewables and storage e.g. a VRET expansion.

What is the role for gas-fired power generation and hydrogen in maintaining electricity reliability?

Currently peaking demand is met by gas fired power plants and diesel generators. These plants are only active for a small fraction of the year, and they provide an important service in maintaining reliability. It may be inefficient to replace these plants as they are only active when needed.

Going forward we should either legislate that those plants become carbon neutral by purchasing offset credits or legislate that they move to a zero-emissions fuel such as biomethane or hydrogen.

Key issue 2 - Transitioning to more sustainable gaseous fuels with minimal disruption to end-users

- **Hydrogen**
  - **Green hydrogen** has to be the priority as it produces low or zero emissions. At the moment, hydrogen is mainly used in thermochemical processes which produce large amounts of CO2 emissions.
  - **Green hydrogen through water** is a clean alternative. However, this technology requires a large amount of water (9L per 1kg of H2 produced). Victoria has strong alternatives for water resources including water recycling and waste water resources. Further, investing in this type of solution is required and this would be preferred as a long-term solution.
  - Blended hydrogen in the distribution networks is the short term solution. It has been identified that the addition of 10% blended hydrogen (by volume) into the domestic gas distribution networks has no significant implications on gas quality, safety and risk aspects, material and network capacity in Australia. Therefore, we believe that this is the short term solution which avoids the cost of building new infrastructure and reduces CO2 emissions. We recommend further investments on projects that seek high percentages of blended hydrogen in our gas networks.
  - **Transmission pipelines** have a risk of hydrogen embrittlement due to higher pressures and pipeline material. If the Roadmap recommends a hydrogen-dominated pathway, new infrastructure would be necessary and we recommend this as a long term approach once blended hydrogen technologies are more mature.
  - As part of the short term solution, we recommend that **downstream appliances** operate safely and reliably with the addition of hydrogen concentration in the gas networks.
  - We recommend developing further studies that assess **hydrogen as a feedstock** on a case to case basis for each industrial process which requires high temperature.
  - H2 and green ammonia demand is expected to increase in Asia. Australia is well positioned for **export**. Further investment in this field could boost the Australian economy.
- **Biogas / biomethane**
  - There are no technical issues associated with the injection of biomethane into the pipelines. It can be injected directly into the natural gas network. Therefore, this is a preferred short term solution.
  - There are no biomethane plants in Victoria at the moment. Further investment in this field is necessary.

Key issue 4 - Supporting Victoria's workforce, industry and the institutions that support them

- How to support workers in gas production and distribution industries:
    - We believe there will be plenty of jobs in the gas industry for existing workers for decades to come, no matter what path we take.
        - If we take a green hydrogen-dominated path, plenty of gas network assets will need replacing/upgrading to accommodate hydrogen, even in the distribution networks e.g. compressors, valves, etc.
        - If we take an electricity-dominated path, decommissioning the existing extensive gas network is a significant piece of work. This will take many years, likely one to two decades, to ensure it is done safely.
        - In either pathway, the upstream natural gas production industry will likely decline but there will be many years of work to decommission and seal offshore wells.
    - In addition to the above, re-training existing workers and creating new vocational education programs to train the next generation of future energy workers is essential.

- Ample opportunities exist in a renewable energy future. We need people for:
    - the roll out large-scale renewables and storage
    - the roll out small-scale renewables and storage
    - energy efficiency retrofits
    - replacing of natural gas appliances with alternative gas or electric appliances
    - If gas use is to be electrified, we need people who can install and maintain heat pumps for space and water heating. While these are established technologies in many regions of the world, their current lack of popularity in Victoria means there is likely a relative lack of trained fitters. This could pose a constraint on a rapid rollout of heat pumps.

- Support gas-reliant industry:
    - Polyethylene, ammonia, alumina and cement are the industries that traditionally use large volumes of natural gas, but our understanding is that these exist on a limited scale in Victoria. In other industries, gas is a small share of input costs (<1% according to Grattan Institute) and therefore not critical.
    - The best way to support industries that rely on natural gas is to help them use *less* e.g. via energy efficiency measures. For those that use natural gas as a feedstock, the Victorian government can support by contributing funding to the research and development of novel processes that use a gas alternative e.g. hydrogen as a feedstock, biomass for polyethylene manufacture, etc. For gas users that primarily rely on gas for energy, support can be provided via a combination of better information (to help make better energy choices) and low-interest loans to finance asset replacement e.g. to replace gas boilers with heat pumps.

Key issue 5 - Managing uncertainty in the transition

- The Consultation Paper makes it clear that the Victorian government is keen to leave all options open. However, providing a level of certainty to businesses and residential consumers is key to a smooth transition away from natural gas. The infrastructure, machines and appliances that may need to be replaced are generally long-lived assets, so the people making the decisions about replacement need a level of certainty to enable them to invest.
- Currently, we agree that it is appropriate to make only no-regret or low-regret decisions as we are at the beginning of the journey away from natural gas. However, as more information is gathered and feasible paths forward begin to crystallise, attempting to make *only* zero-regret decisions or attempting to leave all options open at all times will itself be regretful because of the impact of uncertainty on businesses and consumers.

Key issue 6 - Transitioning the Victorian economy efficiently and equitably

- The gas transition, like many aspects of the clean energy transition, risks perpetuating economic and social inequalities already present for consumers in the energy sector. Vulnerable and low income households and consumers already face disproportionate burdens to manage energy bill pressure and are often priced out of new technologies, retrofits or upgrades that can contribute to reducing bill pressure.
- We recommend the Victorian government adopt key principles of equity when making decisions to adopt new technologies and incentivise the roll-out and uptake of such technologies. Key principles could include:
    - targeted consultation with peak bodies and community groups that represent vulnerable and low income consumers
    - develop programs and policies in a way that is consumer-centred
    - work in partnership and participation with existing organisations and community groups
    - just transition for all participants in the energy sector
    - using energy to promote equity rather than structurally perpetuate inequalities
- As an example, the Australian Energy Council recently adopted 'a statement of objectives and principles' for best practice energy retail customer assistance, in particular in response to COVID-19. AEC principles include:
    - focusing on positive long-term outcomes that will benefit the customer
    - partnerships with networks and other service providers, that enable delivery of positive customer outcomes
    - innovation as a pathway to improved outcomes.
- Consumer groups at greatest risk of inequitable outcomes from the gas transition include:
    - First Nations individuals and communities
    - migrants and non-English speaking individuals and communities
    - low socio-economic groups
    - renters
    - consumers in regional areas, particularly those in any of the groups above.
- Policies and programs should be developed in consideration of the particular needs, access barriers and enablers and energy practices of each of the consumer groups (and others) described above.
- From a socio-economic perspective, there is a risk that the technology transition may exclude low socio-economic consumers and perpetuate energy access issues. For example, consumers on higher incomes and who own their own homes (typically people who can afford to buy new appliances and can control the purchase) will move away from gas or towards electrification first, leaving those on lower incomes and renters to pay for the gas network infrastructure and unable to afford 'early adoption' of these new technologies. This has happened in the roll-out of rooftop solar across the east coast of Australia.

- NSW has implemented several successful and targeted energy programs for low income consumers. For example, appliance replacement schemes, energy bill rebates and the Empowering Homes initiative, which provides an interest free loan for a solar and battery system or battery retrofit. We do not consider energy bill rebates to be the most cost-effective policy, but reducing bill pressure is a necessary piece of the energy transition. We encourage programs that deliver enduring outcomes and support access to new technologies that are low emissions, save money and energy for consumers and allow all consumers to participate in the energy transition.
- In developing and implementing the pathways proposed under the Consultation Paper, we recommend that the Victorian government focus on the following objectives from an efficiency and equity perspective:
    - developing programs and policies in a way that is inclusive, collaborative and puts consumer needs at the centre, in line with industry best practice, in particular vulnerable and low income groups;
    - reducing rather than exacerbating existing bill costs and pressure for consumers;
    - targeting programs for vulnerable and low income consumers to reduce upfront costs of adopting new technologies; and
    - promoting access to emissions reduction and clean energy opportunities for all consumers and not locking in older, more polluting and expensive technologies to vulnerable and low income groups.