

Submission

Victoria's Renewable Gas Consultation Paper

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Victoria's Renewable Gas Consultation Paper

Introduction

Gas Energy Australia (GEA) welcomes the opportunity to provide a submission on Victoria's Renewable Gas Consultation Paper.

We recognise the limited scope of the consultation, confined to green Hydrogen and Biomethane, noting the Consultation Paper makes it clear the Victorian Government sees no scope for these renewable gases to play a part in residential or commercial settings, rather they appear to be limited to hard-to-abate industrial uses.

GEA is encouraged by our discussions with the Victorian Government – at both ministerial and departmental levels – noting that LPG is different and, therefore, is not in scope for this consultation, with specific regard to the positive role renewable alternatives to LPG can play in residential, commercial, industrial (including agriculture) and recreational settings.

As such, we have been invited by the Department of Energy, Environment and Climate Action to provide this submission to articulate the opportunities for those renewable gases that can, and should, be considered as part of Victoria's future renewable energy mix across all settings.

As detailed in this submission, net zero bioLPG will be available in Australia from as soon as 2025-26. As a by-product of biodiesel and sustainable aviation fuel production using the hydrotreated vegetable oil process, it has the capacity to initially displace 11% of conventional LPG demand almost immediately, seeing up to 160,000 tonnes of CO₂-e abated per year.

The exponential growth of this sector has the potential to replace all conventional LPG, which would abate up to 1.5 million tonnes of CO₂-e each year.

However, the advent of renewable synthetic LPG (rLPG), derived from green Hydrogen and CO₂ from the atmosphere, is an actual zero emitting gas. The only CO₂ expelled when it is burned is what was captured when it was made – meaning it has a zero impact on the environment and, as such, requires no offsets. It is expected rLPG will be available in Australia from the mid-2030s.

The modelling detailed in this submission shows that by 2045, only bioLPG and rLPG are in use in Australia. That is, all conventional LPG will have been replaced. And, that by 2050, actual zero rLPG replaces all LPG uses.

A great benefit of bioLPG and rLPG is they are simple 'drop in' replacements for conventional LPG, requiring no additional capital costs as the same cylinders, pipes and appliances/equipment can be used seamlessly.

Further, the availability through the transition of renewable DiMethyl Ether (rDME) is another fillip for the energy sector, in that it can be blended up to 20% capacity with LPG, bioLPG and/or rLPG. This blend requires no change equipment or appliances, providing even greater flexibility and reliability in renewable gas supply.

LPG is already relied on by 356,667 Victorian households for in-home cooking, hot water and heating. This footprint has been growing year-on-year since 2008.

The ability for these homes to remain on the gas they know and trust, while transitioning to net zero bioLPG over the same timeframe as set for electrification and actual zero rLPG

come the mid-2030s, means Victorian families and businesses can choose a renewable energy that suits them.

LPG's transition meets the Consultation Paper's stated objectives, in that, it:

1. Complements the Victorian Government's stated goals of affordable, reliable and decarbonising energy.
2. Saves families and businesses tens of thousands of dollars each in expensive new appliances/equipment, refits, premise rewiring and repair work to cope with the new electrical supply. The costs can run to some \$50,000 per premise. In some cases higher.
3. Means 356,667 Victorian LPG homes need not move onto electricity. With bioLPG and rLPG servicing them, and a growing number of Victorian households and businesses that choose LPG, this relieves pressure on the electricity grid while achieving not only net zero energy in the short-term, but actual zero energy.

LPG's unique opportunities to decarbonise should be seized upon.

The trajectory for the LPG sector is that, by 2050, all conventional LPG supply in Australia will be replaced with rLPG.

Based on current national LPG demand that equates to the removal of over 1.94 million tonnes of CO₂-e from the atmosphere each year, all while continuing to use a renewable gas(rLPG) that is cost-effective, reliable, relatively easy to transition and can be an important complement to electrification.

To be clear, by 2050, the LPG industry will have fully abated its current fuel emissions of (32PJ's [32×10^6 60.6kgCO₂e/GJ*] 1.94 million tonnes CO₂-e per year.

LPG stands to not only continue in its current uses – including in over 2 million Australian households for in-home cooking heating and hot water, as well as some 130,000 commercial and industrial businesses – but to significantly increase this footprint as a renewable, flexible and reliable energy source.

The key opportunities for these renewable gases to assist in decarbonising include:

- Transitioning to replace conventional LPG use with net zero bioLPG, sourced as a by-product from domestic biodiesel and sustainable aviation fuel production, from 2025-26.
- Transitioning to phase-in renewable, actual zero synthetic LPG by the mid-2030s.
- Replacing all conventional LPG use with bioLPG and rLPG by 2045, and solely rLPG by 2050.
- Throughout this transition, replacing many uses of natural gas, including residential, commercial and industrial (including agriculture) with renewable and actual zero synthetic LPG.
- Replacing many uses of diesel, especially in regional and/or agricultural settings, with renewable and actual zero synthetic LPG.
 - Importantly, this includes maritime fuels, where LPG's transition to bioLPG and rLPG is seeing increasing uptake as a fuel, both overseas and in Australia. Australia's most recent ship purchases include three vessels that run on LPG. In displacing diesel, emissions are reduced by 25% immediately (100% when rLPG is used), is safer for the marine environment in event of

shipping incidents and presents a sovereign benefit by delivering domestic fuel security.

The policy framework to enable this transition is critical. The need to recognise LPG's transition, beginning from 2025-26 via net zero bioLPG, and continuing the transition in the mid-2030s via actual zero renewable LPG, is essential.

Firstly, governments should move to give the industry confidence to invest in these new technologies and, secondly, to ensure Australia is ready to reap the benefits of the transition as soon as bioLPG becomes available from 2025-26.

About GEA

GEA is the national peak body representing the downstream gas fuels industry, encompassing Liquefied Petroleum Gas (LPG) and associated gases – including a raft of new renewable gases such as bioLPG, synthetic renewable LPG (rLPG) and renewable Dimethyl Ether (rDME). The industry comprises major companies, medium and small businesses across the gas fuels supply chain including producers, refiners, fuel marketers, equipment manufacturers, gas transporters, consultants and service providers.

Having engaged directly with the Australian Government Department of Industry, Science and Resources, Department Climate Change and Energy, relevant Ministers and Shadow Ministers, as well as state and territory governments, GEA has provided seminal research undertaken by Frontier Economics on LPG's path to zero emissions.

This research has identified no fewer than eight pathways for LPG to decarbonise that are clear, commercially-viable and relatively easy. This enables LPG to assume a unique position within the gas sector and, indeed, in comparison to many sectors.

LPG supply can begin this transition as soon as 2025-26, offering governments another important string in their bow to deliver on 2030 targets and beyond. We see these developments as complementary to government objectives in shifting to renewable energy, while offering customers diversity in choosing the zero energy sources that best suit their needs.

As a distributed fuel, LPG is vitally important in regional areas and, therefore, the renewable gas alternatives detailed in this submission assume greater significance for regional and remote communities heavily reliant on distributed energy. In many instances electrification is not an option in these settings.

Importantly, we have made it clear to all governments – and do so again here – that the LPG sector is not seeking any government funding. That is, we require no subsidies, seed or project funding or the like to facilitate the transition.

We simply seek a level playing field. That is, recognition and inclusion of bioLPG, rLPG and rDME technologies in the array of government considerations, programs and mechanisms so homeowners and businesses can choose the path to zero best for them.

Pleasingly, work towards this recognition is underway with several state government departments. The NSW Office of Energy and Climate Change advises that it is developing Stage 2 of the Renewable Gas Certification Pilot Rules and that the updated pilot in 2024 will include bioLPG, rLPG and rDME.

Victoria's Gas Substitution Roadmap Phase 2. GEA has been, and remains, directly and positively engaged in this process. We have taken heart from the Victorian Government's

assurances that the announced ban on natural gas connections in new residential sites does not apply to LPG.

Given LPG's demonstrable path to decarbonisation, LPG was expressly exempted from the ban. We see this as a positive development, recognising LPG's unique proposition and applicability for homes, commercial and industrial businesses (including farms), as well as recreational uses.

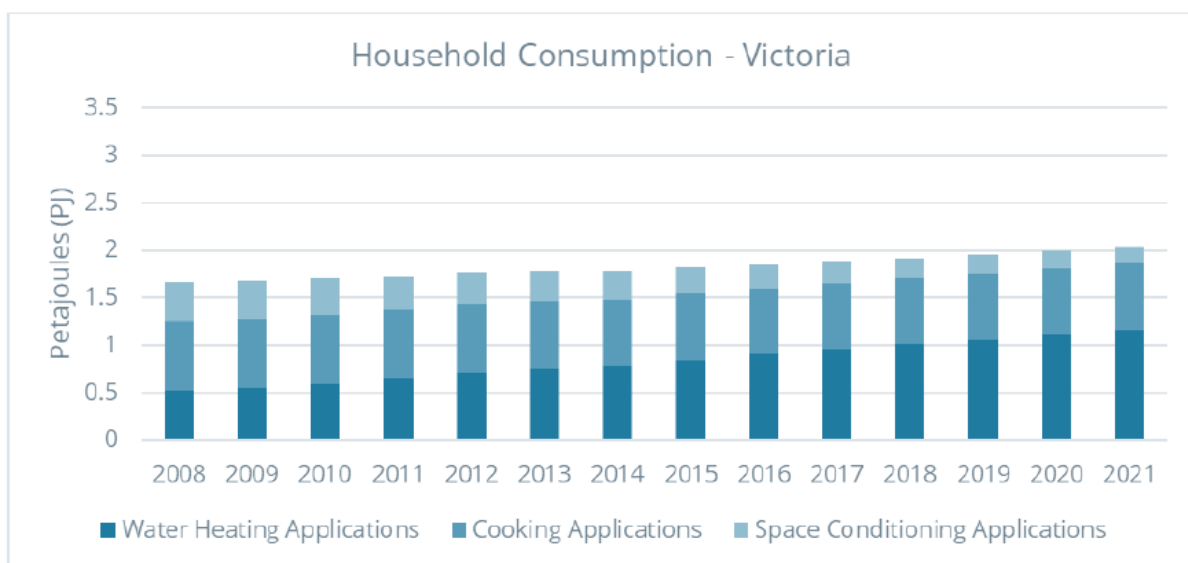
GEA engaged in the development of Tasmania's Future Gas Strategy, with the draft recognising the important role and contribution LPG plays in that state with LPG having a higher presence than natural gas.

LPG Use in Victoria

To appreciate the opportunities bioLPG, rLPG and rDME provide to homeowners, businesses and governments, it is important to understand how LPG is used in Victoria today.

LPG use is, perhaps, more prevalent than many think. ABS data shows that almost 321,000 Victorian homes used LPG for in-home uses (that is, indoor cooking, hot water and space heating) in 2014. This was the last time ABS reported the data.

However, as the Table from the Department of Industry, Science, Energy and Resources 2021 Residential Baseline Study below shows, demand for in-home uses of LPG has consistently grown year-on-year in Victoria – up from 1.8PJ in 2014 to 2PJ in 2021.



Source: Frontier Economics analysis of the Department of Industry, Science, Energy and Resources 2021 Residential Baseline Study.

Based on this growth, in 2021 356,667 Victorian households (more than 2 million nationally) use LPG for in-home cooking hot water and heating.

LPG is, typically, relied on due to the absence of mains natural gas and/or electrification not being applicable to needs. Further applications include:

- Commercial: space heating, water heating, commercial kitchens (restaurants, cafes, clubs, fish and chip shops), hospitals, schools, catering vans, and increasingly as shipping fuel.

- Industrial: process heat for manufacturing (ovens, furnaces) for metal processing, as well as feedstock (glass, plastic, metals, fertilisers, pharmaceuticals, to list just a few).
- Agricultural: power equipment (i.e. water pumps) and heating (crop drying, animal rearing, greenhouse heating).
- Recreational: 6 million BBQs, 72,000 campervans, 669,400 caravans, as well as camping equipment, boating, outdoor heating and hot-air ballooning.

In all, there are more than 20 million LPG cylinders in circulation across Australia, servicing these sectors every day.

All can easily be changed to bioLPG and/or rLPG as 'drop in' replacements for conventional LPG. That means no extra capital costs to homeowners, businesses or anyone using it. Existing cylinders, pipes and appliances require no changes.

Similarly, rDME can be blended with LPG, bioLPG or rLPG up to 20% of capacity without any changes to equipment, providing another element of renewable flexibility.

LPG in the Australian Economy

Australia produced 6,234 million litres of naturally occurring LPG and 335 million litres of refinery-produced LPG in 2021-22. In the same year, Australia exported 2,577 million litres and imported 760 million litres of LPG.

Import and export terminals around the Australian coast support LPG trade into and out of Australia. Australia exported 80 PJ of LPG in 2021-22. The location of major LPG export facilities in Australia includes Westernport (Victoria), Port Bonython (South Australia), and Kwinana and Dampier (Western Australia). These facilities can handle Very Large Gas Carriers typically used for the international shipping of LPG.

While Australia produces more LPG than it can currently use, around 34 PJ of LPG was imported into Australia in 2021-22, mainly through an import facility at Port Botany in New South Wales.

With Australia being a net exporter and producing enough LPG to be self-sufficient, these imports occur due to the commercial costs associated with freighting LPG internally. In short, it is cheaper to import LPG than transport it across Australia.

LPG use by industry was 55 PJ in 2021-22. There are multiple uses for LPG in Australia, with traditional use the most prevalent, comprising residential (water heating, space heating and cooking), recreational, commercial (e.g. commercial kitchens, forklifts) and industrial uses (e.g. steam-raising, kiln firing and food processing).

LPG for the traditional market is mainly propane to meet domestic and industrial heating specifications.

It is also a growing part of the national economy. As reported in ACIL Allen's *Economic Contribution of the Australian Gas Economy 2021-22*, LPG drove over \$5 billion in domestic economic activity (up from \$3.6 billion the previous year), while supporting 20,516 Australian jobs (up from 16,154 a year earlier).

Examples for LPG to Achieve Net Zero & Actual Zero Emissions

BioLPG:

- Derived from plant and vegetable waste.
- Identical to LPG. A simple 'drop in' replacement.
- Same storage, transport infrastructure and appliances. No change. No additional capital costs.
- Net zero as an 80% renewable gas.
- Potential to be actual zero as related sectors (i.e. transport) reduce their emissions.

rLPG:

- Synthetically produced from green hydrogen and CO₂ taken from the atmosphere.
- Identical to LPG. A simple 'drop in' replacement.
- Same storage, transport infrastructure and appliances. No change. No additional capital costs.
- Is an actual zero gas – that is, the only CO₂ expended in its use is what was captured in its creation. No offsets are required.

rDME:

- Derived from methanol.
- Chemically similar to LPG (propane and butane).
- Can be blended with rLPG up to 20% with no change to appliances.
- It can fully replace LPG, however, would require minor changes to existing appliances.
- Derived from gasification and catalytic synthesis or electrolysis (i.e. green H₂) and catalytic synthesis.
- As described above, it is net zero, but can be actual zero as related sectors (i.e. transport) reduce their emissions.

Timeline for Transition

Internationally, the transition is already underway.

Case Study 1: BioLPG Consumption - Europe

Europe is by far the largest consumer of HVO in the world presently and it is forecast that demand for HVO will only continue to grow throughout the 2020s. A high proportion of demand is driven by the transport sector, with bioLPG being made available at petrol stations and bioLPG vehicles operating in a number of jurisdictions.

BioLPG is also increasingly being made available for purchase in cylinders for a range of off-grid leisure activities as well as industrial heating. In partnership with SHV Energy, Circle K in Sweden since mid-2020 has provided 100% bioLPG cylinders across all its stores.

Rural and regional homes and hospitality venues across the UK and Ireland are also increasingly adopting bioLPG for use in their kitchens as well as for water heating and space conditioning functions. Examples include Montalto Estate and BrookLodge & Macreddin Village in Ireland.

BioLPG has also emerged as an important energy source in the industrial sector. For example, La-Roche-Posay in France became the first industrial site in France to use bio-LPG in 2018. Since 2019, the facility now emits no greenhouse gas emissions, with the switch to bioLPG representing the last step towards carbon neutrality.

Source: Frontier Economics, Pathway to Zero Emissions for LPG, 2023.

Further, the emergence of Biodiesel and Sustainable Aviation Fuel (SAF) are growing internationally.

Sustainable Aviation Fuel & BioLPG in Australia

BioLPG is a by-product of Biodiesel and SAF production using the Hydrotreated Vegetable Oil (HVO) production method. This by-product represents 10% of total Biodiesel/SAF production. This represents the low-hanging fruit, in that, these will be major new industries for Australia and the by-product of bioLPG a clear opportunity for Australia to responsibly capitalise on.

As the CSIRO's *Sustainable Aviation Fuel Roadmap* (August 2023) makes clear, there is currently enough feedstock in Australia to supply approximately 5 billion litres of SAF production every year. This task, according to the CSIRO, would ultimately be shared among some 30 production facilities around the country.

While Australia is late to the opportunities SAF provides, there has been a 33,000% increase in exports of Australian used-cooking oil over the last two years to service international SAF producers.

It is estimated that Australian airlines will need around 6 billion litres of SAF each year, while the local companies developing SAF will also be eyeing expansion into export markets. While the HVO process will not be the only means to produce SAF, Australia boasts ample feedstock that can be drawn upon, meaning there will be a lot of Australian-produced bioLPG over coming years.

Technologies for LPG to Decarbonise

The modelling undertaken by Fronter Economics in *Pathway to Zero Emissions for LPG* (January 2023), details eight distinct paths for the LPG sector to decarbonise, charting a clear, commercially-viable and relatively easy transition to net zero renewable gas (over the short-term) and actual zero renewable gas (from the mid-2030s).

The technologies to achieve these outcomes are clear.

1. Hydrotreating. Converts vegetable oils (seeds and waste) to biodiesel, SAF and other hydrocarbons by combining them with H₂. This process produces BioLPG as a by-product up to 10% of production volumes. A ready-made First-Generation replacement for cLPG.
2. Gasification and Fischer-Tropsch: Synthetic gas from H₂ and organic carbon through a thermochemical process, converting syngas into liquid hydrocarbons – all from municipal waste, sewage, food waste, crop residues, waste water, straw and manure. This would typically be used for biodiesel and SAF – with up to 10% of output producing rLPG as the by-product.
3. Gasification with Methanation: Similar to gasification with F-T above, rLPG is produced from the production of syngas, sourced from bioenergy feedstock, for a liquid fuel. Methanation involves the reaction of H₂ and carbon dioxide in syngas at high heat and pressure to produce water and hydrocarbons. Sourced from a range of waste streams, sewage, agricultural/municipal waste, food waste, crop residues, waste water, straw and manure.
4. Oligomerisation: Converting methane into hydrocarbons to produce BioLPG.

5. Digestion: Using the digestion of organic matter to produce biogas. Then apply the FT process to produce hydrocarbons to produce rLPG (propane and butane). Sourced from a range of waste streams, sewage, agricultural/municipal waste, food waste, crop residues, waste water, straw and manure.
6. Pyrolysis: Similar to gasification, but at lower heats to produce bio-oil (not syngas). Hydrotreating the bio-oil produces liquid fuels, including bioLPG. Again, sourced from a range of waste streams, agricultural/municipal waste, food waste, crop residues, waste water, straw and manure.
7. Fermentation: Involves microorganisms fermenting sugars to produce bio-based isobutene, to produce a component of rLPG. Using sugars and starch from cellulose.
8. Power-to-X: producing green H₂ using renewable power, then synthesizing the H₂ with carbon dioxide (for instance using the F-T process) to produce liquid hydrocarbons, including rLPG. Sourced from renewable electrolysis (H₂ from H₂O) and CO₂ capture.

rDME Development

- Derived from methanol. Produced from a wide range of bioenergy and renewable feedstock – human and agricultural wastes.
- Chemically similar to propane and butane – same storage and transport infrastructure.
- Can be blended up to 20% of LPG, bioLPG or rLPG with no change to appliances or equipment. At more than 20% some minor modification to appliances required, i.e. change jets.

The assumed pathways to produce rDME include:

1. Gasification and catalytic synthesis: DME produced from syngas via two steps: methanol synthesis from syngas via hydrogenation and the water-gas shift, followed by the dehydration of methanol to produce DME. rDME is produced when syngas comes from bioenergy feedstock.
2. Electrolysis and catalytic synthesis: Similar to the above, except methanol is produced from carbon dioxide and green H₂ powered by renewable energy to produce rDME.

Both pathways have the potential to produce rDME with zero emissions. rDME has been commercially available in the US since 2021 and retailers since 2022.

Case Study 2: rDME in the United States

A world-first project, from mid-2021 Oberon Fuels began producing rDME in California. RDME is now commercially available for consumption in the United States, with retailers such as Suburban Propane making rDME available to consumers since 2022.

Source: Frontier Economics, Pathway to Zero Emissions for LPG, 2023

LPG Path to Zero

Based on these technologies, there are many combinations for the LPG sector to pursue and achieve zero emissions.

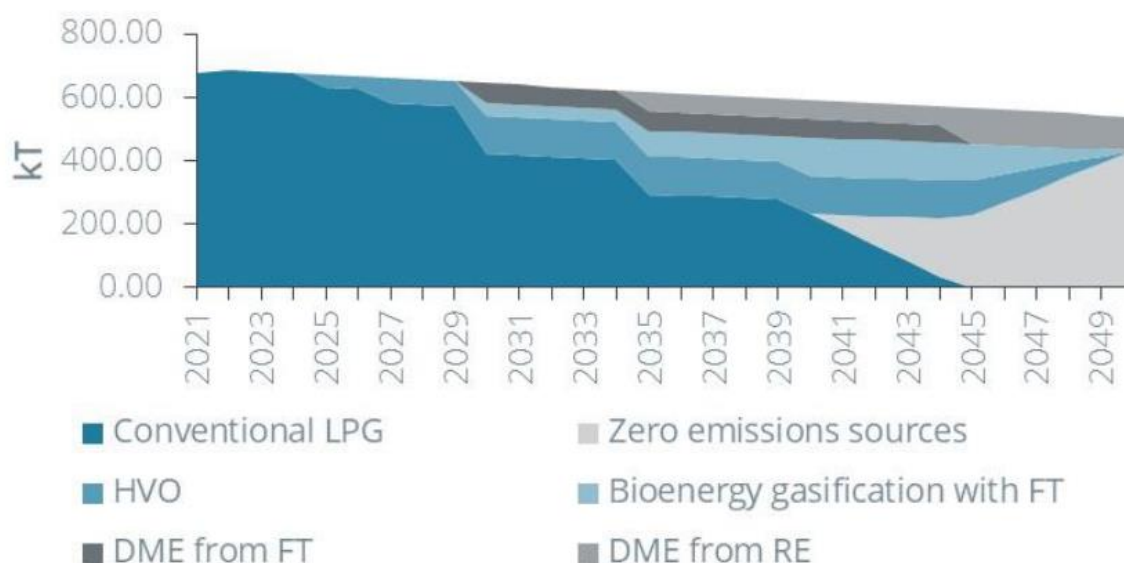
Typically, to achieve net zero energy requires offsets. However, these technology pathways show how LPG, as a closed loop process, can be actual zero. That is, capturing the same CO₂ in its production that is expended when it is used – meaning no offsets are needed.

The Frontier Economics modelling charts one credible path, comprising of:

1. BioLPG produced as a by-product of biodiesel or SAF through the hydrotreated vegetable oil (HVO) process – from 2025-26.
2. BioLPG produced as by-product of biodiesel or SAF through gasification with the Fischer-Tropsch process – by 2030.
3. rDME produced from biomass blended – by 2030.
4. rDME produced from renewable energy blended – by 2035.
5. rLPG produced through a Power-to-Liquids pathway – by 2035.
6. LPG phased-out and replaced by bioLPG and rLPG – by 2045.
7. Only rLPG in market by 2050.

The assumed transition pathway is illustrated in **Figure 1** below.

Figure 1: LPG transition pathway



Source: Frontier Economics, *Pathway to Zero Emissions for LPG*, January 2023.

First Cab of the Rank – Biodiesel/SAF from HVO:

Case Study 3: European HVO Production

As of 2021, pure HVO is available in nine European countries: Belgium, Denmark, Finland, Estonia, Latvia, Lithuania, the Netherlands, Norway and Sweden. For off-road purposes it is also available in Germany, the UK and Switzerland.

In 2019, approximately 1.9 million tonnes of HVO was consumed across Europe where the biggest consumers were France, Norway, Spain and Sweden.

Standalone HVO production capacity is presently around 3.5 million tonnes across Europe, with new production plants and capacities proposed and forecast, this figure is expected to rise. The Netherlands currently has the largest HVO production plant (Neste, Rotterdam) with new production plants also proposed in the coming years in France, Italy, Sweden and Finland.

Co-processed HVO is also prevalent across the continent with a current production capacity of around 1.8 million tonnes (the majority of which is concentrated in Spain).

Source: Frontier Economics, Pathway to Zero Emissions for LPG, 2023.

In Australia, it is expected that bioLPG from the HVO process will come as a by-product of production of biodiesel and/or SAF, as is the case globally. Production and use of Biodiesel and SAF are likely to increase as part of the transition to net zero as transport industries seek to lower their emissions.

At the time of the release of the Frontier Economics modelling, there were three sizeable Biodiesel and SAF projects in the planning for Australia, including:

- **Sherdar Australia Bio Refinery (Qld):** Sherdar Australia is currently proposing to develop Australia's first biodiesel refinery and storage plant. There is currently no location for the project, however the proposal would cost \$600 million, and the site would be able to produce 500,000 tonnes per year of biodiesel and SAF upon completion. Proposed feedstocks for production at the site include animal fats, seed oil and waste greases.¹
- **BP renewable fuel and green hydrogen project (WA):** BP is currently proposing to establish a renewable fuel and green hydrogen site in the Kwinana industrial site in Western Australia. The project would involve repurposing a fuel import site to produce 8,000-10,000 barrels of biodiesel and SAF per day from products such as waste oil, tallow and used cooking oil.²
- **Oceania Biofuels Project, Gladstone (QLD):** Gladstone, Queensland was selected as the site in April 2022 for a \$500 million biodiesel and SAF refinery. The project proposes to use locally sourced tallow, canola and used cooking oil to produce 350 million litres of SAF and biodiesel per year. Construction is planned to begin in 2023 and operations by 2025³.

Under this assumed transition pathway, bioLPG from HVO becomes available from 2025-26, bioLPG from gasification with FT and rDME from biomass from 2030, rDME from green hydrogen and rLPG from Power-to-Liquids (or synthetic rLPG) by the mid-2030s.

The supply of conventional LPG is steadily phased-out in favour of these net zero and, ultimately, actual zero emission alternatives. All conventional LPG supply is phased-out entirely by 2045. By 2050, zero emission sources are the only sources of supply still in the market.

¹ Brelsford, *Plans launched for Australia's first renewable diesel, storage complex*, Oil & Gas Journal, 2021.

² Lewis, *BP targeting renewable fuels and green hydrogen future for former Australian refinery*, Upstream Energy Explained, 2022.

³ Oceania Biofuels, *Our Australian Project*, 2022, <https://oceaniabiofuels.com.au/port-of-gladstone/>

Since the release of the Frontier Economics modelling in January 2023, additional biodiesel and SAF projects have been announced for Australia. Notably, in March 2023, GEA Member AMPOL entered into a Memorandum of Understanding with ENEOS to explore the production of advanced biofuels at the Lytton refinery in Brisbane.

In March 2023, Qantas, Airbus and the Queensland Government announced they will contribute to a \$6 million feasibility study to explore the creation of a \$400 million ethanol-based sustainable aviation fuel plant in north Queensland.

The CSIRO's *Sustainable Aviation Fuel Roadmap* (August 2023) forecasts capacity for 30 SAF plants across Australia, drawing on available feedstock, to produce 5 billion litres of SAF each year.

Clearly, the transition to SAF in Australia is in its infancy, however, the reality is it will grow to be major new domestic industry. Even based on the initial production runs of the Sherdar, BP and Oceania projects alone, these will produce 134,880,000 litres of bioLPG a year.

To put this production into perspective, if sold into the LPG market this net zero bioLPG would replace 11% of current LPG demand in Australia virtually overnight. This would represent immediate carbon abatement of up to 160,000 tonnes of CO₂-e per year from 2025-26, growing in line with production. This would increase as export markets for biodiesel and SAF are developed.

If this production grew to see bioLPG replace all conventional LPG, the abatement would be up to 1.5 million tonnes CO₂-e each year.

Again, as renewable actual zero rLPG replaces all LPG use, the abatement achieved is 1.94 million tonnes CO₂-e per year. Providing flexibility to families, businesses and governments, while alleviating pressure on the electricity grid.

Residential LPG Modelling

Case Study 4: Victorian Homes

At present, 356,667 homes use LPG for in-home use (cooking, hot water and heating). The modelling below assumes a 50% premium in the wholesale cost for rLPG.

Here the Frontier Economics modelling looks at the relative cost and emissions profiles comparing those replacing their LPG appliances with high-efficiency electrical appliances or cheaper, less efficient electrical appliances.

Switching to High-Efficiency Electric Appliances: Considering energy bills and appliance costs, continuing to use LPG appliances remains lower cost for the representative household, Swan Hill in Victoria, until the 2040s, when using LPG appliances and using electrical appliances are very similar in cost.

This scenario shows total emissions are marginally lower if using high-efficiency electrical appliances.

- Result: The household would incur \$11,871 in upfront costs, save \$718.33 on annual bills and reduce emissions by 467kg per year (or 9kg per week – equivalent to a typical BBQ cylinder).

This means, if homeowners are prepared to pay for all high-efficiency electrical appliances in their home, it would take more than 12 years to get a return on investment for a relatively small reduction in their CO2 output.

Given switching to these electrical appliances only reduces emissions by 9kg a week, the price of carbon abatement is \$282.65 per tonne, which is 8-times higher than the current average price per tonne of buying Australian carbon credit units at \$36.75.

It makes for very expensive and inefficient carbon abatement.

Switching to Cheaper, Less Efficient Electric Appliances: Emissions are lower if the customer sticks with using LPG appliances.

- Result: The household would incur \$6,520 in upfront costs, save \$212.19 on annual bills, while increasing their emissions by a substantial 960kg per year.

In this scenario, emissions from LPG appliances are significantly lower, which means switching to electrical appliances actually increases emissions.

These scenarios dispel the notion that electricity is, by default, cheaper and lower emitting than LPG.

The timeline covers the coming decade. However, with the emergence of actual zero emissions technologies for rLPG users replacing LPG by the mid-2030s, gas can be lower emitting than electricity. That is, not requiring offsets.

In both scenarios, the cost of switching to electrical appliances does not include the costs of likely power supply upgrades (from Phase 1 to Phase 3 wiring), which, depending on appliances and dwelling size can take total outlays up to \$42,000 per premise. This was previously modelled by Frontier Economics 'Cost of switching from gas to electric appliances in the home', released in 2022.

Indeed, on the back of GEA's widespread media coverage for these issues, we have been contacted by several Victorian homeowners advising they have received quotes on switching to electricity and told: "not to expect change out of \$50,000".

Commercial Modelling

Case Study 5: Commercial Applications

Here the Frontier Economics modelling looks at the ability for commercial enterprises to achieve actual zero emissions without replacing their LPG equipment/appliances.

1. Tomato Growers

Approximately 340,000 tonnes of tomato were produced in Australia in the 2020/21 financial year. Of these 340,000 tonnes, roughly 30% of this was grown undercover. That is, 30% of production was in greenhouses or artificially space conditioned structures. Part of the appeal of greenhouse cultivation of tomato is that it is, approximately, 4-times more productive than outdoor cultivation.

As well as sunlight, water and nutrients, optimal tomato growing also requires the right temperature and a supply of carbon dioxide to provide the optimal carbon dioxide levels inside the greenhouse.

Greenhouses for growing tomatoes are often located in regional and rural areas away from natural gas networks, and so rely on LPG for both heating and the supply of carbon dioxide. LPG is a preferred input for tomato growers because the boiler can be used to produce carbon dioxide, so that carbon dioxide does not need to be purchased from a third party.

Diesel boilers cannot be used to produce carbon dioxide for toxicity reasons. LPG is also a preferred input for tomato growers as a result of the lower cost of LPG compared to liquid fuels.

A typical commercial greenhouse growing tomatoes consumes 1,000 tonnes of LPG per year – 1,000 tonnes of LPG is equivalent to 47,519 GJ of energy.

Under the case with conventional LPG with no transition, this annual consumption of LPG results in approximately 3,364 tonnes of CO₂e per year. Extrapolated out over the modelling period and assuming constant consumption, this results in emissions of 3,364 tonnes of CO₂e per year every year over the modelling period.

With respect to the emissions under the LPG transition pathway case, emissions are also initially 3,364 tonnes of CO₂e per year. However, as low and zero emissions sources of LPG are integrated into the supply mix, the emissions intensity and consequently total emissions from LPG consumption for the tomato grower begin to decline.

By 2050, estimated emissions from LPG consumption for the tomato grower are zero, consistent with the transition scenario detailed in this submission, in which zero emissions sources are the only sources of supply in the market by 2050.

In the assumed transition path, these zero emissions sources are rDME produced from renewable energy blended with rLPG produced through a Power-to-Liquids pathway.

Figure 1 shows the relative emissions per year from LPG consumption for the tomato grower under the respective scenarios modelled.

Figure 1: Tomato grower – emissions per year (CO₂e)



Source: Frontier Economics, Pathway to Zero Emissions for LPG, 2023 – Commercial Case Studies.

Tomatoes are not the only agricultural good produced in Australia in greenhouses. Other popular, widely produced goods include cucumbers, leaved greens, mushrooms and capsicums.

Given LPG is a popular source of energy for greenhouse cultivation of these agricultural products, a feasible transition path for LPG to low and, ultimately, zero emissions are critical for enabling these industries to continue to exploit the benefits of LPG.

2. Regional Hospital

A common-use case for LPG by commercial customers is a regional customer that is using a 10 MW boiler for heating purposes. This could be for agricultural use, but we will consider a case of a regional hospital using the boiler for heating purposes.

Customers using LPG boilers for heating purposes are generally in regional areas in which natural gas is not available. In the absence of natural gas, customers would generally have chosen LPG for heating as a result of the lower cost of LPG compared to liquid fuels or electricity.

A 10 MW boiler operating at a capacity factor of 30% will consume close to 100,000 GJ of LPG each year.

Under the case with conventional LPG with no transition, this annual consumption of LPG results in approximately 6,835 tonnes of CO₂e per year. Extrapolated out over the modelling period and assuming constant consumption, this results in emissions of 6,835 tonnes of CO₂e per year every year over the modelling period.

With respect to the emissions under the LPG transition pathway case, emissions are also initially 6,835 tonnes of CO₂e per year. However, as low and zero emissions sources of LPG are integrated into the supply mix, the emissions intensity and consequently total emissions from LPG consumption for the regional hospital begin to decline.

By 2050, estimated emissions from LPG consumption for the regional hospital are zero, consistent with the transition scenario detailed in this submission, in which zero emissions sources are the only sources of supply in the market by 2050.

In the assumed transition path, these zero emissions sources are rDME produced from renewable energy blended with LPG produced through a Power-to-Liquids pathway.

Figure 2 shows the relative emissions per year from LPG consumption for the regional hospital under the respective scenarios modelled.

Figure 2: Regional hospital – emissions per year (CO₂e)



Source: Frontier Economics, *Pathway to Zero Emissions for LPG, 2023 – Commercial Case Studies*.

3. Hospitality Business/Commercial Kitchen

There is considerable heterogeneity within the hospitality sector with respect to the consumption of energy. The type of restaurant (e.g. restaurant, hotel) size of the enterprise (e.g. small café, large convention centre or hotel) and the climate all influence LPG consumption.

Commercial hospitality customers using LPG are generally in regional areas in which natural gas is not available. In the absence of natural gas, these customers would generally have chosen LPG either as a result of a preference for the quality of LPG cooking over electric cooking or as a result of the lower cost of LPG compared to liquid fuels or electricity.

For the purposes of this case study, it is assumed that the representative commercial business is a commercial kitchen that uses 100 GJ of energy from LPG per year.

This figure is derived from a recent report by Energy Consumers Australia examining the retail energy tariffs for small and medium enterprises in Australia (Alviss Consulting and Energy Consumers Australia, *Analysis of small business retail energy bills in Australia*, 2022).

Under the case with conventional LPG with no transition, LPG consumption equivalent to 100 GJ results in just over 7 tonnes of CO₂e emitted per year. Given consumption is assumed constant over the modelling period, this results in just over 7 tonnes of CO₂e emitted every year for the duration of the modelling period.

With respect to the emissions under transition with zero emission supply scenario, emissions are also initially just over 7 tonnes of CO₂e emitted per year. However, as the low and zero emission sources of LPG are integrated into the market, the emissions intensity and total emissions from LPG consumption for the commercial kitchen begin to decline.

By 2050, emissions from LPG consumption equivalent to 100 GJ per year results in zero emissions under this scenario, consistent with the transition scenario detailed in this submission. Under this transition path, zero emissions sources are the only sources of supply in the market by 2050.

In the assumed transition path, these zero emissions sources are rDME produced from renewable energy blended with LPG produced through a Power-to-Liquids pathway.

Figure 3 shows the results of this case study.

Figure 3: Commercial kitchen (hospitality business) – emissions per year (CO₂e)



Source: Frontier Economics, Pathway to Zero Emissions for LPG, 2023 – Commercial Case Studies.

LPG & Agriculture

Poultry farming is a sector that has always relied on LPG for its heating and lighting needs.

Chicken growing, fuelled by LPG, is expected to reach a revenue of \$706.4 million in 2023-24 as reported by IBISWorld. With NSW (34%), Victoria (21%) and Queensland (21%) holding significant market share in these states.

Fruit and Tree Nut growing – specifically, grape growing, is also expected to see a rise in LPG usage as a result of climate variations and changing weather patterns. During the grape-growing season, LPG-powered heaters are used to regulate temperature and protect the crops from the frost.

According to the Australian Wine Industry, more than 90% of vineyards in the state use LPG for machinery and vineyard operations.

LPG is an essential fuel for sheep, beef and cattle, farming in Australia. It is used for livestock sanitation, irrigation, power generation and transport systems.

Grain and crop growing is a critical component of this \$1.9 billion sector in Australia's hinterlands. Operators in the industry grow fodder crops such as hay (Cereal hay, Pasture Hay, Lucerne hay), silage and other niche crops, such as peanuts, ginger, coffee, chicory (grazing feed for dairy herds) and lavender.

LPG is used for crop drying, fuelling generators and engines powering irrigation systems, tractors, and other equipment.

Nursery and Floriculture - vegetable farmers (indoor and outdoor) use LPG to provide heat to greenhouses, power boilers and run heaters in individual greenhouses crop areas. The

undercover grower's segment is dominated by tomato growers accounting for 83% of production. Some 30% of all tomatoes produced in Australia are via undercover growers.

Under Cover Vegetable Growing in Australia has been growing at an annualised 3.1% over the five years through 2022-23 – including an estimated 5.0% jump in 2022-23 – and is expected to total \$960.1 million as reported by IBISWorld.

LPG agricultural applications include:

- Grain drying: high grade heat in large volumes to support post-harvest operations.
- Heating: large area space heating for nurseries, greenhouses, stables and sheds.
- Livestock farming: instantaneous hot water for sanitising livestock processing areas.
- Flame weeding: highly controlled, chemical-free weeding ideal for organic producers.
- Nurseries and greenhouses: CO2 enrichment to maximise photosynthesis potential.

Clearly, the advent of bioLPG and rLPG represents a major boost to these sectors, enabling them to decarbonise to actual zero, while using the same gas, equipment and production techniques they rely on.

LPG as a Substitute

Displacing Natural Gas

Thus far in this submission we have covered the ability for bioLPG and rLPG to replace existing uses of LPG. This is a simple one-for-one replacement, requiring no additional capital costs for residential, commercial industrial consumers.

But what of LPG (and bioLPG and/or rLPG) replacing natural gas?

Replacing natural gas with LPG is also relatively straight-forward and inexpensive.

For example, cooktops are really simple. Assuming pipes are compatible, which they typically are, it's a case of changing jets and rubbers. This represents an incidental change.

For converting natural gas heaters and hot water systems to LPG, again, it's typically not much more complex. But that can depend on the equipment in use:

- Converting jets is required.
- Converting the regulator is required.
- Each conversion is unique. Some may take 5 minutes... some a few hours. It depends on compatibility.
- Compatibility depends on the manufacturer of the heater/hot water system. If they have not allowed for LPG conversions, then there is the possibility of a new system being required. It's a case-by-case situation.
- As the Frontier Economics modelling shows, even if a full replacement is required it costs half as much as converting to electrical appliances (based on appliance and installation costs). Additionally, it saves homeowners potentially tens of thousands of dollars on upgrading to Phase 3 wiring.

As the Queensland Government Department of Natural Resources and Mine's Fact Sheet *Safely converting Natural Gas installations and appliances to LPG* (January 2014) makes clear:

“Q: Can most natural gas appliances be converted to LPG?”

A. Yes: Most natural gas appliances can be converted but this work must be done by a licensed gasfitter. The gasfitter is responsible for making sure the appliance is suitable,

including ensuring the appliance is certified for use on LPG. Some gas appliances are not designed or certified for use on LPG and cannot be converted to LPG.”

Further, the Grattan Institute’s *Getting Off Gas* report (June 2023) states:

*“Ending the widespread use of natural gas in pipelines need not mean an end to the great Australian barbeque. Most outdoor cooking is powered by LPG, which has the advantage of being portable. Continuing to use LPG for barbeques will have minimal impact on Australia’s carbon emissions. Using a barbeque for three hours emits 13.4kg of greenhouse gases. To generate a million tonnes annually would require every household in Australia to hold eight barbeques every year. LPG could continue to be used in barbeques until a non-fossil substitute such as hydrogen or synthetic bioLPG is developed. **Governments should support LPG companies to develop these substitutes. Where natural gas from pipelines is used, it should be possible for equipment suppliers to develop and sell conversion kits to change these items to burn LPG.**” (Page 20.)*

We are already seeing this in practise.

Similar to Victoria, the ACT Government’s impending ban on new natural gas connections in greenfield residential sites does not apply to LPG. Since the announcement of this decision by the ACT Government in November 2022, LPG in-home installations have gone in at the rate of six per week.

Displacing Diesel

The advent of bioLPG, rLPG and rDME enhances the desirability of consumer-led choice. These renewable gases have the capacity to replace diesel, especially where there is no other viable option, especially in rural/regional settings.

LPG produces 45% less CO₂ and 99% less NO_x pollutants than diesel. For many stationary engine applications where a diesel tank of fuel is required, LPG is a flexible and efficient energy source. Unlike diesel, LPG does not deteriorate in tanks and does not require water to be drained from the bottom of tanks over time.

Replacing diesel with bioLPG or rLPG has numerous benefits:

- Suitable for fixed diesel installations and vehicles.
- The rate of substitution is typically 30-35% and depends on engine size and application.
- A diesel substitution kit is fitted to the engine without the need to make any modifications.
- The kit can be easily removed and installed on another engine.
- Diesel Substitution Control Units ensure the optimum substitution rate.
- Engine monitoring and data logging systems continuously check engine performance and fuel consumption.

Displacing Marine Diesel

At the 2022 Federal Election, the Labor Party pledged to rebuild Australia’s coastal shipping fleet. What will power these vessels? There are two viable options – marine diesel or gas.

LPG yields an immediate 25% reduction in emissions compared to marine diesel. As renewable gases are developed over the next few years, those emissions will plummet to net zero (bioLPG) and, ultimately, actual zero (rLPG).

It has an instant positive impact in reducing emissions now, while preventing the inherent dangers posed by marine diesel ships. If a marine diesel ship were to run aground, collide

with another vessel or sink in Australian waters it could be an ecological disaster without parallel for our pristine beaches, waters and the sea life they support.

It would likely have far-reaching and long-term ramifications for local businesses, fisheries, tourism operators, hospitality venues and a host of associated impacts. Such a catastrophe is entirely avoidable. Gas-fueled vessels are clean and, in the event of an incident at sea, the gas can be released, dissipating without environmental impact as it neither slicks nor sediments.

European nations and the US already provide incentives encouraging fuel switching from marine diesel to gas. Across the globe, gas-fueled ships have increased from 18 vessels in 2010 to 936 vessels currently in service and another 876 on order.

Perversely, this means Australia gets the world's clunkers – diesel-powered cruise and freight vessels – navigating through our waters to dock at our shores.

In Australia, three of the most recent acquisitions to the shipping fleet are powered by LPG. These vessels are purchased to be in operation for many decades, with LPG chosen as the fuel of choice given its immediate emissions reductions, but, equally, the ability to switch to bioLPG and, ultimately, rLPG as a 'drop in' replacement, requiring no additional capital costs.

All new vessels in Australian waters, including ferries, should be geared for gas. Supporting such a shift would set-up our maritime sector to achieve net zero in the short-term and actual zero longer-term.

It would also overcome our national reliance on imported diesel-oil, replaced with renewable gases that Australia can produce in abundance. This would deliver genuine fuel security and self-sufficiency, which underpins the point of having a sovereign fleet.

Conclusion

GEA's hopes that, from this submission, there is greater understanding leading to recognition that not all gases are the same.

LPG has a unique value proposition in the gas space, with a vital role to play as a renewable energy source that can quickly and relatively easily decarbonise.

We encourage governments to change their rhetoric to recognise that not all gases are the same and see this reflected in public discourse. LPG presents a solution to the growing problem of coal-fired power coming out of production, at the same time as renewable sources like solar, wind, etc., struggle to meet expected targets.

While LPG is a relatively small part of the Australian gas landscape, its footprint across Victorian and the nation is significant – encompassing over 2 million homes, 130,000 businesses, millions of outdoor recreational users, as well as a major exporter – exporting some 70% of current production.

LPG's clear and commercially-viable scope to provide flexible, reliable, affordable and secure energy for household, commercial, industrial (including agriculture) and recreational uses, while being net zero emitting and moving to actual zero emitting, is an opportunity.

It can also be a growing part of the national economy. As reported in ACIL Allen's *Economic Contribution of the Australian Gas Economy 2021-22*, last year LPG drove over \$5 billion in

domestic economic activity (up from \$3.6 billion the previous year), while supporting 20,516 Australian jobs (up from 16,154 a year earlier).

Based on current domestic demand, replacing all conventional LPG with synthetic actual zero rLPG by 2050 would reduce CO₂-e emissions by up to 1.94 million tonnes every year. It would take massive pressure of electricity supply and provide much-needed flexibility in meeting the future energy task.

This can be achieved while continuing to deliver families, businesses and industry the gas they know, trust, can afford and rely on. It also represents an opportunity via exports to assist our trading partners to decarbonise.

Finally, the LPG sector has undertaken to complete this transition without any calls on government funding. However, the need for governments to recognise this transition is vital to giving the industry confidence to invest in these renewable technologies.

For More Information

Should you require more information, have any questions or wish to discuss the issues arising from this submission, please contact:



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