Submission to the Australian Energy Market's Commissions proposed rule-change:

'AEMC has made a draft determination and rule to enable distribution connected facilities to participate in the Victorian Declared Wholesale Gas Market (DWGM) – meaning hydrogen blends could be sold into it'.

Date: 19 May 2022

Submission by Michael Nolan

Consultant engineer and project manager, B.E (Mech) Uni of Melbourne, Masters Course (part-completed) in Environment and Planning (RMIT) with a focus on low carbon economy and renewables.

I've worked in global food manufacturing and logistics companies for over 35 years, most recently for the global number 1 Chilled/Frozen logistics company. In my most recent role I was the lead manager for engineering services and capital works across our Australian operations, and the lead manager for energy procurement contracts for our Australian operations.

Preamble:

AEMC has a choice about the pathway to reform of the national gas regulatory framework to allow hydrogen and renewables gases.

Namely:

Extending the regulatory framework to allow hydrogen (and other renewables gases) into the pipeline network.

Or

Case-by-case approvals for incorporating hydrogen and gas blends into specific networks.

There are very significant differences in these cases as to the outcomes we can expect for cost to end user and consumer, and emissions over the next 10-15 years. Both outcomes are extremely important, with the first impacting cost-of-living and cost for industry, and the second impacting directly the Climate emissions reductions targets for various States (e.g. Victoria 45-50% reduction by 2030).

Summary:

The economic and emissions advantages of *electrification*, compared to natural gas or a hydrogen/NG blend, are compelling.

Slowing this transition through embarking on widespread and wholesale injection of hydrogen in particular, into existing pipeline and gas appliances, delays the electrification and the necessary gas substitution. Delay of electrification is extremely detrimental to reducing costs and reducing emissions.

The gas industry should only be allowed to inject other gases into pipelines on a case-by-case basis. To make the regulatory change now is premature, given the very significant economic headwinds for hydrogen and hydrogen blends, versus electrification.

Economics dictate hydrogen generation and use this is likely to be mainly confined to industrial precincts.

In refining the scope of the 'national gas regulatory framework' it is critical to understand what the advantages and disadvantages are of changing the regulatory framework. However, before looking at the advantage and disadvantages it is necessary to understand the highest priorities overall that might be affected in the wider perspective.

I submit that these priorities are to tackle Climate Change, and to drive down the cost-of-living for households. These priorities in-turn suggest we must have:

- alignment with Victoria's Climate Act (2017)
- and by extension, alignment with the Paris Agreement goals for Victorian emissions reductions targets for 2025, 2030 and 2035.
- long-term consumer interest, particularly for house-holds.

The first two points above relate to emissions, and a reduction across all fossil fuels uses of 25% by year 2025, and 45-50% reduction by 2030. It seems probable that the year 2035 target will be in the range of 60 - 80% emissions reduction.
The reduction will primarily come from setting targets and then managing Policy settings for reducing the consumption of coal, gas and oil.
The third dot point above, relates primarily to the economics of a transition away from fossil gas, to either using renewables electricity or hydrogen made from renewables electricity. Or by energy efficiency to reduce the use of energy.

The National Gas Regulations should prioritise emissions reduction and long-term consumer interests rather than gas industry interests.

Extending the regulatory framework is therefore premature, and instead case-by-case approvals for incorporating hydrogen and gas blends into specific networks should be adopted.

Discussion:

Let us look at what the Government energy.gov.au website says about Hydrogen and its '**different properties'** as well as what it indicates albeit in generalized language, about it **'taking time ':**

It is informative to read the 'Preamble' from the **energy.gov.au** website:

Preamble from energy.gov.au website:

Extending the national gas regulatory framework to hydrogen blends and renewable gases | energy.gov.au

What are hydrogen blends and renewable gases?

Biomethane and other synthetic methane products can be processed to have the same specifications as natural gas, with net zero emissions. After this processing, they can be used safely in existing gas infrastructure and current appliances.

Hydrogen has ***different properties*** to natural gas. It can be made suitable for injection into the gas network by blending it with other suitable gases. Work completed under the National Hydrogen Strategy found that blends of around 10% hydrogen could be used in most existing appliances.

It will take time before existing infrastructure and appliances can safely handle 100% hydrogen gas supply. Where possible, the reforms will be 'future proofed' so when other gases such as higher percentage blends of hydrogen can be safely injected into the network, the regulatory framework will allow for these to be supplied.

Let us now look at:

'What the gas industry *wants* us all to believe':

- We have ample time to decarbonise the gas industry relatively slowly. Reaching net zero by 2050 is OK.
- Net zero by 2050 is a reasonable goal to have. A rapid decarbonisation by the year 2035 doesn't really apply to gas. Gas is lower emissions than coal, and gas is a 'transition fuel'. So don't need to worry about reducing gas, until after coal is phased out.
- We need gas-fired generation to firm up renewables - as coal fired generation is closed. (Meaning: This means we need to continue to hang onto gas everywhere)
- Hydrogen is the long-term replacement for gas. (Meaning: we can carry on with gas while we work on developing Hydrogen)

- The blending of hydrogen into the natural gas in our existing gas network is an incremental step in the right direction.
- Blending 10% hydrogen – any hydrogen – blue or green - into the NG network, is a pre-cursor to blending higher levels of hydrogen into the NG network.
- Blending synthetic methane, or biomethane into natural gas is somehow similar in concept to blending hydrogen into natural gas.
- Blue hydrogen could be a possible inclusion, as well as green hydrogen.
- Green hydrogen will get cheaper over 10-15 years. But we will need more renewables electricity to make green hydrogen. Building more renewables will take time !
- Moving to heat pumps means we need more electricity. This in turn means we would need much more renewables electricity and transmission. This will all take time and money and cannot happen quickly. So persisting with gas for longer is just part of getting rid of coal.
- We will have to 'learn-by-doing' when it comes to gas appliances running on hydrogen/methane blend, and when it comes to putting higher hydrogen blend into the gas network. We're not saying this will be quick or easy.
- Gas is embedded in our community and our economy. A slow change is what is called for, so we don't have destruction of jobs.
- We need gas molecules as industry feedstocks, and for high temperature applications in industry.
- People like cooking with gas. It is better cooking with gas.
- Can't electrify households. We need to let people keep cooking with gas!
- People want choices. We need to give people choices. Dual-fuel to homes. Cooking with gas will continue even if they have heat pump hot water.
- Sure gas supply in Vic is declining – another reason why we need to put hydrogen into the network to reduce NG gas required.
- We absolutely cannot run out of gas in homes – anything that reduces gas use incrementally is a good thing.
- We have time. There is no big rush. It's not a race. 2050 is a long way away.
- The picture is not clear at the moment. Let's not panic about a rapid transition from gas.

Let us now look at:

'What the gas industry doesn't want us to realise'.

The *reality* is that changing the regulatory framework to extend the life of natural gas - by allowing hydrogen to be blended with natural gas in a widespread and generalized way - is a convenient mirage for the gas industry. Promoting 10% hydrogen blends with NG, as a legitimate economic and emissions pathway to a slow transition to 100% hydrogen, is flawed on both counts - with respect to economics and emissions. The economic and emissions advantages of *electrification*, compared to natural gas or a hydrogen/NG blend, is compelling.

The advantage of electrification is already very compelling for 'almost' all situations where gas is currently used (excluding industrial high temperatures and feedstocks).

Blending hydrogen (or other gases) into natural gas/methane will be a slow and expensive process. Whereas, electrification of nearly everything, tackles both cost and emissions relatively quickly and with certainty of cost and emissions assumptions.

We must substantially reduce costs and reduce emissions - by around years 2030 to 2035.

Hydrogen will play just a small role in difficult-to-electrify industrial areas. Around 5-10% of world energy needs. Not households. Not Commercial space and hot water heating.

In summary, reviewing what the gas industry wants us to believe, and comparing that with what is the economic reality and the emissions reduction imperative:

1. **Electrifying (nearly) everything will mean cheaper costs for most gas users**
2. **Gas (methane) must reduce fairly quickly, in-line with Victorian Climate Act targets, and the Paris Agreement and staying below 1.5-2C**
3. **Blending Hydrogen in gas networks in general is a time-wasting idea. And we don't have the luxury of time. Hydrogen is more expensive than gas, whereas electrification of (almost) everything ticks both boxes - emissions and cost.**
4. **Gas prices are trending up over time (gas is getting scarcer) and gas prices are likely to be increasingly more volatile (due to uncertainties in investment in more gas).**

Let us examine these four (4) areas above, in more detail.

These four (4) key issues demonstrate that a 'wholesale regulatory reform' is a mistake on a very significant scale.

1. **<u>Operating costs are much lower for electric households:</u>**

   Operating costs for Gas appliances are much more expensive than electric appliances. The economics are clearly in favour of electrification for homes and commercial. Heat pump capital costs continue to fall through manufacturing efficiencies and volumes in Japan and China. Running costs for heat pumps are already lower, and continue to fall due to increasing co-efficient of performance (COP) of heat-pump technologies

An efficient reverse-cycle air conditioner has an amazing conversion ratio. One (1 kWh) unit of electric energy converts to about four (4 kWh) units of heat in the room hot water. This is called the coefficient of performance; in this example it has a COP of 4.0

Whereas, one (1) unit of energy burnt in the gas appliance typically converts to 0.6 to 0.9 units of energy in delivered heat, often lower. Many gas ducted heaters are 30-60% efficient. Lack of detailed monitoring means most households and businesses don't realise this.

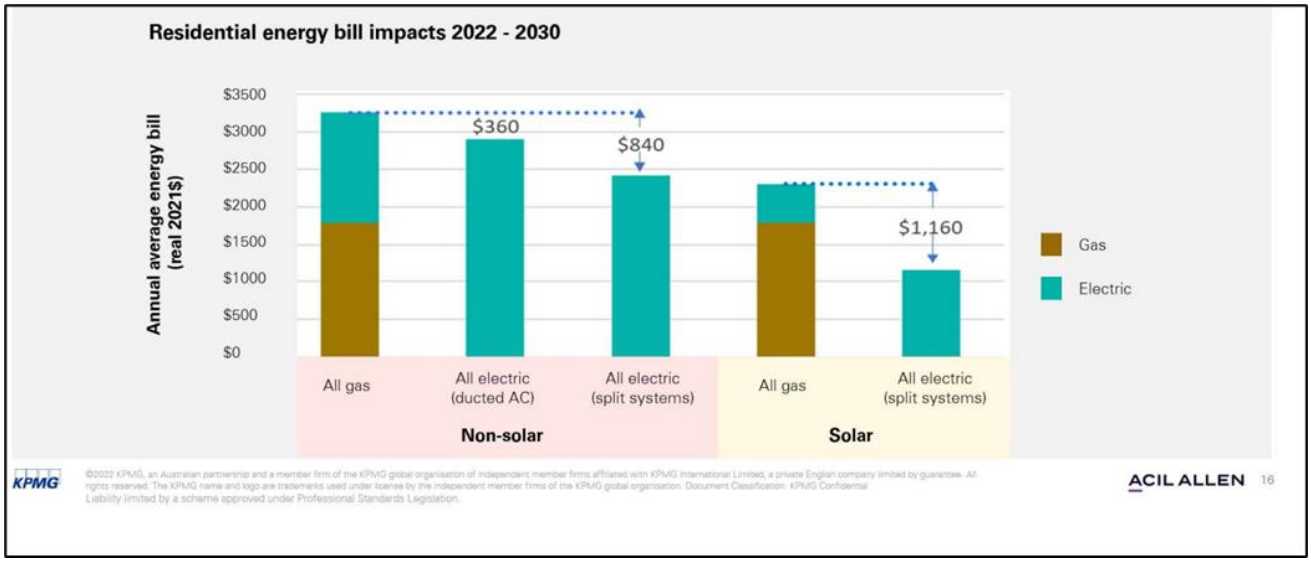
Modern heat pumps are extremely energy efficient.

We all use 'heat pumps' already – our refrigerators are cooled using heat pumps - they pump or move heat from inside the 'fridge' to outside the 'fridge'.

A fully electric home is about $1,000 per year better off.

From the KPMG/ACIL modelling commissioned by the Victorian government, and presented at the 'Victorian Government Gas Substitution Roadmap stakeholder forum, February 2022':

There are huge savings for households that can afford efficient non-gas space-heating, hot water and cooking. Savings according to modelling commissioned by the Victorian Government for the Roadmap are **$840 per year** in energy bills and **$1,160 for homes with solar panels**.



Gas for space and water heating is already more expensive than electricity for heating as shown in the Victorian Government's research (ACIL/ALLEN). Hydrogen is the residential setting would be more expensive still. Hydrogen is also a gas molecule - and likewise is burnt with an efficiency of 0.3 to 0.9, whereas as we have seen, electric heat pumps have a COP of around 4.

Similar results have been shown by research in California, USA. Refer California Energy Commission, 'The Challenge of retail gas in California's Low-carbon Future' , Gary Newsom, Governor, April 2020.

*The Challenge of Retail Gas in California's Low-Carbon Future

EXCERPTS from this California Report, pp. 1-2:
'This research evaluates scenarios that achieve an economy wide reduction in **greenhouse gas** (GHG) emissions of 40 percent by 2030 and 80 percent by 2050 from 1990 levels'.

'Natural gas is an integral part of California's energy system, including in buildings, industry, and electric generation. Nearly 80 percent of all homes in California are connected to the natural gas system'.

'Zero-carbon electricity requirements under Senate Bill 100 (de León, Chapter 312, Statutes of 2018) will lead to a substantial reduction in annual demands for natural gas in electric generation'.

'This study finds that, at scale, the costs of these fuels (RNG - renewable natural gas) far exceeds that of natural gas'.

'The question of the future of retail gas – defined here primarily as gas usage in the buildings sector – hinges on cost and consumer acceptance. Electrification, the use of electricity in place of other fuels, appears to be a cost-effective strategy for some consumers today. The addition of relatively high cost RNG into the gas pipeline would improve the economics of electrification in buildings. If demand for natural gas in California falls dramatically because of some combination of policy and economically driven electrification,

the fixed costs to maintain and operate the gas system will be spread over a smaller number of gas sales and, ultimately, will increase costs for remaining gas customers'.

In Europe and in Germany, there is clear recognition that Hydrogen will only become widely used in those industrial sectors where electrification is not suitable.

Bloomberg New Energy Finance (BNEF – ref Figure 3 below) suggests that industry feedstock will be the priority use of green hydrogen (**A-group**: replacement non-combustion uses of methane) followed by combustion uses where there are currently few viable alternatives to combusting fossil fuels (**B-group**: aviation, shipping, steel, deep storage for electricity firming).

Industry will arrive later at the optimum pathway – be it hydrogen or ammonia, or gas with CCS, in **D-group** and **E-group** in due course.

Progressing down the chart moves into uses where (typically) **electrification is increasingly technically and economically preferre**d to hydrogen. (In particular **F-group,G-group**)

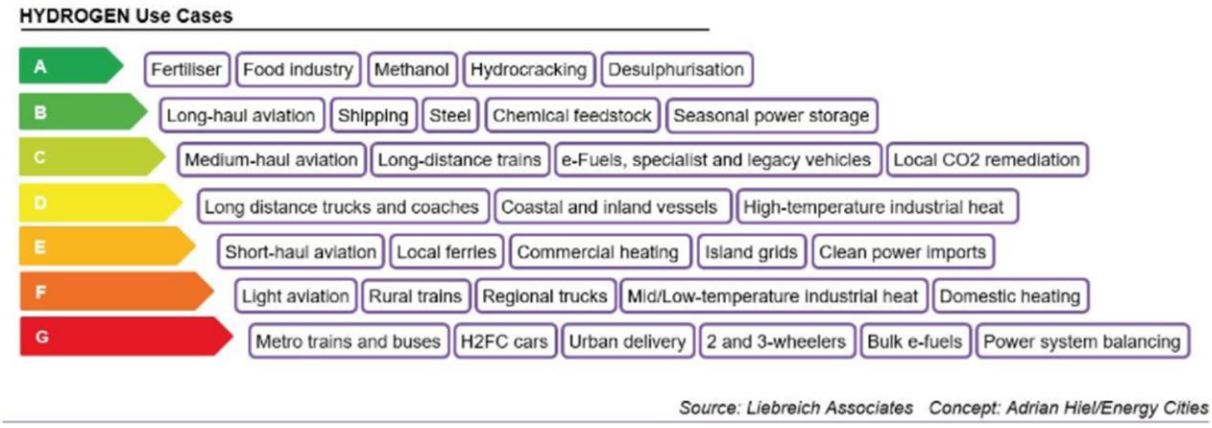
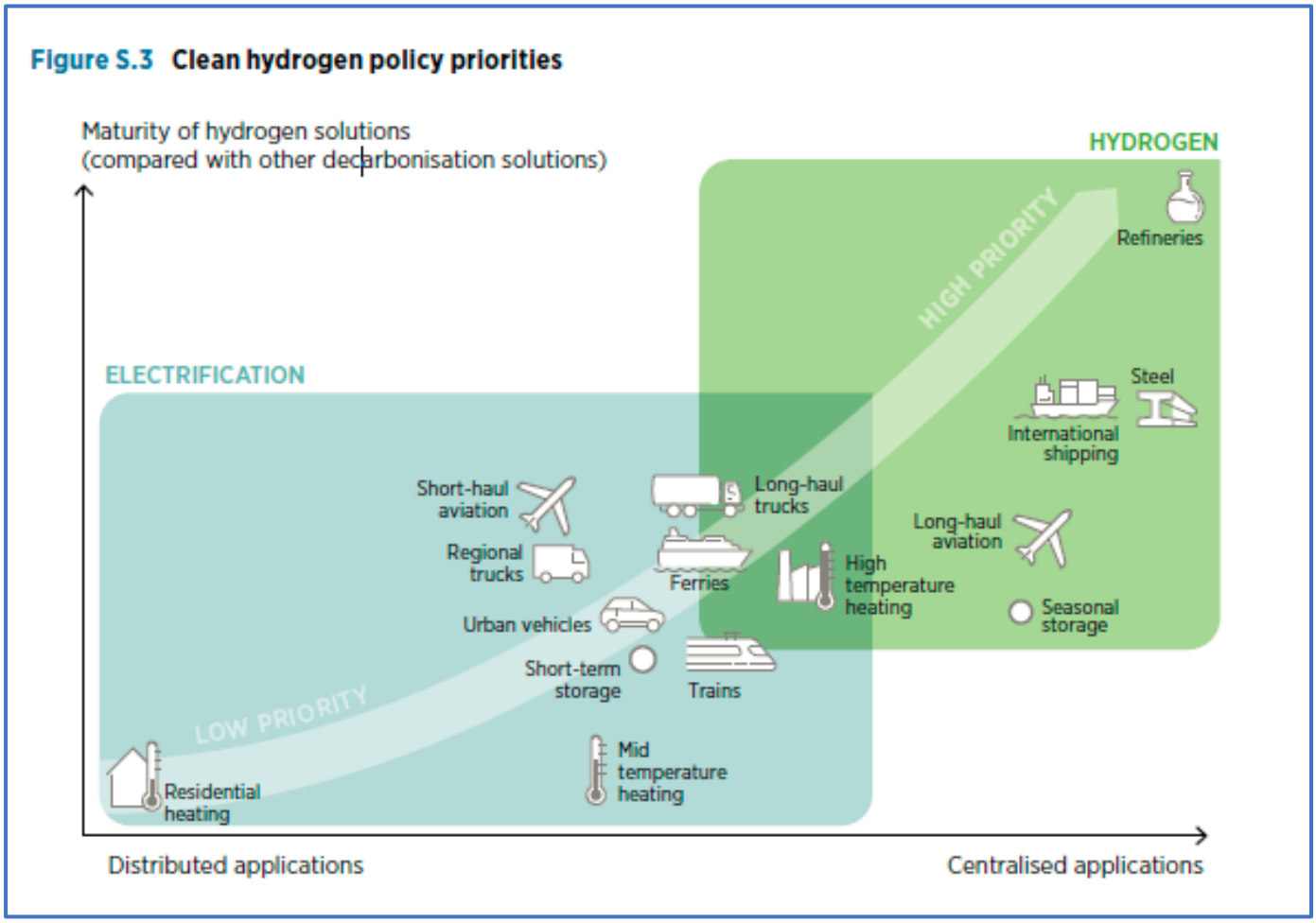


Figure 3 Bloomberg NEF (M Liebreich) hydrogen demand priority (merit order by demand sector)

https://about.bnef.com/blog/liebreich-separating-hype-from-hydrogen-part-two-the-demand-side/



Irena 2022 Geopolitics of the Energy Transformation: The Hydrogen Factor.
https://www.irena.org/publications/2022/Jan/Geopolitics-of-the-Energy-Transformation-Hydrogen
As this graph shows, hydrogen for domestic purposes is by far its least valuable use.

The priority uses of hydrogen are well-recognised. See IRENA graphic above which summarizes the findings. Residential energy needs - mainly space heating and hot water heating - will be met by electrification. Amending network investments to assist in carrying hydrogen and other gases would be economically disadvantaged, except in very limited circumstances (e.g., specialised hydrogen pipelines for industry). Long-term consumer interests, especially residential and commercial users, will be met through electrification.

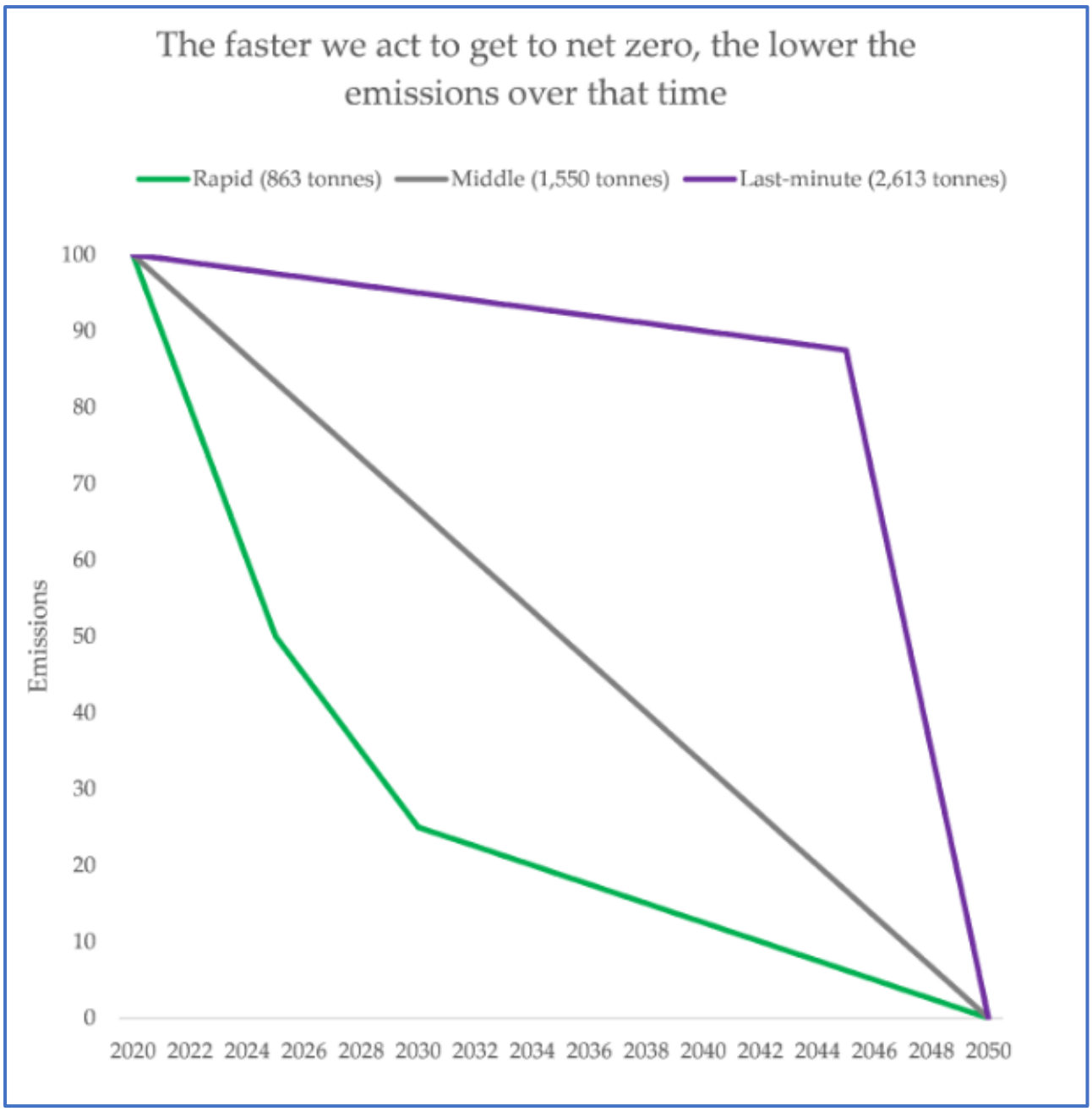
1. **A *rapid transition (AEMO Step Change)* to electrification is required for limiting warming to 1.5C to 2 C.**

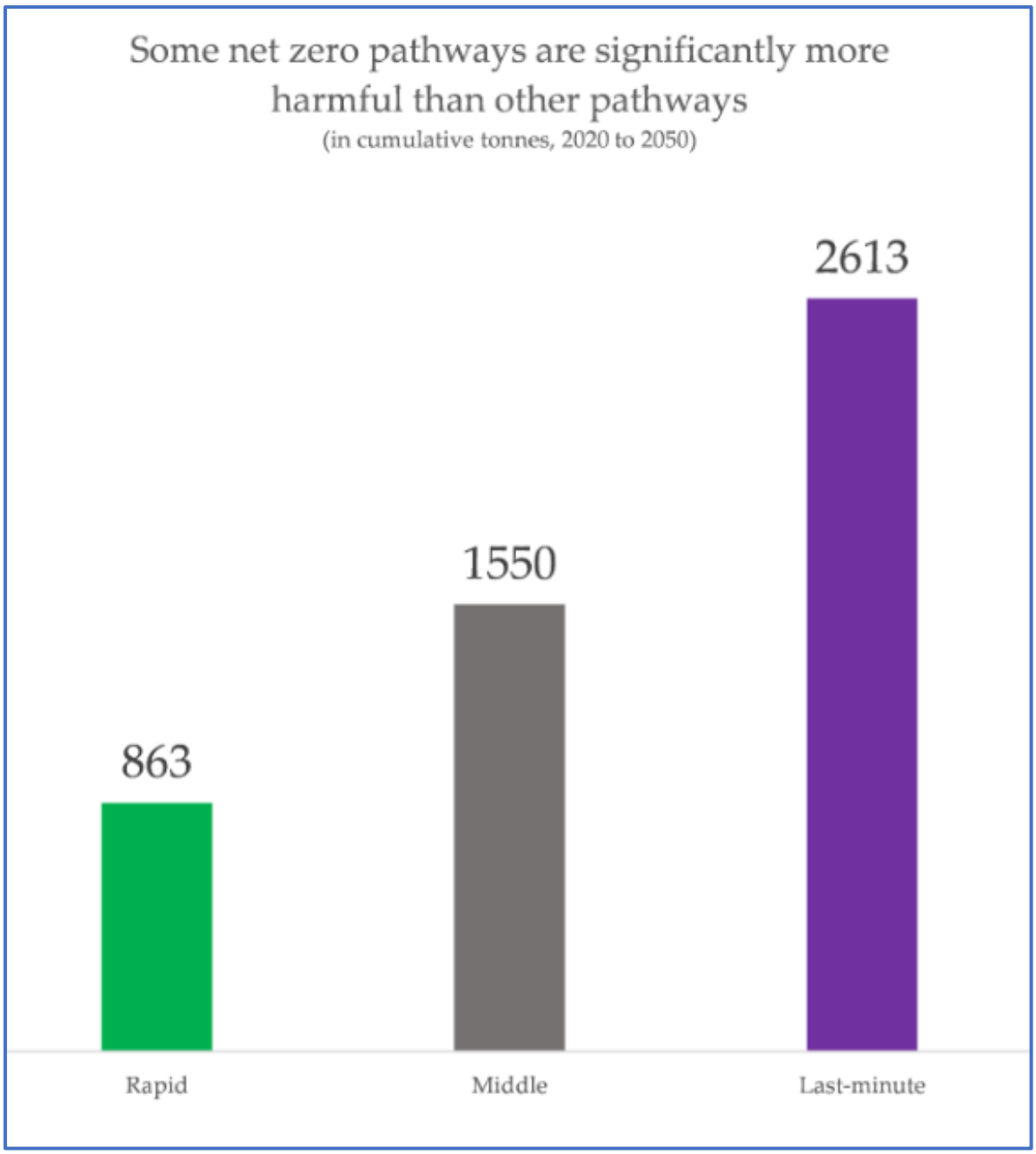
Ketan Joshi's article shows clearly that a 'rapid transition' is required to tackle total carbon emissions emitted over the next 30 years. Paraphrasing:

'Here's the absolute key message that you cannot ever, ever forget:

getting to net zero by stronger cuts in early years…. releases 1/3 the cumulative emissions by 2050…. compared to getting to net zero by slow reductions in early years, then implementing most cuts years 2040 to 2050'.

The gas war part 2: The Australian gas industry and their anti-electrification campaign | by Ketan Joshi | LobbyWatch | Medium


The faster we act to get to net zero, the lower the emissions over that time
Rapid (863 tonnes)
Middle (1,550 tonnes)
Last-minute (2,613 tonnes)
Emissions
100
90
80
70
60
50
40
30
20
10
0
2020 2022 2024 2026 2028 2030 2032 2034 2036 2038 2040 2042 2044 2046 2048 2050



A slow transition means more emissions **– it is the emissions budget (area under the graph) not the end point per se**. In the example, a Rapid trajectory creates 863

1. **Hydrogen blend slows the transition, to electric**

It is a race. Against time. We need to cut emissions strongly in early years, as Ketan Joshi's graphs show. It is cumulative emissions that are *critical*, by 2030/2035, rather than focus on zero by 2050.

1. Gas prices are set globally are both trending up, and becoming more volatile. To be a viable source of energy, a fuel, any fuel, must be available at an affordable price, over a time frame of at least a decade. We have seen extreme volatility of gas prices in Australia since our LNG export commenced in 2016/17 and the war in Ukraine in 2022 has again brought gas price volatility into sharp relief.

   With the uncertainties of the impact of decarbonisation on Supply, and the volatility of gas prices due to investment uncertainty, gas consumers are in for a rocky ride. At the top of each gas price cycle, gas will become un-economic for many users which will also drive the reduction in gas use.

IEEFA: Russia's invasion of Ukraine is affecting global gas demand with LNG unable to deliver energy security - Institute for Energy Economics & Financial Analysis

In summary:

The advantage of electrification is already very compelling for 'almost' all situations where gas is currently used (excluding industrial high temperatures and feedstocks).

Wholesale regulatory reform for allowing Hydrogen in particular to be blended at 10%, with a view to this being somehow an economic a pathway to 100% hydrogen and zero emissions looks to be extremely flawed.

Electrification of households and the commercial sector is the clear winner on economic grounds and it can also be achieved relatively quickly (10 to 15 years). This means emissions can also be reduced very quickly in this time-frame. Whereas the injection of hydrogen will increase costs to gas users, and the pathway to 100% hydrogen seems extremely unlikely due to the unfavorable economics versus electrification.

Due to these economics, Wholesale gas regulatory reform now is a mistake. The wholesale reform proposed seems very premature. The much-preferred approach for now, should be approvals case-by-case.

The economic factors surrounding hydrogen indicate Hydrogen blends will be limited to industrial settings, where the private industry focus is on key

sectoral emissions reductions - for their commercial and/or social license situation. It seems very likely that hydrogen will be generated in the future in the precinct it is required - by utilizing electricity and water in an electrolysis plant near to end-use. Not via the existing network pipeline.

Instead of undertaking wholesale reform, and while case-by-case Approval of Hydrogen is the approval process, Government Authorities should be focused on planned reduction in gas demand, not gas demand growth. Thus ensuring low-income people are not left behind, nor stuck with high gas bills, and thus ensuring gas assets are not stranded. Assets not fully depreciated must be minimized, and the situation must be mitigated with careful management, of a diminishing number of gas users on one hand, and remaining gas assets depreciating on the other hand. That is, the government should focus on carefully managing the gas asset cost allocation to a declining customer base.